moods logo

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- DISCOVER MOODS -

The first perfect software for musicians.

MOODS main features:

- **signifiant reduction of time (hence, costs -20%-) needed for modifying main scores and parts during rehearsals (the time spent for a simple modification will be reduced from 30 sec to 1 sec, while for a heavy modification it will pass from several hours to less than 1 minute),**
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- **registering and reproducing the performing rate in which each measure os the score has been executed**
- **automating the "page turning" during rehearsals and performances,**
- **fast retrieval of scores and parts,**
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The MOODS Technology has been evolved/used in other Projects and products:

- **FCD version of the MPEG symbolic music representation standard: w8632-MPEG-SMR-part-23-rev-public.pdf**
- **LINK to IEEE Multimedia article on Symbolic Music Representation in MPEG: other links:**
- **Demonstration Tools -- CLICK HERE to GET MPEG-4 Player with SMR decoder including--**
  - **MPEG-4 Player with SMR decoder and an example mozart.mp4**
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- **Free Music Notation Tools -- CLICK HERE to GET THE INSTALLABLE FILE including ---:**
  - **Music Editor based on MPEG SMR format, for PC, Windows**
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  - **several examples of Coded Music in MPEG SMR**
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    - **you have to install the RUN TIME of MAX/MSP version 4.6 for WINDOWS**

- MUCS: Cooperative work support for MAX/MSP also for MED
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- Chord editor in MPEG SMR format
- w8632-MPEG-SMR-part-23-rev-public.pdf

- WEDELMUSIC IST 1999 R&D FP5 (WEB delivering of music scores) (as coordinators), In this case, several innovations were added, XML models, secure transactions models, distribution models, certification of clients, multimedia content models, watermarking of symbolic content like music but could be text. XML modelling, transactions, watermarking audio and image score, synchronisation of media, Z39.50, UNIMARC, etc. It has generated also a series of conferences. http://www.WEDELMUSIC.org Every month about 100 of the WEDELMUSIC related tools are freely downloaded. Presently it is distributed in Open Source. Relevant installations are present in Milan and Fiesole. (concluded in the 6/2002), it has been "adopted" by ADOPT-IT.
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- MUSICNETWORK IST FP5 (as coordinator), Thematic Network, Technology Transfer, to reduce the technological gap from technology providers and content owners and distributors. www.interactivemusicnetwork.org A network of FP5 on which we have about 850participants, 10 working groups, 230 industries, etc. All the value chains of content and music industry are represented.

See also: The press about MOODS

Music was never so easier.

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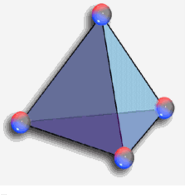
Music Object Oriented

Distributed System

MOODS



[Home page of HPCN Center at DSI](http://www.dsi.unifi.it/)

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See also: The press about MOODS

Music was never so easier.

MOODS Project

[Overview](#) [Objectives](#) [Partners](#) [Background:](#) [Architecture](#) [Components:](#)

Background:
- Market Situation
- Current operational Way
- Technical state of art

Components:
- DLIOO
- MASE/MASAE
- TheNET
- Databases

Just pass the mouse over the link to see it's description.

Home page of HPCN Center at DSI

Demonstrations

[Demo at Florence](#) [Demo at Scala](#) [Our music](#)

Just pass the mouse over the link to see its description.

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[Home page of HPCN Center at DSI](#)

Dissemination

[Disseminations](#) [Press Cutting](#)

Just pass the mouse over the link to see its description.

Just pass the mouse over the link to see here its description.

[Home page of HPCN Center at DSI](#)

Music

[Music Notation] [Music Modelling] [Music Links]

Just pass the mouse over the link to see its description.

Just pass the mouse over the link to see here its description.

Home page of HPCN Center at DSI

MOODS Glossary

- DLIOO: Distributed Lectern Interactive Object Oriented
- ETT: Execution Time Trend, sequence describing the execution rate of the score
- LIOO: Lectern Interactive Object Oriented
- MASAE: Main Score Archivist Editor
- MASE: Main Score Editor
- MOODS: Music Object Oriented Distributed System, this project
- MS: Main Score
- NIFF: an interchange format for music
- ONCE: Orchestra Network Configurator Editor
- ONCM: Orchestra Network Configurator and Manager
- ONM: Orchestra Network Monitor
- SCORE: a format for saving scores into files (please see SCORE site mentioned above).
- TheNet: Theatre Network connecting all lecterns with the MASAE and the Database.
- ENIGMA: a format for saving scores into files (please see CODA site mentioned above for FINALE).

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MOODS downloads

- Moods for Windows - selfextracting file
- Installation note for windows version
- Ghostview for Windows - needed for printing - selfextracting file
- Preliminary version of MOODS depliant
- Final version of MOODS depliant 20/8/1998
- Final Version of MOODS depliant in Italian
- Documentation distributed at SCALA 22/9/1998 in WORD (Italian)
- Documentation distributed at SCALA 22/9/1998 in WORD (English)
-

Please, if you are interested in having and testing a demo version of MOODS please visit the tinyMOODS page.

You can read and download articles at the press www page of MOODS

MOODS: Examples

Example 1: Mozart Clarinet Quintet, K.581

The five MOODS files which comprise the encoding of second from Mozart's Clarinet Quintet, K.581, are reported.

Mozart Clarinet Quintet (trio section), up to double bar. First part (clarinet) of five; the string parts are shown below. All encoded attributes (here pitch name, chromatic inflection, octave number, duration in time, duration name, stem direction, beam and slur information, and articulation) are indicated explicitly for each event.
The following image has been printed by using MOODS editor. The full resolution file in PDF format can be downloaded here.

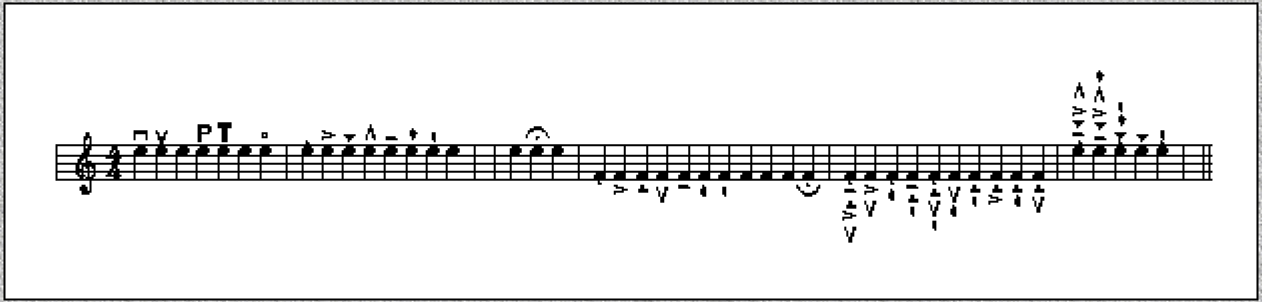
MOODS files which represent example 1:

- Main Score
- clarinet part
- first violin part
- second violin part

- viola part
- violoncello part

Example 2 PDF

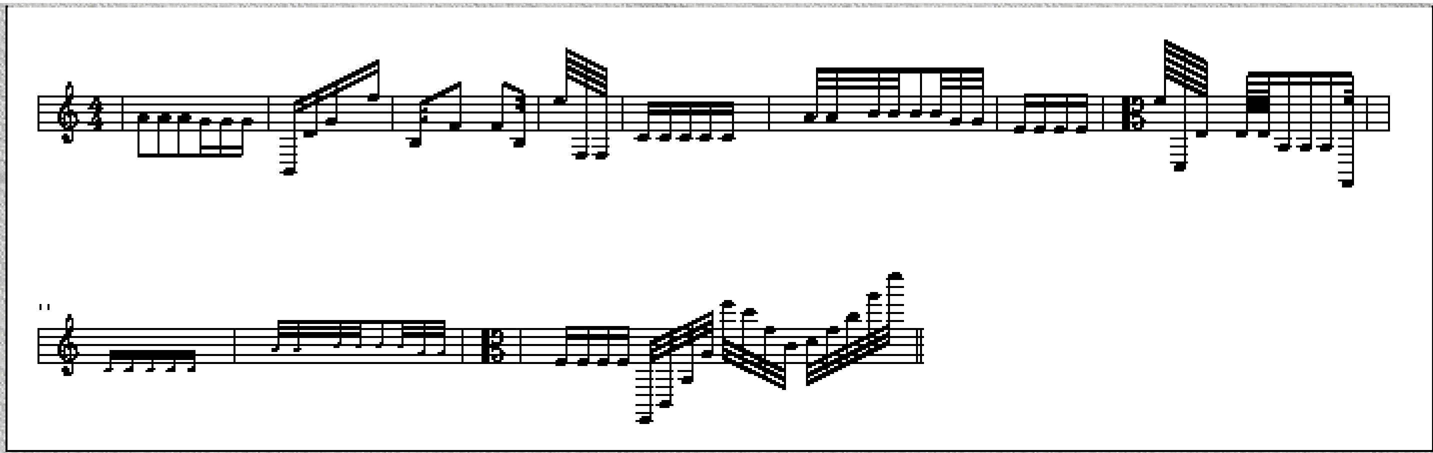
PDF file can be downloaded here.



MOODS files which represent example 2:

- ex-accent.mds
- 1.ex-accent.mds

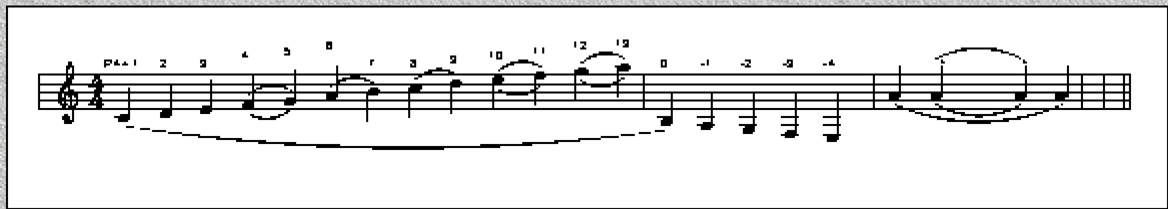
Example 3 PDF



MOODS files which represent example 3:

- ex-beams.mds
- 1.ex-beams.mds

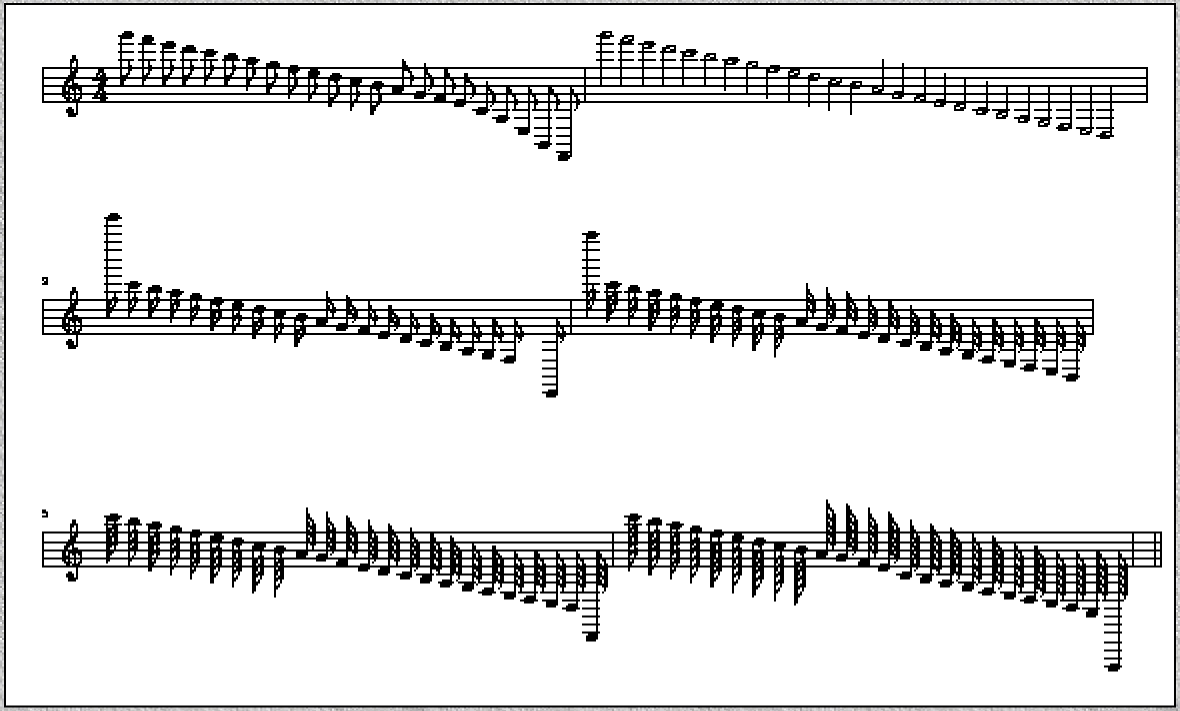
Example 4 PDF



MOODS files which represent example 4:

- ex-legat.mds
- 1.ex-legat.mds

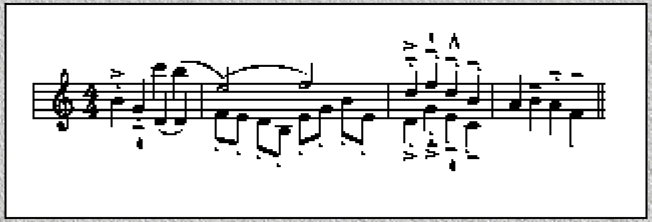
Example 5 PDF



MOODS files which represent example 5:

- ex-note.mds
- 1.ex-note.mds

Example 6 PDF



MOODS files which represent example 6:

- ex-note.mds
- 1.ex-note.mds

Last update: 05.03.1999

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MOODS Press Release

- Teatro alla Scala Press Release
- Press Release by Informatic System Department University of Florence (engl. vers.)
- Comunicato stampa del Dipartimento Sistemi Informatica Università di Firenze (ital. vers.)
- Document distributed during presentation at Scala (in Italian)
- Document distributed during presentation at Scala (in English)

MOODS articles on Newspapers and Journals

- *"Cooperative Visual Manipulation of Music Notation"* P. Bellini, P. Nesi, M. B. Spinu
  ACM - Transactions on Computer-Human Interaction *(TOCHI)*
  - Authorisation Rights
  - Overview of the Object-Oriented Architecture
- *"Spartiti addio, arriva il leggio elettronico"*- Corriere della Sera - 23 September 1998
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- *"La musica corre sul monitor, ecco lo spartito elettronico"*- La Nazione - 23 September 1998
- *"La musica corre sul monitor, ecco lo spartito elettronico"*- Il Giorno - 23 September 1998
- *"MUSICA: arriva "MOODS", nuovo leggio elettronico"*- ANSA Service - 22 September 1998
- *"NOVITA' E' in arrivo «MOODS»: trasmette via Internet la musica agli strumentisti*- Avvenire - 24 September 1998
- *"Nasce il Leggio elettronico e le note passano sul monitor"* - La Repubblica - 23 September 1998
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MOODS Demonstration has been mentioned

- In several local and national RADIOs during news.
- during the 8:00 PM National Television news of RAI 3 (23-September-1998)
- Interview at Prof. P. Nesi, at RAI RADIO 3 (16:45, 31-October-1998, during the cultural program: Due sul Tre)
- ..
- ..

http://www.dsi.unifi.it/~moods

MOODS - TETRApc HPCN ESPRIT Project n.25968

MOODS project consists in realizing a distributed system of lecterns/editors for music by starting from stand-alone editors/lecterns for music.

Please visit download page for a DEMO and technical documentation

Please visit press page for articles and documentation

A MOODS system consists in an integrated system of computer-based lecterns/stands which can be used for both editing and visualizing music in cooperative manner. The distributed system of lecterns is an innovative idea for automating and managing the large information used by (i) orchestras during rehearsals and public performance of concerts, operas, ballets, etc. (ii) students of music during lessons in conservatories and schools of music, (iii) publishers during massive editing of music.

The targeted end-users are theaters, itinerant orchestras, groups of musicians, schools of music, television network orchestras, and publishers of scores.

Main objectives and results of MOODS project are:

- the adoption of HPCN technology for drastically reducing the time needed for modifying main scores and parts during rehearsals of concerts, ballets and operas; at least a 20% of reduction of costs for preparing performances for orchestras, theaters, schools of music has been estimated;
- the introduction of HPCN technology in a new environment;
- the deployment of HPCN technology for creating of a new product and for opening a new market for many products (lectern systems for orchestras, lecterns for pianists, lecterns for small group of musicians, etc.), using electronic versions of scores already available in the archives of publishers, on the basis of already present stand-alone editors/lecterns for music scores;
- the dissemination of results at European level.

Other interesting features of the MOODS system are:

- managing (saving and reloading) the instrumental and personal symbols on main score and parts; Thus saving artistic details never save up to now;
- managing (saving and reloading) the exact tempo in which each measure of the score has been executed;
- avoiding, by automating all mechanisms, the turning of pages during rehearsals and final performances;
- visualizing in few minutes any score on the lecterns of musicians, fast changing of music piece of reference point, or arrangement;
- manipulating in real-time main score in parts as a whole music score, thus presenting the final version of the score in short time to musicians;

All these features leave at the artistic aim of compositors and directors more space for experimenting new effects and arrangements in few minutes. This opens a new era for the expressiveness of the artistic aim of director/maestro establishing a more direct feedback from its requests and results produced from the orchestra or with its pupils.

Please visit our related projects:

- O3MR (Object Oriented Optical Music Recognition), a project concerned with building an optical music recognition system for converting paper versions of music scores in a suitable format for music editors. O3MR is based on the adoption of the neural network for low-level recognition of symbols, while at high-level the constructs of music notation are recognized by using the object-oriented model of music discussed in this paper. The activity on music at the Department of Systems and Informatics is partially supported by Hewlett Packard Italy.
- IMEASY: Integrated Multiprocessor Expandable Audio Spatialization sYstem. IMEASY is an activity within the TETRApc TTN HPCN ESPRIT n.28472. It focuses on an audio and sound processing and spatialization system based on a highly interconnected network of digital signal processors, intended for applications in the fields of entertainment and professional music; the device will be completely reconfigurable and will allow the advanced control of a multi-channel sound system to create and handle spatialization effects applied to external signals.

  The targeted end-users are professionals involved in audio and multimedia installations, post-production services, and more generally in the field of entertainment activities, including game parks, theater and outdoor events.
  The goal is to provide an interactive system to allow spatial effects in real-time; this is mandatory for live events, theater applications, interactive museum shows, entertainment parks, as the exact timing and temporal evolution of spatial effects may be dependent on external events and for this reason unpredictable in advance. The spatial effects cannot be preencoded or prerecorded and are required to be created in real-time.

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http://www.dsi.unifi.it/~moods

Technical Objectives of MOODS Project

The major objective of MOODS activity is to insert HPCN technology within the theaters, orchestras, groups of musicians, schools of music, soloists, and music publishers. These end-users are mainly SME in which no distributed computerized system for editing music is present, and the adoption of HPCN technology will allow the application of computer science technology to a new sector providing new functionalities and business benefits for both end-users and technology transfer receivers. The activity has the following specific objectives:

- introducing HPCN technology for building, on the basis of already available editors/lecterns for music of DSI a distributed system of lecterns/editors in order to reduce of about 20 % the costs of rehearsals. The system has been considered strongly needed by theaters, orchestras, groups of musicians, schools of music, soloists, and music publishers for technical and business benefits.

  1. reducing the time needed for modifying main scores and parts during rehearsals of concerts, ballets and operas, or simply in the case of score editing by a publisher. In the case of concerts, the time spent for a simple modification by pencil will be reduced from 30 sec to 1 sec, while for a heavy modification (cut and past) it will pass from several hours to less than 1 minute;
  2. simplifying the execution of score centralizing the turning of pages. This feature is completely new with respect to the traditional operations; in some cases, a musician needs the help of another person for page turning. With MOODS page turning will be automated and reduced to less than 0.5 sec;
  3. simplifying the execution of score automating the jump to refrains and/or to selected points. In this case, the time for changing the execution point is at least 1 sec and depends on the distance of the point. In critical cases, some musicians need the help of another person to turn the page. With MOODS page turning will be automated and reduced to less than 0.5 sec;
  4. introducing HPCN technology in a new application field opening a market for a set of new products:
  5. electronic lecterns for orchestras, lecterns for small groups of musicians, lecterns for chorus, lecterns for pianists, etc, electronics versions of scores already available in the archives of publishers (end-users);

- distributing the main score and parts, stored into a database, in few seconds on the distributed systems of lecterns of the whole orchestra. This features can be very useful for schools of music and orchestras in general. The music score database will be obtained by customizing a product of SHYLOCK.

The main results:

The consortium includes 6 Partners:

- **DSI**, Dipartimento di Sistemi e Informatica, Università di Firenze, Prime Contractor and HPCN technology provider (Project Coordinator Prof. Ing. P. Nesi);
- **SCALA**, Teatro alla Scala, one of the most important theaters in the world, as end-user (Mestro C. Tabarelli);
- **RICORDI**, Casa Ricordi, BMG Ricordi S.p.A., one of the most important publishers of music in Europe, as end-user (Maestro G. Dotto);
- **SMF**, Scuola di Musica di Fiesole, school of music and end-user (Mestro N. Mitolo).
- **SHYLOCK**, SHYLOCK Progetti, provider of distributed database technology (Dr. S. Moro): builder of music score databases and, thus, of MOODS's database;
- **ELSEL**, industrial firm, receiver of HPCN technology transfer (Ing. F. Cicillini): builder of MOODS music lecterns;

MOODS's Partners:

University of Florence

Dipartimento di Sistemi e Informatica

Teatro alla Scala - Milano

Casa Ricordi - Milano

Scuola di Musica di Fiesole

ELSEL - La Spezia

Shylock Progetti - Venezia

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For the MOODS activity, the partners have chosen to select TTN-TETRApc as their ``reference TTN" that proposed by CPR (Consortium Pisa Ricerche, Pisa, Italy), CESVIT and CSM. In particular, CESVIT High-Tech Agency (a no-profit agency) has been selected by MOODS partners as the reference TTN-TETRApc site.It should be noted that CESVIT for TTN-TETRApc activity collaborates with the Department of Systems and Informatics (DSI partner) which provides support about the technological and scientific aspects of TTN HPCN. This collaboration is very suitable since the complementary roles of CESVIT and DSI within TTN HPCN have been well-identified. CESVIT has a very high visibility and sensitiveness with respect to the market, for distribution, advertising, evaluation, etc. activities (very useful for the management of the TTN-TETRApc), while DSI provides know-how in HPCN technologies (see the enclosed bibliography and biographies, Annex 4). According to the cooperation agreement between CESVIT and DSI for the TTN-TETRApc, the scientific responsible of the CESVIT part of TTN-TETRApc is Dr. Ing. P. Nesi of DSI. Please note that he is also the coordinator of the present activity.Project MOODS at DSI includes many aspects non included into the MOODS project and funding. These parts are internally founded by DSI and partially supported by Hewlett Packard.

Reference to the TTN TETRApc and its related partners:

TTN HPCN TETRApc CESVIT

Consorzio Pisa Ricerche ARTTIC

General Background 1

Content:

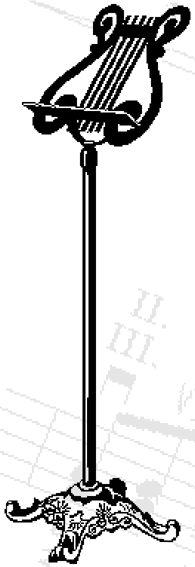
With MOODS activity, the partners intend to exploit a strongly innovative idea: automating and managing the large information used by orchestras during rehearsals and public performance of concerts (e.g., symphonic music), as well as for operas or ballets.

The amount of information to be managed by orchestras is really huge; a main score is usually comprised of more than 100 B4 pages, and for each musician, or every two, a specific music part is used (usually about 100 musicians are needed for constituting a medium-sized orchestra, and 200 for a large one). In certain cases, also chorus are present with even more than 100 choristers. All this information is consumed in about 30 minutes.

Market Situation

In Europe there exists more than 3000 theaters, 600 orchestras, 20 television networks, 500 schools of music, among these 350 are medium-sized orchestras. All these orchestras use paper versions of main scores and parts for rehearsal and final performances.

> Paper versions of main scores and parts are usually manipulated by the director/conductor (before rehearsals) and by musicians (during rehearsals for preparing the final performance) for modifying and/or adding interpretation comments (by using jargon symbols of each instrument, for example see {LIOOMANUALE95}, {MSLIOOMANUALE96}, and {LIOOEVOLUTION96}). The modifications are usually very heavy and time consuming for preparing operas and ballets, while for classical music lighter changes are introduced. Simple modifications consist in adding interpretation/execution symbols (position of fingers, arc up, arc down, mute on/off, etc.) or modifying other figures (ties, slurs, measure, etc.) {LIOOANALISI95}. Heavy modifications can also consist in moving score parts, adding new portions of score, arranging the music for different instruments, etc.
>
> When the same paper version of a music score is used by different musicians, old modifications are deleted on the paper (if possible) and new modifications are made on the same scores. This is due to the fact that the cost of buying a new paper version is too high for the theater; hence, it is very often that main scores and parts are rent by the theater from the publishers paying in this way also the Copyrights. Modifying scores, even by using a pencil, causes the deterioration of paper versions of music scores (some of these are also very antique), others have interpretation notes of very famous authors and directors. Thus, some of these modified versions are very precious (technically and economically as discussed in the sequel), but have to be frequently returned to the publishers.
>
> There exists in the market several professional programs for editing music by using a computer: Score, Sibelius, Finale, Encore, Graphire



Music Press, etc. Many other non-professional editors for music are also available, but these are mainly based on executing music by means of a MIDI interface: Darms, Csound, QuickScore, CUbase, Cakewalk Express, Lime, MasterScore, MusicShop, Hightingate, Music Manuscript, Music Time, Notator, Overture, etc.

It should be noted that, in recent years, publishers are more interested in using professional editors, such as Finale, Score, Sibelius. Since 1991 their adoption has led to the computer-based production of many scores. On the other hand, due to the constant evolution of music editors and to the fact that up to now there only exists a market for paper versions of scores, the electronic versions of scores are only present in publishers' archives (sometimes they appear in some multimedia CDs).

According to our market analysis, performed by interviewing publishers, conductors, archivists, teachers in schools, and musicians, and by performing direct experiments, none of the professional editors in the market is completely satisfactory:

- none of the professional editors in the market is completely satisfactory for editing main scores and extracting parts producing a true representation in both cases. The same music is differently represented in main scores and parts. In the main score, interpretation symbols are missing and each measure is explicated; in score parts, techniques for compressing measures are used as much as possible (pauses during more than one measure, abbreviation of notes repeated, etc.). Only in score parts each musician needs to add its interpretation symbols. In turn, the conductor add comments on the main score.
- none of these editors produce a lectern-oriented visualization on a computer monitor; they are mainly focussed on editing and producing good results on printers;
- only few music editors provide interpretation symbols for instruments. None of these editors covers all interpretation symbols of all instruments. Even well-known languages (e.g., Finale, NIFF, SMDL, Score, etc.) for saving music are incomplete from this point of view.
- such editors are very complex to be used by musicians. They were built to be employed by publishers rather than by musicians who need to perform fast modifications of scores such as for adding interpretation symbols in real-time by using a mouse or a trackball.

These are the reasons for which the DSI has implemented stand-alone lecterns/editors for musicians, LIOO {LIOOMANUALE95} and for directors/archivists, MSLIOO {MSLIOOMANUALE96}.

LIOO and MSLIOO have been considered quite satisfactory as stand alone editors/lecterns for parts and main scores, respectively by important musicians, archivists, etc., as the partners involved in this project: SCALA, RICORDI, SMF and others.

Finally, *none of the above mentioned editors/lecterns (including LIOO and MSLIOO) allows at present the connection with other similar editors for implementing a distributed system of synchronized music lecterns and allowing the cooperative editing of the same score.*

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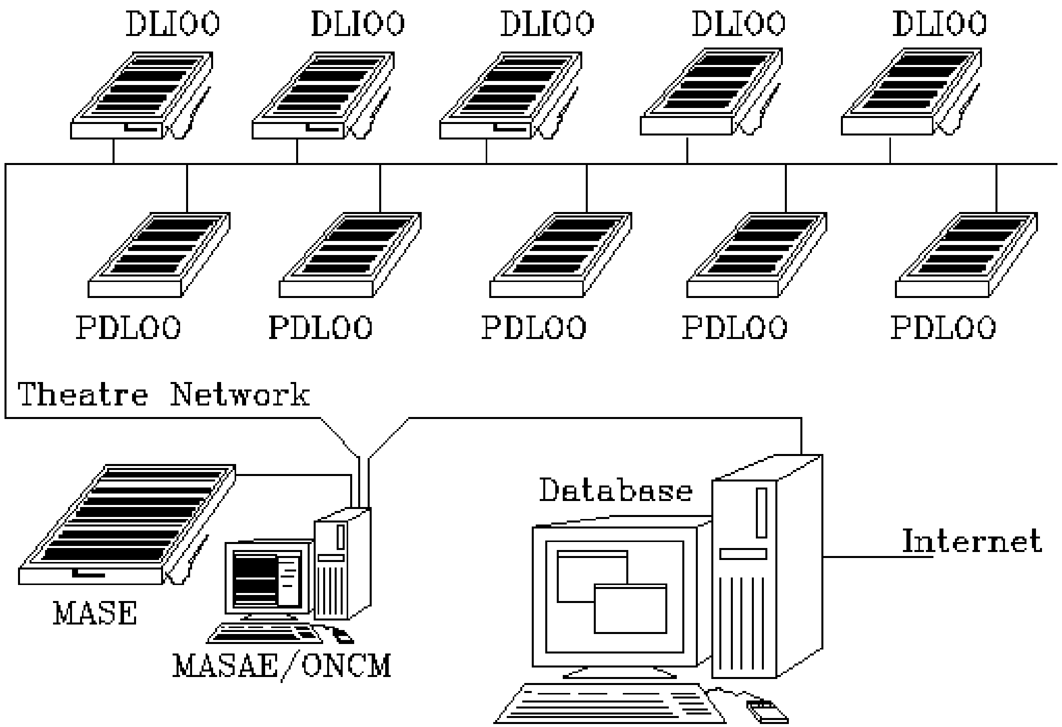
General Architecture

The prototype of the computerized system of electronic lecterns/music editors will be implemented by using technologies based on: HPCN, object-oriented paradigm, real-time technique; thus, the name MOODS: Music Object-Oriented Distributed System. The implementation of MOODS prototype involves both hardware and software aspects.

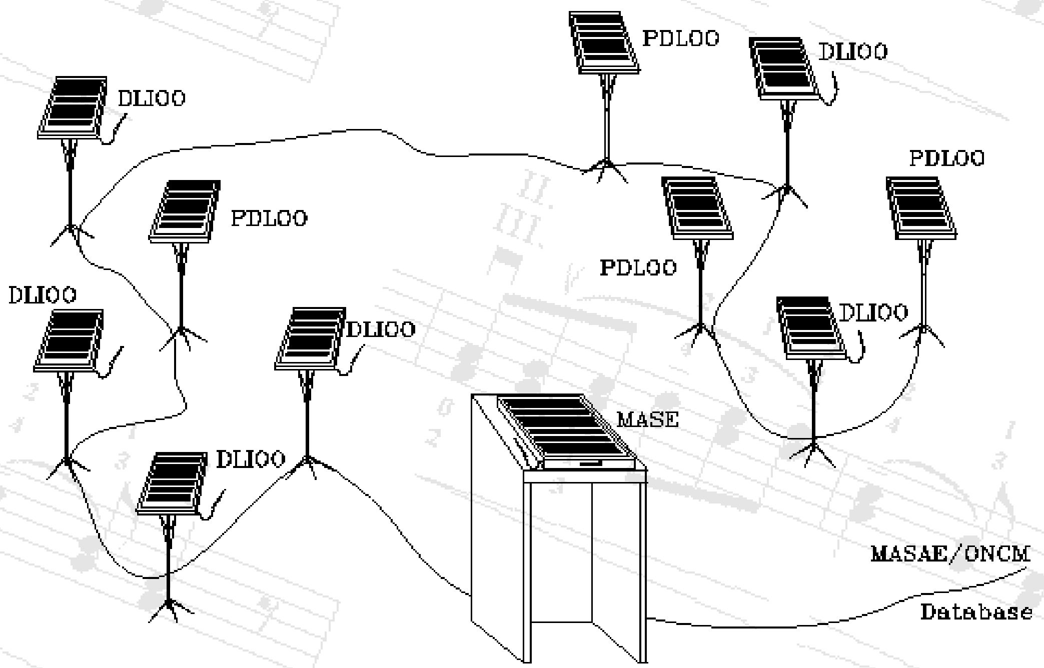


A MOODS system, as reported in the figures, will be comprised of:

- DLIOOs: a set of lecterns (Distributed LIOO, which means Lectern Interactive Object-Oriented.
- PDLOOs: a set of Passive Distributed Lecterns Object-Oriented. A DLIOO not enabled to edit/modify the score visualized.
- MASE: a MAin Score Editor and lectern used by the director/conductor for managing DLIOOs and PDLOO lecterns.
- MASAE: a MAin Score Auxiliary Editor which present the same user interface of MASE and to which is strictly related. This is a music editor/lectern by means of which the archivist can (i) make even heavy modifications on score during rehearsals or score revision and (ii) beat time indicating the measure under execution, thus allowing the automatic turning of pages of all lecterns during performances.
- Theater Network, TheNET: a network support for connecting lecterns based on 100 BT, TCP/IP and PVM.
- ONCM: the Orchestra/Network Configurator and Manager. It is an application running on the same workstation of MASAE for establishing logical and physical relationships among DLIOOs and controlling the behavior of the Theater Network, TheNET
- Database: a database for storing and retrieving main scores and parts. This will be on a workstation endowed with a suitable hardware for containing a

huge archive of scores and orchestra configurations, and also for printing, etc.

Specific hardware for DLIOOs and MASE will be built by using commercial components but considering ergonomic aspect and usability -- i.e., DLIOO-HW and MASE-HW. MASAE and the Database use standard hardware.



The adaptation, customization of LIOO, MSLIOO software will consists in adding parts (i.e., methods and specialized classes) for distributing lecterns and controlling them on the network (see {LIOOEVOLUTION96}). New functionalities due to the possibility of working cooperatively on the same score will be implemented.

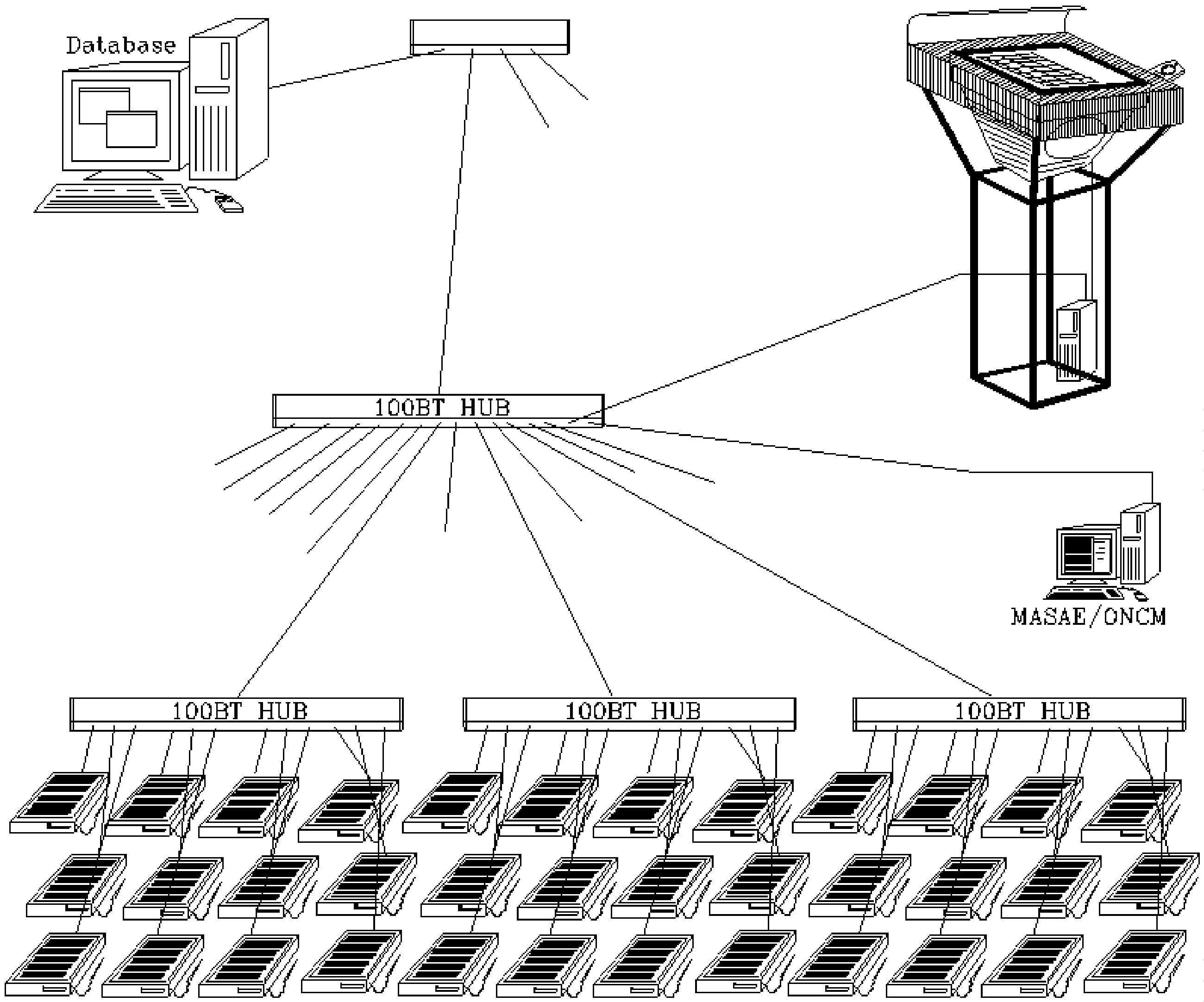
Therefore, software support for integrating DLIOOs with MASE/MASAE along the network, configuring the network/orchestra (ONCM), and monitoring the network behavior (ONCM) will be implemented by using HPCN technology.

For these reasons, a great work will be performed by integrating components. The complete system will reach a greater value with respect to the simple sum of the corresponding components, since a new set of strongly innovative products with a set of new functionalities will be implemented.

In the following subsections, details about the main components of MOODS are reported. This technical part has been derived from the preliminary study of DSI {LIOOEVOLUTION96}.

The main result:

According to the following architecture in which more than one director can be present with more than 200 DLIOO continuosly configured from completely passive PDLOOs to full power DLIOOs:



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Details about MOODS Components

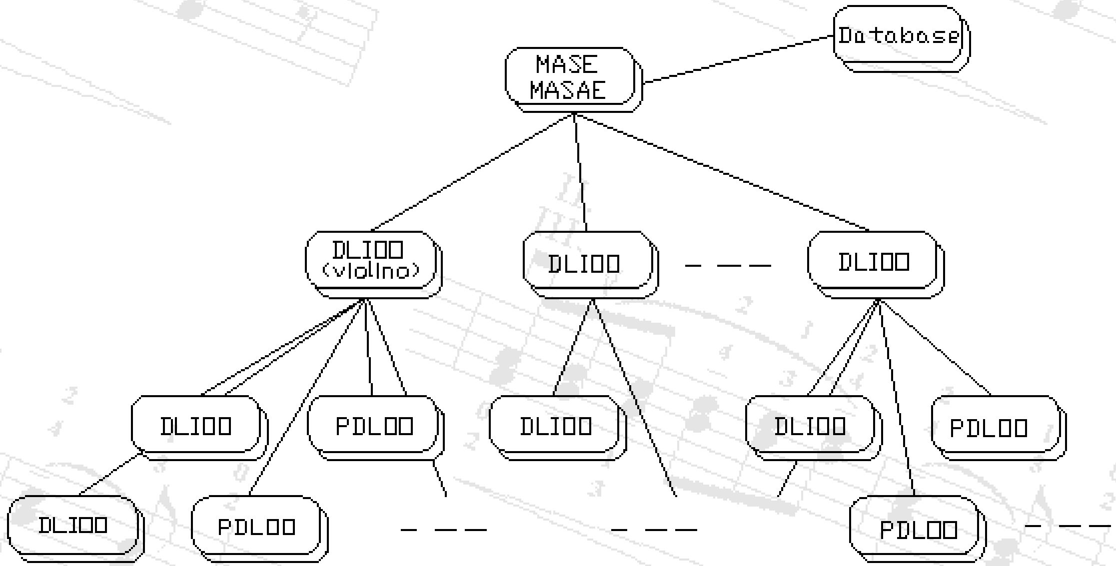
Content:

DLIOOs, Distributed LIOOs

DLIOOs and will receive from MASE/MASAE station all information for visualizing the current score by means of the network. In DLIOOs the visualization will be performed according to the specific musical instrument to which each DLIOO is assigned. On each DLIOO, different sets of interpretation symbols will be provided depending on the instrument assigned.

Each DLIOO will work in two different modalities: EXECUTION and EDITOR. Each DLIOO on the Theater Network switches to EDITOR mode if MASE or MASAE is in EDITOR mode and the MASAE send an enabling to do changes. A DLIOO in EDITOR mode will be used for modifying classical and interpretation symbols for the instrument to which it has been assigned by using the ONCM. The modifications performed on DLIOOs in editor mode will be sent in real-time to MASE/MASAE editors for visualization and saving.

The DLIOOs is organized according to the hierarchical organization of the orchestra. In the orchestra/network two levels of DLIOOs will be present. Those of the first level are qualified to perform changes on the current score (main and interpretation symbols), while the others can be active or passive. The firsts have the same capabilities as those of their parent. The latter, the PDLOO, can only visualize scores/changes performed by the former. In EXECUTION mode DLIOOs and PDLOOs have the same behavior.



This hierarchical organization allows the first instrument (e.g., the 1st violin) to directly transmit the changes decided on the score of the other sub-lecterns (e.g., violins). Sometimes, the 1st violins can be two: in this case a DLIOO child is qualified to perform a cooperative work on the score and changes are reflected to the other violins. In any case, changes are sent to MASE/MASAE workstation. PDLOOs will be totally equal to DLIOOs from the hardware point of view; they receive a different role during the Orchestra/Network Configuration by the ONCM. This cooperative work among distributed lecterns is possible only if a high reliable and fast network is provided, since strong real-time constraints have to be met to guarantee real-time concurrent distributed editing.

Each DLIOO on the Theater Network will be in EXECUTION mode when MOODS is the EXECUTION mode (set by the MASAE). In EXECUTION mode any active lectern is qualified to editing the score. On the other hand, DLIOO and DPLOO can go ahead in the score part in order to look for the evolution of the music by pushing a button of the trackball or selecting with the pen a specific graphical button on the user interface. This navigation is allowed only if the next measure to be executed is farther than a given number of T seconds. This is evaluated by using timing of the execution given by the MASAE. Thus, T seconds before the execution the current score page is automatically visualized.

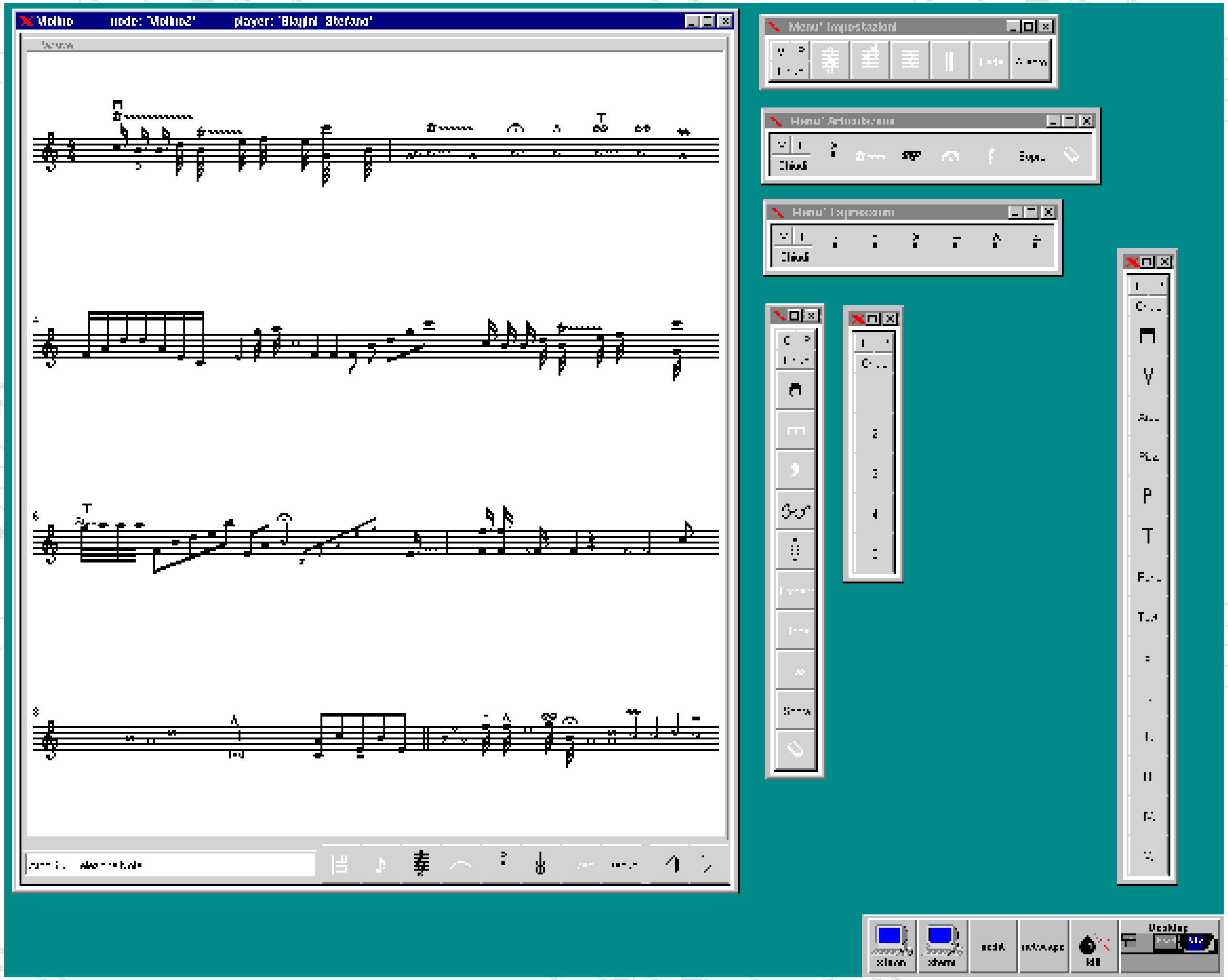
To make more acceptable to work with the electronic lecterns, the mechanism for page turning for DLIOOs/PDLOOs will be similar to that of MASE/MASAE editors/lecterns. The next page will be constructed by starting from the top as soon as the pentagrams on top are already executed. Also in this

case the screen will show two parts, one presenting the current page which is gradually reduced as soon as the measures and the pentagrams are executed, and the other which presents the next page growing in dimension from top to bottom. This is possible since in each instant the measure under execution is known on the basis of beat time by MASAE. In this way the modality adopted for reading scores by musicians will not be changed.

Thus passing from paper to DLIOOs will be facilitated. The mechanism of turning pages is driven by the MASAE lectern during execution on the basis of rules discussed in the sequel. It should be noted that different instruments, and thus different DLIOOs can have the turning of pages at different time instants; this is due to the different quantity of written music which has to be executed by each instrument.

DLIOO hardware, DLIOO-HW, will be built up by considering the usability in terms of ergonomicity, functionalities, and learnability. Operatively, the DLIOO-HW will be implemented by using commercial macro-components such as: mother board, network board, video adapter, LCD screen, etc.

The next image reports a snapshot of DLIOO, please consider that the actual resolution is much much better, we have in this case reduced the resolution in order to make the whole screen visible in this small part and the image fast loadable from the network. Moreover, the music reported has no sense is only an example.



Please note that the above images grabbed from the screen are shown at a lower resolution than the actual.

MASE/MASAE: MAin Score Editor/MAin Score Auxiliary Editor

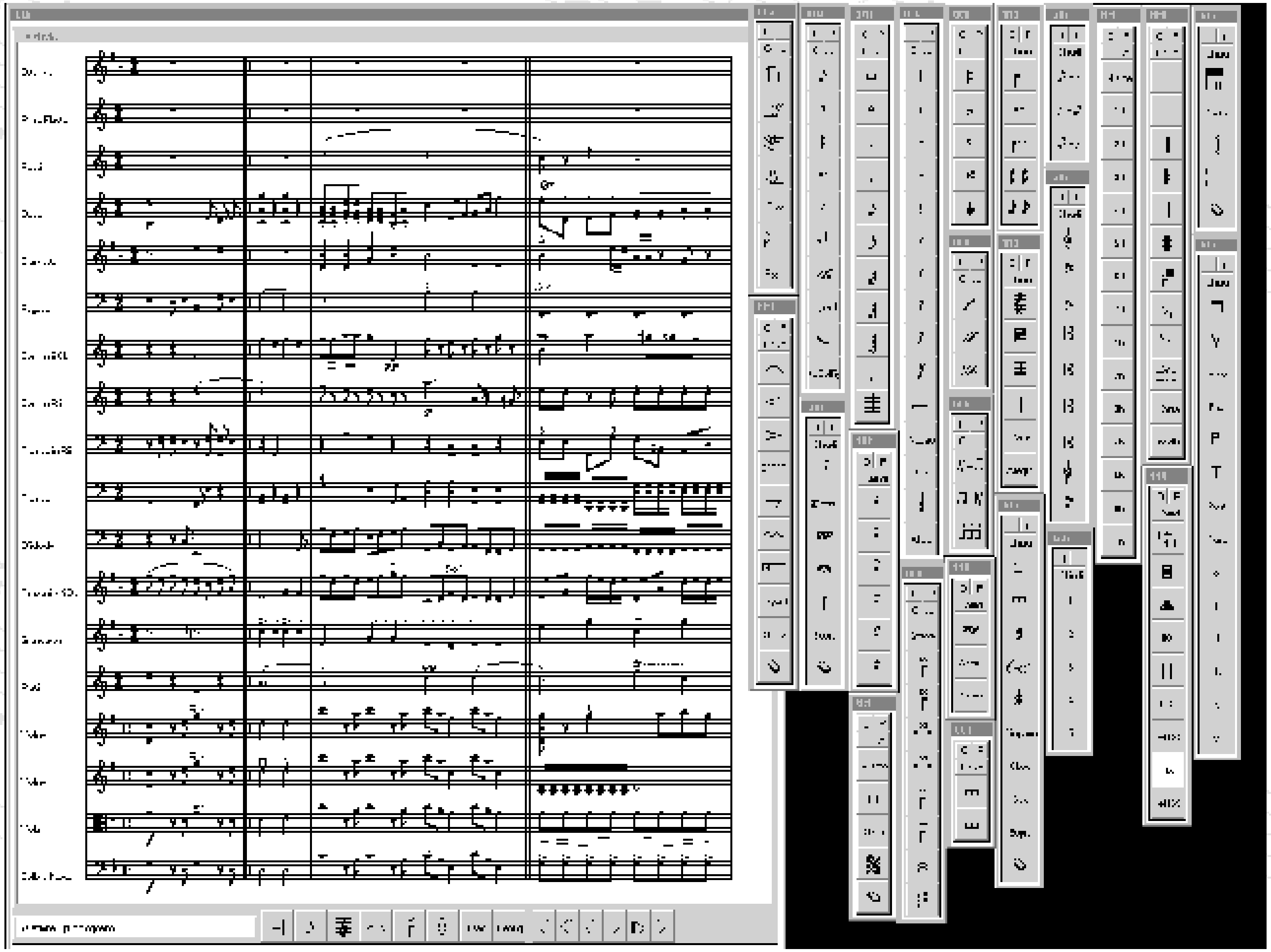
MASE/MASAE will be capable of selecting a main score and parts from a temporary archive to distribute them to DLIOOs on the basis of a current Orchestra/Network Configuration.

Each modification performed on the current score by using MASE/MASAE is sent in real-time to the corresponding DLIOOs/PDLOOs, according to the association of each pentagram of main score to the corresponding physical lecterns connected by the network (using the ONCM). Modifications of the main score can involve all classical symbols of music and all the interpretation symbols. From the MASE/MASAE it is also possible to build new main scores and modifying old scores without loading the scores on DLIOOs (off-line modifications).

When MOODS is in EXECUTION mode, MASAE can be used for tracking the measure under execution by pushing a STEP KEY, and thus beating time. This causes the automatic turning of pages on all DLIOOs and on MASE. The pressing of STEP KEY will cause the passing to the next measure. When this leads to change page, this is automatically performed on all lecterns, DLIOOs and on MASE. In effect, MASE/MASAE editors/lecterns will not implement the page turning by scrolling the screen (strongly unacceptable) or with a complete redraw of score on the screen. MASE/MASAE will change the page by using a new idea: the next page will be gradually prepared from the left as soon as the measures from left of the current page will be already executed. This means that the measures corresponding to the next page will replace those of the current page as soon as the latter are executed. This also leads to have on the screen two areas one presenting the current page which is reducing in size loosing measures from left, and the other presenting the next page with an increasing number of visible measures. This process will be made continuously. This mechanism does not change the habit of musicians to read pages of paper-based lecterns. After a certain number of pressing actions on STEP KEYs the velocity of execution can be supposed as already learned and the MASAE will continue at that rate. A pressing action on STEP KEY will cause an adjusting to the current velocity, and the blinking of a marker will help the MASAE user. In this modality, the fast jumps defined for refrains are automatically executed.

MASE related hardware, MASE-HW, will be built up by considering usability in terms of ergonomicity, functionalities, and learnability. As DLIOO-HW, also MASE-HW will be implemented by using commercial macro-components.

The next image reports a snapshot of MASAE, please consider that the actual resolution is much much better, we have in this case reduced the resolution in order to make the whole screen visible in this small part and the image fast loadable from the network. Moreover, the music reported has no sense is only an example.



Please note that the above images grabbed from the screen are shown at a lower resolution than the actual.

Theater Network, TheNET

According to the low-level protocol selected (100 VG-AnyLAN and TCP/IP), a set of classes for guaranteeing the fulfillment of real-time constraints have been already designed and implemented. This low-level network software is based on PVM and object-oriented {TheNET96}, {PVM394}. On the other hand, to be profitably used in MOODS these must be customized, since a support for distributing high-level messages among objects in different lecterns is needed. This work will be performed by integrating of LIOO and MSLIOO of DSI for using the low-level network support implemented by DSI.

The Theater Network can have even 200 lecterns. Some of these could be DLIOO other PDLOO, while only one MASE and only one MASAE station will be present on the network.

Before using the Theater Network the Orchestra/Network Configuration must be performed. In that phase, the physical lecterns are associated with instruments. For example: lectern 13 for 1st violin (DLIOO), lectern 45 for a violin (PDLOO) depending on 1st violin, lectern 150 as the 1st flute (DLIOO), lectern 140 as a viola (PDLOO), etc. This association will define the relationships among lecterns according to the conceptual model described above. This work will be performed by the Orchestra/Network Configurator and Manager, ONCM.

Please note that the actual network is implemented by using 100 BT thus a hierarchy of HUBS serially connected is used.

Database of Scores and Orchestra Configurations

In the literature, there exists several formats for storing scores in computer files: Finale, Score, MusicTex, Darms, SMDL, NIFF, MIDI, etc., (see {LIOOEVOLUTION96}). Some of these formats are capable of covering only phonic aspects, and others are limited in representing music symbols. Even the SMDL (Standard Music Description Language) is unsatisfactory, being incomplete (see project CANTATE and SHYLOCK partner; see also SMDL standard and HyTime). Among the formats for storing music, NIFF format was considered the most diffuse and complete{NIFF695}. presently this role is covered by SCORE format and FINALE format. Two formats belonging to the respective music score editor.
SCORE can convert FINALE files in SCORE and it is presently used by the most important publishers of music.

The Database for MOODS prototype will allow the easy retrieval of main scores and parts in both MOODS and NIFF formats. MOODS format will be obtained by customizing the already present MSLIOO format, see for example the BNF in {MSLIOOMANUALE96}. The MOODS format for scores will include the features related to the distributed architecture of lecterns/editors. The direct adoption of SCORE format for saving scores has been rejected since the information modeled with MOODS format cannot be mapped in a SCORE or NIFF or other formats. MOODS will present more symbols than any other music format and will include all syntax relationships among them, for example several interpretation symbols {LIOOEVOLUTION96}.

For this reason, a converter from MOODS to SCORE format and vice versa will be implemented, accepting some loss but allowing the import of many many scores in SCORE or FINALE format. The large diffusion of SCORE format guarantees the possibility of printing main scores and parts by using commercial modules or applications (e.g., Music Printer Plus). The same mechanism will be used for producing and acquiring music in many other formats.

The Database will be capable of managing also orchestra/network configurations made by the ONCM. The Database will be capable of maintaining several versions of the same main score and parts and their related orchestra/network configurations, and all the related relationships will be maintained. The Database will be connected with the MASE/MASAE station by means of the network for allowing the transferring of main scores and parts from the archive to MASE/MASAE on the basis of remote queries. Database will maintain information about the exploitation of main scores and parts for accounting copyrights.

The Database will be placed in a different location with respect to MASE/MASAE station and to DLIOOs.

During the customization of the Database manager, a particular attention will be devoted to implement a suitable user interface for theaters and publishers. The Database and the relationships with the publishers will be developed by customizing a product of SHYLOCK partner and derived from CANTATE project.

The Database station could be connected with the publishers by means of Internet for establishing the automatic accounting of copyrights related to the manipulated scores on MASE/MASAE station, on DLIOOs and, if these are printed, in a given period, etc.

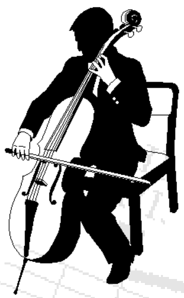
http://www.dsi.unifi.it/~moods

General Background 2

Content:

- **[Market Situation](#) (General Background 1)**
- **Current operational Way (General Background 2)**
- **[Technical state of art](#) (General Background 3)**

Current Operational Way



When the modifications are heavy, such as for ballets and operas, they have to be made by using cut and past (paper and glue). Minor modifications are directly decided and made by musicians by using pencil/pen -- e.g., position of fingers, personal interpretation symbols. Important changes are decided by the director and mainly performed by the archivist during the rehearsals (only sometimes before for classical music). As a result, during rehearsals, due to the high number of different scores (at least 30 in a medium-sized orchestra), the musicians as well as other people involved are frequently constrained to wait even hours for the new version of score.

The time spent in waiting for the new version of score is usually 40 % of the total duration of rehearsals. This is an unsuitable cost considering that musicians, dancers, choristers, supernumeraries, etc. are usually paid on the basis of the number of hours spent (for non-stable orchestras, ballets, etc.). For this reason, it is reasonable to assume that with a distributed system of lecterns/editors for music the modifications could be made for all musicians in few seconds saving at least 50 % of time lost, *saving thus 20 % of total duration of rehearsals*.

Therefore, for evaluating the benefits for the **end-users** (i.e., orchestras, theaters, etc.) in a more realistic case, it can be assumed that at least 20 % of the time spent by 100 people including musicians, dancers, choristers, supernumeraries, etc., could be saved for each rehearsal. A rehearsal can take typically 6 hours for concerts and 15 days for ballets and operas (6 hours per day). Thus considering a cost of 37.5 ECUs per hour per person with 6 hours per day, then a saving of 20 % leads to save 45 ECUs per days per person. This leads to save 4500 ECUs per concert, and 67500 ECUs per ballet or opera. Considering that a programme of a medium-sized theater comprises in a year at least 5 operas, 3 ballets, and 15 concerts, it could save about 405 KECUs by using a MOODS system. Please note that this value is lower than the final cost of a MOODS system of lecterns for a 100 musicians orchestra.

This guarantees the return of the investment for end-users such as theaters and orchestras in general.

Moreover, according to the mechanism of score renting, the modifications are not saved even when they are performed by very famous **directors/conductors**, thus loosing *precious information* for these professionals. This produces a lot of work for the directors and the **soloists** which have to remake their usual modifications on the scores of every theater in which they give the performance. The cost of these people is very high and difficult to be evaluated; they are usually paid per performance with a forfeit. For this reason, they are strongly interested in adopting a mechanism/tool to reduce/simplify their work. MOODS can avoid the problems of remaking modifications.

From the point of view of **publishers**, it should be noted that each director, in each specific theater, executes a different version of the same piece of music by adopting a different set of personal modifications which define the ``interpretation''. These specific versions are presently not available for the market and could open a possible *new market for distributing main scores and parts of each specific performance* as it presently happens for audio CDs of classical music. Moreover, due to presence of modifications several versions of the same main scores and parts are present in the archives of theaters. Presently, publishers let scores to theaters; in the future, they could let the electronic versions and the system of lecterns could maintain trace of the exploitation of each score and part for accounting the copyrights that the theater must pay to the publisher (see project CITED of EC). Publishers have also interest in MOODS for editing in parallel scores of music, thus reducing the time to make a new edition of a score.

The mechanisms for maintaining all specific version of the scores are strongly relevant for **schools of music**. These have a strong interest in discussing with students different interpretations of the same score, to this end it is very useful to have fully annotated main scores and parts of important directors and soloists. On the contrary, with a MOODS system, different scores should be available on the lecterns of students in few seconds. Several schools of music have also large orchestras.

Also the **musicians** are interested in using a MOODS system for saving their specific annotations and interpretation symbols without replicating on the scores of the theater their personal modifications. In addition, during the actual public performance some musicians are usually in trouble for turning pages fast, since both hands are needed to play their instruments. These problems are even greater for the presence of jumps to labeled points for refrains. In critical conditions, the page turning must be performed within the execution of a measure, in less than 1 second. Musicians frequently memorize the score in these critical points, but they are human beings! This problem is evident for individual pianists who usually need help for page turning. This need has been noted by Roland/Sony which in the past tried to produce an electronic piano incorporating a very small display as a soloist lectern, showing only a small part of the score under execution. Thus, it cannot be considered an electronic lectern. As far we know, no other patent about electronic lectern exists other than that by

ELSEL (partner of this project). The mechanism studied for turning pages is described later.

In general, during the rehearsals or the preparative actions there exists the need of recovering scores contained in the theater archives in real-time. The recovering of scores is usually made for extracting score pieces or for comparing the work under modification with those of other directors/conductors who have prepared the same opera/ballet in the same theater in the past, for example to look for a suitable (modifiable) version of scores. Please note that an archive of a medium-sized theater contains more than 10,000 scores (Teatro alla Scala of Milan, one of the project partners, has an archive with more than 90,000 scores).

General Background 3

Content:

Technical State of the Art

In the previous paragraphs, the technical state of the art of this sector has been explained. As regards the HPCN technology more details are reported in the next section.

Please note that, in the field of music, there exists several European projects mainly belonging to Library Area:

- CANTATE, Computer Access to Notation and Text in Music Libraries, definition of a client-server architecture for distributing music in different forms;
- IMPRIMATUR, Intellectual Multimedia Property Rights Model and Terminology for Universal Reference,
- JUKEBOX, Applying Telematic Technologies to Improve Public Access to Audio Archives, managing music libraries of phonic format;
- MODE, Music on Demand, techniques for delivering music in paper and phonic formats by means of Internet;
- PARAGON, SR Target Development as a Paragon for Catalogue Systems (access to music archives) , study of techniques and methods for managing archives of music by means of Internet;
- GREATCOM, Great Composers - the multimedia reference on European classical music heritage
- MAEMH, Multimedia Access to European Musical Heritage
- CITED, management of copyrights for selling information covered by copyrights by means of Internet;
- HARMONICA, a concerted action about projects in the field of music library;
- E-MOLL, a real scale development of CANTATE project.

MOODS project will take into account the results produced by these projects and in particular by projects CANTATE, E-MOLL and HARMONICA. This is guaranteed by the presence of SHYLOCK among the partners of this project. SHYLOCK has been a partner of CANTATE, E-MOLL projects, and it is presently a partner of HARMONICA project.

HPCN Technology Related Issues

According to the preparatory study for this project {LIOOEVOLUTION96}, it should be noted that a huge quantity of information has to pass on the network connecting lecterns in conditions of score transferring due to loading/reloading of refrains. By considering 200 lecterns and the dimension of a score page in electronic format (5000 bytes), an acceptable transfer time (1 second) is obtained with at least 10 Mbps (bit per second) of throughput. Given the high cost that a fault can produce during the execution of public performance, the communication must be strongly reliable. To this end, real-time constraints will be imposed on each transmission; this leads to select for the low-level support a solution consisting of a network having a limited time of wait, such as FDDI (ISO 9314), Token Ring (802.5), 100 VG-AnyLAN (802.12), ATM, {100VG96}, {ATM95}, {Nassar96}, {Bird94}.

On the basis of the early analysis, the network support must provide: (i) a throughput bigger than 30 Mbps; (ii) a very fair access and bounded latency, (iii) a predictable behavior (jitter free or limited), (iv) a support for monitoring network behavior and reliability in real-time, (v) the possibility of connecting at least 200 nodes without decreasing point-to-point performance (as it happens in token-based networks, FDDI and Token Ring), (vi) a low-cost solution (differently from FDDI and ATM solutions), (vii) the possibility of using both twisted pairs (low cost) and optic (noise immunity) wiring, (viii) a possible evolution towards faster versions in the future, (ix) the possibility of implementing fault tolerance networks, (x) a mature technology, (xi) the possibility of using broadcast and multicast addressing.

For these reasons, the adoption of HPCN technology for providing a safe and fast communications among lecterns/editors, is mandatory.

Moreover, with the preliminary study the 100 VG-AnyLAN was selected for its high predictability, throughput (100 Mbps nominal with 95 % of actual utilization) and reliability. In fact, by using this network support, fault tolerant networks can be built. Moreover, high reliability and predictability are obtained, since this allows the use of two levels of priority: normal and high (it is based on Demand Priority protocol instead of collision detection such as Ethernet and Fast Ethernet, CSMA/CD protocol), and has bounded latency and intrinsically supports the monitoring of the network by means of specific nodes. The topology is a HUB-based star with a maximum of 5 levels.

Unfortunately HP have announced the abandon of 100 VG AnyLAN technology from the market. With this notice, and with the aim of maintaining low the cost of the lectern the only possible solution is the fast Ethernet, 100 BT. Moreover, since all work for the MOODS prototype and project will be performed by using TCP/IP and PVM, the substitution of the 100 BT with a faster network will be possible with low expenses.

At higher level, please note that, several supports for distributed systems have been proposed in the market -- e.g., CORBA, OLE Microsoft, etc., but they are not suitable for guaranteeing the fulfillment of real-time constraints. In addition, these supports are quite heavy to be adopted since they present

several internal levels of software which in practice impede the exploitation of capabilities of 100 VG-AnyLAN. This is mainly due to the fact that such supports for distributing objects are mainly focussed to implement non-safety critical applications.

For these reasons the DSI has implemented a low-level object-oriented support based on PVM {TheNET96}, {PVM394}, {Chang96}. This support will be customized and optimized for constituting the low-level network support of MOODS.

The Best Pictures of MOODS

These pictures have been taken during rehearsals at Faculty of Engineering, University of Florence, July 1998, click on them to see a bigger version.

A special Thanks to all Musicians that have tested and used MOODS:

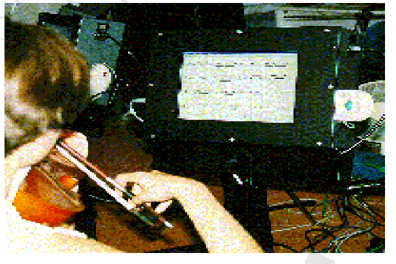
Amerigo Bernardi (Basso)
Benedetta Chiari (Cello)
Martina Chiarugi (Viola)
Paolo Chiavacci (Violino, Viola)
Claudio Fredducci (Violino)
Francesco Loi (Flauto)
Nicola Mitolo (Violino)
Giovanni Prosdocimi (Viola)
Patrizia Ronconi (Violino)
Angela Savi (Violino)
Carlomoreno Volpini (Violino)


Four musicians on two 14 TFT lecterns


A 12 TFT Lectern

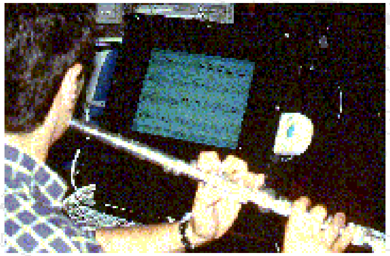

A group of musicians


Musicians and the monitor of archivist


Musicians with MOODS lecterns


Musicians with MOODS lecterns


Musicians with MOODS lecterns


Musicians with MOODS lecterns


This is the backstage during the first rehearsals of MOODS

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http://www.dsi.unifi.it/~moods

The Best Pictures of MOODS

taken at Teatro alla Scala during the demonstration

- 22 September 1998 -

The execution of music has been directed by Maestro Carlo Moreno Volpini.
The musicians involved were:

- Claudio Fredducci (I Violin, Orchestra Regionale Toscana, Orchestra Maggio Musicale Fiorentino)
- Andrea Cortesi (I Violino, Città di Castello)
- Nicola Mitolo (II Violin, Scuola di Musica di Fiesole)
- Patrizia Ronconi (II Violin, Conservatorio Luigi Cherubini, Firenze)
- Carmelo Gianlombardo (Viole, Scuola di Musica di Fiesole)
- Giovanni Prosdocimi (Viole, Scuola di Musica di Fiesole)
- Veronica Lapiccirella(Cell, Orchestra Maggio Musicale Fiorentino)
- Benedetta Chiari (Cell, Conservatorio Luigi Cherubini, Firenze)
- Francesco Tomei (Contrabass, Conservatorio Luigi Cherubini, Firenze)

The role of the Theatre Archivist was covered by: Timna Panfietti Monaco and/or Antonio Albino (DSI).
The role of MOODS configurator was covered by: Pierfrancesco Bellini (DSI)

The music used during rehearsals and execution were those selected at the begin of the project, and the following have been executed durting the demonstrationa at SCALA:

- ``Eine kleine Nachtmusik'' (Serenate in G) of Mozart (1st movement);
- Le 4 Stagioni di Vivaldi (La primavera, 1st movement);
- La Traviata of Verdi (il preludio, the prelude of the first);
- La Traviata of Verdi (il preludio, the prelude of the third act).

Other available music pieces:

- Linda di Chamonix of Donizetti (symphony) for a group comprised of two violins, a viola, a violoncello and a contrabass (first movement);
- Suite dei Boschi of A. Ferrari (IV movement) for a group comprised of one violin, a piano, a flute and a guitar.

The Musicians with MOODS in the Ridotto dei Palchi at Teatro alla Scala

From left: M. Campanai (CESVIT), John Lomas (ARTTIC), Paolo Nesi (DSI, Project Coordinator), Maestro C. Tabarelli (SCALA), Laura Serra (SCALA), Cesare Freddi (SCALA).

A view of the first violin. A cello in background.

Violins and viole at work.

Maestro G. Dotto (Casa Ricordi). In background the MOODS system and the presentation panel for slides.

Musicians during the execution. On the Left the Archivist.

Musicians at during the execution. In background the presentation panel for slides.

Musicians at during the execution.

Prof. P. Nesi during technical demonstration.

Dr. S. Moro during technical demonstration

From left to right: Prof. M. Durech (SMF),
Prof. G. Bucci (DSI), Ing. S. Mitolo (CESVIT),
Dr. C. Giachetti (CPR), Dr. A. Ciampa (CPR, INFN).

Ing. F. Cicillini (ELSEL)

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The Executed Music

Several discussions were performed in order to select the most interesting pieces to be executed during demonstrations. The early result was the fact that the some small pieces have to be identified from which the final pieces will be selected.
These pieces of music will be used for testing: database, MASE/MASAE and DLIOOs, hardware for lecterns HW-DLIOO and for the director HW-MASE/MASAE, and for testing MOODS <-> SCORE converter. For this reason, most of these pieces should be already present in NIFF format. This also avoids the costs of inputting scores into the MOODS system.
Moreover, since the early hypotheses were to built 5 prototypes of HW-DLIOO, thus, the number of parts has to be limited to 5, plus the machine of the director MASE and the machine of the archive chief MASAE.

For these reasons, the pieces used for the demonstration will be selected among:

- Linda di Chamonix of Donizetti (sinfonia) for a group comprised of two violins, a viola, a violoncello and a contrabass; (by Ricordi)
- Le 4 Stagioni di Vivaldi (La primavera, 1st movement) for a group comprised of two violins, a viola, a violoncello and a contrabass; (by Ricordi)
- La Traviata of Verdi (il preludio, the prelude from the first) for a group comprised of two violins, a viola, a violoncello and a contrabass; (by Ricordi)
- La Traviata of Verdi (il preludio, the prelude of third act) for a group comprised of two violins, a viola, a violoncello and a contrabass; (by Ricordi)
- Suite dei Boschi of A. Ferrari (IV movement) for a group comprised of one violin, a piano, a flute and a guitar. (by Ferrari)
- ``Eine kleine Nachtmusik'' (Serenate in G) of Mozart (1st movement) for a group comprised of two violins, a viola, a cello and a contrabass. (Public Domain)

In some cases, a violin could be substitute by a flute.

The Copyrights to produce some of the above scores of music have been provided by RICORDI a partner of this project.

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Disseminations

Disseminating the results obtained at two levels:

National

The partners will presents of their results and experiences against complex and real applications in 2 public demonstrations at:

- Teatro alla Scala in Milan, SCALA (22nd of September 1998)
- Scuola di Musica di Fiesole, SMF.
- Mediartech, March 1999. YOU HAVE TO BE PRESENT

At this demonstration several the relevant sector operators will be invited. The partners also plan to attend the next national Fair of Music (Turin in October, "Salone della Musica").

European

As above, the partners intend to demonstrate their results and experiences in a public presentations at SCALA theater in Milan. At this demonstration the relevant sector operators of Europe will be invited. The partners also plan to present their results at the International Music Fair Frankfurt in March 1999 with an exhibition stand.

MOODS consortium is ready to give you any kind of technical demonstration in Florence, please contact Project Coordinator.

Please contact the project coordinator (prof. Paolo Nesi) if you are interested in attending a demonstration.

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Music Notation

Content:

In this section, a brief overview of music notation is reported. This overview is mainly focused on highlighting the structure of music from the point of view of its meanings for the executor, and the visual representation and syntax of the notation. In this context, only classical music is considered (e.g., Rossini, Bellini, Donizetti, Verdi, Vivaldi, Scarlatti, Puccini, Bach, Beethoven, etc.), modern and antique music should be separately considered. In modern music (e.g., Berio, Corghi, Donatoni, Grisey, Guarnieri, Huber, Maderna, Manzoni, Nono, Nunes, Pennisi, Sciarrino, Vacchi, etc.), several other symbols have to be added with respect to those of classical music. On the other hand, the proliferation of symbols is mainly due to the fantasy of composers rather than to real needs; since, in most cases, the new symbols are proposed for expressing effects that can be described even with the classical notation. Publishers tend to limit the adoption of new symbols to those that are adopted by at least a group of composers since the current trend of composers is to create several personal new symbols for each new composition. For these reasons to consider only classical symbols is not a limitation. On the other hand, from the point of view of publishers, schools of music, and theaters the music notation is that is published, taught and executed in front of large stalls.

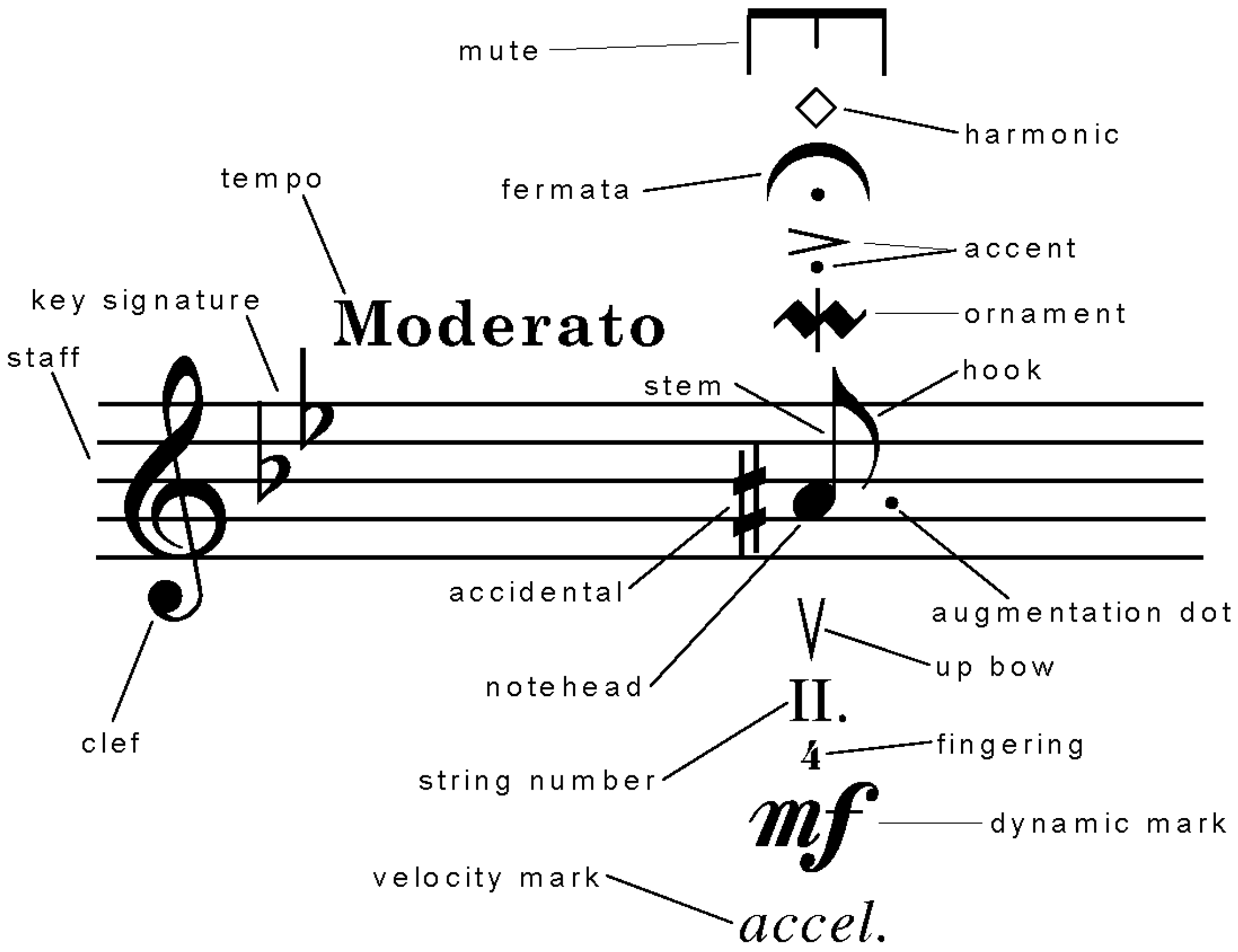
Figures and their Attributes

The basic element of music notation is the *figure*. The figure can be a *note* or a *rest*. The sound is associated with notes, while a rest is a pause in the sound. The figures are read from left to right. Before to discuss about the organization of music figures in the music score a more detailed description of the basic elements related to figures is needed.

The concept of *note* in the music notation is not directly connected to that of pitch in sound, since the sound of a note can be deduced from its representation on the basis of:

- the position of the *notehead* on the *staff* (for some instruments the staff can be comprised from 1 to 6 lines, in the case of 5 lines the staff is also called *pentagram*);
- the *clef* sign (see after);
- the presence of *accidentals* (also called *chromatic inflections*) close to the note or in the *key signature*. For example, sharp and flat, accidentals.

Confidentially, the high of a note in the staff represents its sound in a certain context. Please note that the example in Fig. 2.1, it is strongly exasperate and thus the position of the symbols above and below the note could be performed by following other rules. The rules used in critical cases depend on experience and they are not reported on any book, neither in those mentioned as the handbooks for music engraving (especially for fingering and instrumental symbols which are discussed in the following). This knowledge is verbally inherited and strictly maintained by publishers.



The note, its main components and some related symbols.

The *duration* of a note is conventionally represented by a relative value to the beat -- e.g., a note of an eighth (8th), a note of a quarter (4th), etc. The number of beats is stated on the basis of indications of *tempo*. The effective value of duration depends on:

- kind of notehead (open or filled);
- the presence or not of the *stem*;
- the presence or not of *hooks* (in groups of notes, beams, they are converted in bars);
- the presence of symbols for *changing duration* -- e.g., augmentation dots, a *fermata*.

Moreover, the real duration of a note has to be evaluated considering these aspects and the context in which the note is inserted since the *tempo* (stating the absolute reference of the execution rate), can be different. Visually the form and the position of the notehead and the direction of the stem (if any) of the note follows well defined rules. The position of other symbols around the note frequently depends on the orientation of the stem.

For the duration of *rests* similar but simpler rules are applied. The *tempo* of a musician performance is described by a textual specification -- i.e., *grave, largo, larghetto lento, adagio, andante, andantino, moderato, allegretto, allegro, allegro assai, vivace, presto, prestissimo* (often called *agogic* indications), etc. This specification symbols change the context of the music execution. These indications are often accompanied by adjectives or attributes to better describes the general trend such as *solenne, sostenuto, maestoso, marziale, grazioso, scherzando, giocoso, con fuoco, dolce, tranquillo, impetuoso, agitato, appassionato, deciso, con moto* (sometime are translated in the other languages). In general, these specifications are subjected to interpretation, when an absolute precise vale is required a metronomic indication can be used, fixing in this way the number of beats per minute) remain valid until a different indication is given.

Along the score other indications -- e.g., *rallentando (rall.), allargando (allarg.)* -- are relative changes totally subjective in their realization. These indications are frequently given by means of special graphic symbols -- e.g., an arrow -> or a *wave* for *rall*.

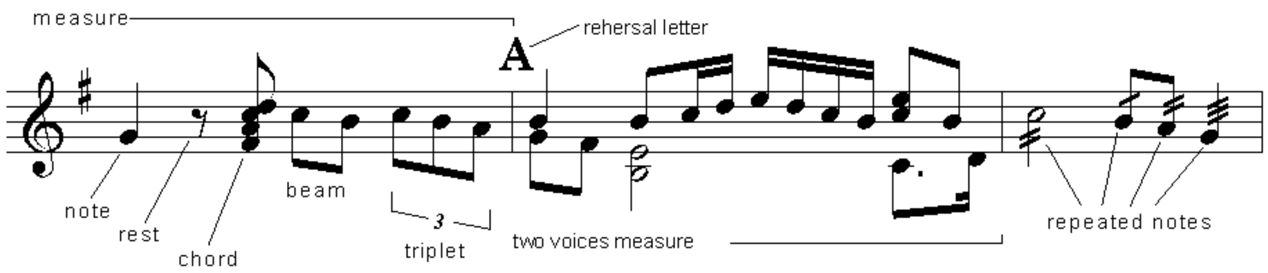
A note may have *ornaments* (abbellimenti) such as: *appoggiatura*, *grace notes*, *mordent*, *trill*, *glissando*, *turn*, *backturn*, *tremolo*. These symbols are associated with the note in order to ornate its sound adding in this way a specific expression to the music phrase. For instance, the *trill* may consist in to alternate the sound of the note with a sound closely higher. Typically, these symbols produce an effect only on the note in which are added. The graphical representation of some of these symbols can be very useful for expressing duration of the effect such as for the *trill*. It states with length the point in which the effect starts and ends.

A note may have *accents* (even called *articulations*) to specify the expression of the note: such as *martellato*, *staccato dot* (truncated), *accent*, *tenuto* (legato, smooth), *sforzato*. The sequence and the relative position of the accents follow a set of well-defined visual rules. In general, the accents affect the duration and in some case also the dynamics. For instance, *martellato* is represented by using a small filled wedge towards the notehead specifying that the sound must be as that of a hammer (martello); *staccato* is represented with a dot over above the note and reduces the note duration of about one half. These accents can be put up or below the note. The position depends on the position of the notehead on the staff; usually on the opposite side of the stem, if any. Each note (in classical music) may present several of these accents at the same time -- e.g., *staccato tenuto sforzato*. Even in this case the visual representation and symbol position give a direct idea of the desired effect. Moreover, many other accents have been recently defined in the modern music.

The *ynamics* is a relative concept to specify the loudness of the sound. For example different gradations of, soft: (e.g., *pianississississississimo*) *pppppp*, *ppppp*, *pppp*, *ppp* or *pp*; loud: *f*, *ff*, *fff*, *ffff*, *fffff* or *ffffff* and middle way values: halfsoft *mp*, halfloud *mf*, and many others: *sf*, *fp*, *fz*, *ffz*, etc.). The symbols of dynamics are typically placed below the staff. The dynamics is a relative specification since it depends on the context. The same dynamics have a different meaning if it is applied to *a solo* or to an orchestra; since in an orchestra the loudness is combined with those of the other instruments. These symbols change the context of the interpretation and remain valid until a different indication is stated. Moreover, the general dynamics can be changed on the basis of relative and local indications for increasing (*crescendo*) or decreasing the dynamics (*diminuendo*). These can be formally stated by either textual (e.g., *dimin*.) or graphical symbols Graphical symbols are much more effective since they have an immediate interpretation. Their direction states if the dynamic has to be increased or decreased, while the application points (starting and ending note) state exactly the range of application. On these bases, with graphical symbols instead of using textual versions other more sophisticated affects can be stated -- e.g., a *crescendo* smoothly connected with a *diminuendo*: <>.

Aggregations of Symbols

According to the music notation there are five main types of mechanisms on the basis of which the figures are grouped or group of figures are represented. Their meaning is strongly different:



- The *chords* are groups of notes (placed on the same stem or aligned on the same column) that as to be executed simultaneously. Instruments like piano can execute chord. The relative position of the notehead depends on specific rules. Chord may present ornaments such as *arpeggiato* from up to down or down to up, depending on the direction of the arrow. In some cases, a different way of representing chords is used. In example the main note on the staff is specified while the other notes of the chord are left to the decision of the musician, or otherwise specified by using their relative numbers: 3, 5 for the 3rd and the 5th note after the dominant.
- The *beams* are groups of notes connected with a large transversal line (simple of multiple depending on the hook value of the notes belonging to the beam). It is a different way to visualize set of notes to make easier the read of the notes but without a counterpart in the execution. The orientation of the bar among the notes is defined on the basis of well-known rules.
- The *tuplets* are irregular groups of notes. A tuplet is comprised by notes which total value exceeded (do not fill) the value assigned in the measure. For instance a triplet if comprised of 3 notes of 1/4 and they have to be executed in a 2/4. These irregular groups may include rests.
- The presence of more than one *voice* is depicted by drawing one sequence of notes for each voice on the same staff. This is used for instruments with more than one voice or in main scores for representing two or more parts on the same staff.
- The *repeated symbols* are frequently used for representing in a concise manner a piece of music. In particular, the presence of one, two, three and sometimes four small lines means that a note must be interpreted as a sequence of distinct notes of 8th, 16th, 32nd and 64th, respectively. This visual representation allows the writing of complex scores in small space. For this reason, it is frequently used for producing the scores of classical music.

Chords, voices, repeated symbols and groups can be considered figures as well. On the other hand, each note in these structures can have all the above mentioned features.

The Structure of Music Scores

According to the music notation, the figures are organized in measures limited by bars, sometime the bar and measure are used as synonyms. Please see the score reported in the previous figure, it presents three measures.

Each measure is comprised of a defined number of beats depending on the meter (e.g., 4/4, 2/4, 6/8). The numerator of the meter represents the number of beats. For instance 3/4 means that one can needs 3 notes of a 1/4th for filling the measure. Therefore, the measure has to be consistent in terms of figure durations that it contains.

The ordered collection of measures represents a *score*. It may contain references to jump from a point to another, from a measure to another for repeating parts (e.g., *ritornelli*), etc. Some special kinds of barlines are defined for marking the start and end of *ritornelli*. In some cases, characters are used for labeling points from which the orchestra has to restart during rehearsals -- for instance, for studying the most difficult pieces of music.

Typically, if the score is for a group of instruments/musicians there exists a score (a part) for each instrument and these are aligned each other being aligned the respective measures. When an instrument has to be quite, it has rests as the 3rd measure of the violin in Fig. 2.3.

Therefore, in orchestras, the director reads the main score observing the measures of all instruments on the same column; while the musician can see only their respective part. In the main score, similar instruments are collected by using a graph or squared parenthesis. The placement of figures on aligned measures depends on the measure length and on the value of the figures.

At the beginning of a score, and when is needed, the *clef* has to be declared -- for example: *G*, *F*, *baritone*, *tenor*, *alto*, *mezzo-soprano*, *soprano* clef. Each clef has to be placed in well specific position on the staff, and not everywhere as allowed by several computer-based music-editors. The clef specifies the current interpretation of the lines and holes of the staff, this interpretation is fixed until a new clef or key signature is placed. The clef may present a key signature (e.g., a group of sharp or flat) for stating changes on the meaning of notes placed on the staff. A new clef, for changing the current one, can be used in instant along the measures, even in the middle.

Moreover, the music observed by the director on the main score is typically formatted differently with respect to that observed by musicians. In fact, it is different since:

- The parts are printed by using compressed versions of music notation symbols - e.g., (i) multi measure rests are represented with a unique symbol on the parts while in the main score a rest for each measure is given; (ii) the adoption of the above mentioned repeated symbols (which in some cases are also present in the main score).
- The parts usually present the above mentioned *general symbols* and several *instrumental symbols* which are excluded from the main score. Moreover, other interpretation/personal symbols may be present in the parts.
- The main score may present some specific textual note or symbol for helping the director.
- The main score may present on a unique staff more than one part, in these cases, they are treated as distinct voices on the same staff. For instance the first and the second violin.
- In the parts, other indications are added for better coordinating musicians -- for instance, the replication of pieces of score in a smaller size (called guides) for helping a musician to restart the execution synchronously with the execution of some specific notes of another musician, etc.

Main score and parts (produced by using Finale).

1. ## Horizontal Music Notation Symbols

Up to now, only simple relationships among symbols have been described.

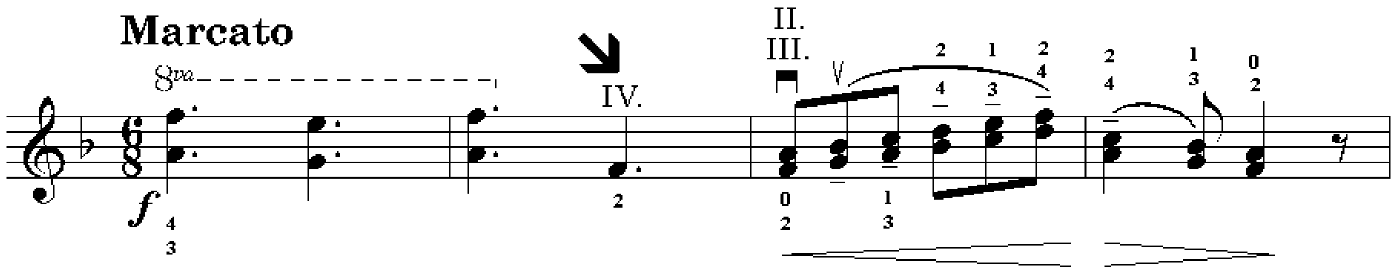
Please note that some of the components of music notation are typically referred to a couple of points along the staff. These points can belong to different measures and in some cases to different scores, for instruments reading music on more than one score:

- The symbols already discussed with the *dynamics* such as *diminuendo*.
- The already discussed local indications for *tempo* such as: *rallentando*, *accelerando* with their graphical representation *wave* and *arrow*.
- The *octave sign* is placed above/below the staff and is similar to a dashed horizontal half square bracket for stating the comprised notes must be considered at an octave above/below the current. The adoption of this symbol to improve readability of the music since reduces the needs of using

additional lines above/below the staff.

- The *tie* is an arc between two notes at the same high. It states that the two notes must be considered as a unique note with duration equal to the sum of the durations of the notes linked. It is visually specified by using an arc among the note. A tie can be cut off at the end of the page, in this case it has to restart from middle of the arc;
- The *slur* is an arc between two notes even if these do not have the same high. A slur between two notes means that these must be executed without discontinuities making smoother (or *legato*) the execution of music.

Please note that this kind of information is totally asynchronous with respect to the sequence of measures. This can be noted by observing the previous figure and the next one.



Horizontal and other additional symbols.

General and Instrumental Symbols

In effectively executed music several other symbols are typically added. These symbols can be classified in two main categories:

- The *general symbols*. For example, a symbols for stating that:
- a 2/4 measure will be beat by the director in 4/4 or vice versa (with 4 lines distributed along the measure);
- the musician has to be careful in a specific point (a couple of small glasses or a transversal big arrow);
- the musician has to take breath (a comma, a V or a |);
- The *instrumental symbols*. For strings: *bridge*, *string number* (in Roman numbers), *finger number* (in Arabic numbers), *bow point*, *bow hell*, *bow up*, *bow down*, *pizzicato*. For timpani: the regulation to the next tone. For harp and piano the pressing of pedals. For brass: the adoption of specific registers for producing certain notes (e.g., oboe mark). For drums the adoption of several kind of stick: *soft*, *metal*, *wire-brush*, etc. For several instruments the presence or not of the mute, or the production of harmonic sounds. Several other symbols have to be added for satisfying the needs of all instruments of a large orchestra.

Most symbols of this last set assume different graphical or textual representations on the basis of the instrument for which they are used. For example the inserting and the removing of the mute can be graphically represented by using a horizontal "E"' for strings, or with a "+" (plus, to insert the mute) or a "-" (minus, to remove the mute) for brass, or with a textual indication: *con sordina*, *via sordina*. The latter are frequently written in the language used by the musician that is playing. Some of these symbols change the context of the interpretation/execution. For example, *with mute* means to insert the mute and in some place will be written *remove mute*.

On the other hand, several interpretation symbols, which are typically neglected in computer music editor, are really relevant during the actual execution of music in theatres and during lessons in schools of music.

Discussion

According to the above presentation, it can be stated that the music notation is a visual language witch presents several rules along both horizontal and vertical directions. Several accompanying symbols strictly related to the notes have been discussed. The presence of more than one of these symbols around the figures changes their order, orientation and positions. For instance, the accents have to be placed on the opposite part of the stem (if any). In the case of a slur on the same note, they have to leave the space close to the note at the slur, thus they have to placed more far from the notehead then usually.

Please note that, in general, the position of accompanying symbols with respect to the note assumes a particular relevance since:

- the musicians are used to read the music formatted in a particular way in terms of notation but also considering the relative position of symbols. Particularly precise scores are greatly appreciated since the musicians tend to associate the action to be performed to well-known visual patterns -- e.g., note plus an accents plus etc. Bad, wrong or, even in some extent, different organizations of symbols are totally non-understandable or unsatisfactory for musicians. They do not have enough time to reasoning about the music notation, they are artistically interpreting music;
- some symbols have different meaning depending on the context and the position in which they are placed in the score. In some cases, different meanings are typically associated with symbols on the basis of their positions and dimension. This is an aid for interpreting music but is also an additional complexity for reproducing music in the exact and understandable form. These different semantics aspects are typically delegated to music writer even in computer-based editor for music. This obviously leaves space to errors.
- some visual constructs can be specified even by using different representations. There are many non-written rules to select one representation at the place of another depending on the context.

Moreover, according to the music notation the same meaning can be obtained by using different representations. In the traditional computer-based music editor, the problems have been addressed by considering only the visual representation of music. This means that in most of them every symbol can be place in any position on the score without constraining the organization of the graphical symbols according to the visual syntax of the music notation. Only few automatic mechanisms are established and they present a lot of situation in which the chosen position is unsuitable.

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Music Modeling

The problem of music modeling in computer systems has been addressed several times in the literature for different purposes. Typical computer-based applications of music modeling are:

- edit/print music for professional and home purposes with the goal of producing a paper version of music scores;
- execute music to produce sounds by means of sound-boards;
- acquire or produce music using Musical Instrumental Digital Interface (MIDI) for coding of sound, composition;
- store/load music scores for analysis, maintenance, execution, versioning;
- analyze music composition styles (musicologists and researchers);
- synthesize music through a computer (by using mathematical and statistical models);
- convert music from a paper score to a computer-based format, OMR (Optical Music Recognition) system similar to OCR (Optical Character Recognition);
- teach music and its rules -- e.g., produce interactive educational CDs for teaching music;
- manipulate music scores in order to change arrangements, transpose keys, etc.
- ..., etc.

Some of the above applications can be used to build powerful tools for specific purposes; analyzing a music style in order to generate similar music; using a MIDI interface as a shortcut to compose music and generate a draft version of a music score.

On the basis of the above list, it can be seen that a music-based software application may use a music model having multiple interpretations and different manipulation mechanisms. In fact, publishers of music scores, composers, musicians, conductors, and computer music analysts, all regard music notation with different interests and use it for different purposes. In general, the elementary operations that can be performed on a music score are: editing, saving, loading, visualizing, executing, coding grabbed sounds, printing, analyzing, etc. In order to provide these capabilities, a specific music model must be defined.

The complexity of the music model needed obviously depends on the application for which the model is produced.
Different applications present different needs in terms of music modeling. Among the above-mentioned applications, one of the most complex is to edit music for professional publishing. Publishing requires a very high quality music score in terms of the number of symbols and their precise placement on the staff (set of parallel lines on which the music symbols are placed). Music scores have to be presented to professional users (musicians) with specific relationships and proportions among symbols. Visual relationships among symbols are the syntax of music notation. The formal relationships among symbols are frequently neglected or misused by most commercial computer-based editors, which frequently focus on producing music by means of MIDI interfaces or sound-boards, or acquiring music by means of a MIDI interface, or simply editing music on the computer for managing sound-boards, etc. Typically, in these cases, a limited number of music notation symbols are needed (e.g., notes, rests, accidentals, clefs and points -- approximately 50 symbols), since it is impossible to reproduce with a MIDI interface the effects specified by most music notation symbols.

The music symbols available in professional editors (e.g., Score, Finale, Sibelius, etc. for publishing music are: the basic symbols (notes, rests, beams, etc.), instrumental and execution symbols, (symbols for describing the behavior of the musicians in playing a specific instrument -- e.g., up or down bow, with mute, without the mute, etc.) for: strings, harps, drums, flutes, etc.; orchestral and complete repeat symbols , etc. These symbols, and many others, are needed when main scores and parts for classical music, operas and ballets have to be produced, and absolutely essential when scores are used in music schools to train students to perform specific executions and interpretations. In commercial editors used to prepare music scores for publishing, the number of elementary symbols is close to 300. These are frequently used as components for building more complex symbols. Typically, musicians have to personalize/prepare a score for the execution; thus, even this great number of symbols is not enough to satisfy all needs. For these reasons, some music editors provide a font editor for adding symbols; these, unfortunately, are treated as simple graphic entities.

The organization of many detailed symbols is frequently left to the user. Typically, music symbols (excluding notes, rests and a few other symbols) are mainly considered by music editors as graphic elements that can be placed in any position on a score page without addressing the problems related to the music notation; e.g., the visual and syntactic relationships among symbols. Most music editors even allow the placement of several notation symbols in incorrect positions, resulting in the production of strange, incorrect music scores. These music editors give no support to the users. These incorrect music scores cannot be played by musicians, or correctly interpreted by style analysis algorithms, or correctly used to generate sound, and are, thus, professionally unusable. In several cases, only those symbols having a counterpart in the MIDI language are considered.
Commercial music editors for publishing are mainly oriented towards placing music symbols on the staff rather than collecting relationships among symbols and on that basis organizing the visual information.
Instead, they are mainly oriented towards printing music, since this is their most important application. They provide a complete set of symbols and instruments that a user skilled in both music notation and graphic computer user interface can use to produce a professional page of music.

For these reasons, professional music editors are powerful, but are difficult for non-expert users in music notation to employ. Typically, musicians are capable of reading music, but are not familiar with the exact rules for arranging symbols (e.g., when symbol A is associated with symbol B symbol C has to be moved up one-half unit). On the other hand, musicians have no problem correctly reading a correctly annotated score, but can be perplexed when non-perfect visual constructs are proposed. These musicians are artists, not music engraving and notation technicians. Conductors and composers are frequently more sensitive to problems of music notation and visual expressiveness. Archivists in music theaters, music engravers, and teachers of music notation are the experts to relied on for problems of music notation.

The above-mentioned problems also exist in general languages for storing/coding music. Concerning definition of relationships among symbols, the most flexible and complete languages are NIFF (Notation Interchange File Format) and SMDL (Standard Music Description Languages). Even these languages do not model all the relationships described above and allow placement of symbols in any point in the staff. There are several languages for coding music, as described in SField97 , but unfortunately all of these languages suffer from the same problems.

In order to solve these problems, music notation should be considered a formal visual language in which errors in the placement of symbols are totally unacceptable because they are out of syntax - e.g., Chang87a . Music editors must provide support for the verification of the visual syntax. Moreover, a visual editor has to help the user to easily produce only correct music scores that are based on the visual grammar among symbols. These very important features can be easily obtained if the syntax and the relationships between the notational entities are formally defined. In the case of music, the definition of the visual grammar is a highly complex task that is not yet formalized. However, the existence of a formal model is a great improvement with respect to the state of the art.

To model all relationships of music notation is quite a complex task.
As the number of music symbols grows, the number of relationships among them and the related rules for visualizing them grows more than proportionally, since the presence of certain symbols influences the relationships among other symbols. The rules for adopting symbols are much more important than their availability as graphic elements to be inserted on a score. Therefore, the knowledge of the syntax and the semantics of music is mandatory for organizing music symbols on the staff.
For these reasons, very few music editors (Finale, MusicEase, Lime, etc.) address the problems of (i) automatic placement of symbols and (ii) music justification. Some of these are capable of correctly arranging a limited number of symbols.

In music, justification involves the placement of symbols both along the staff and the transversal of the staff, and can be performed on the basis of several different algorithms. These rules together with those for the justification of music have not yet been formalized. Several books have been written to solve this problem, but inconsistencies and incompleteness still exist.
For certain aspects, the automatic justification of music should be regarded as an open problem. Moreover, only a few symbols are placed automatically; for instance, in the music notation there are several symbols that have must be placed around the notehead. These symbols frequently must be placed by hand, whereas automatic arrangement could greatly simplify the music editing. For example, by selecting a given symbol and the note, the symbol has to be automatically placed in the right position with respect to the note and the other symbols involved.

Currently, even in very mature music editors, the positioning of music elements on the score presents many critical conditions. These music editors should provide a type of auto-correction, as is done for words in modern text editors.
Instead, the user has to work around the positioning of symbols, performing a very long and tedious process of adjustment.

New Needs

Recently, with the diffusion of computer technology into the artistic fields, new needs for computer-based applications of music have been identified. In 1994 in our research group in Florence, we began to research about a network of computer-based music lecterns oriented to musicians. These were studied for editing/showing music scores by means of a suitable video device, with the goal of totally removing the paper scores from musician stands (lecterns). Computerized music lecterns can be used by musicians to avoid transporting many kilograms of paper music scores, to save their work, to manage version, control, etc.
At first glance, this kind of application seems not much different from the music editors that are currently on the market. An important difference is in the user interface, which has to be much simpler than that of classical music editors, since it has to be usable by musicians . The user interface must incorporate some of the mechanisms that are typical of editors for visual languages: (i) the presence of visual parser based on the grammatical rules of the symbols; and (ii) a visual analyzer for the automatic arrangements of symbols on the basis of lexical rules.

In the last three years, these problems have been studied by our research group, focused on the premise that the orchestras could be supported by a set of computer-based lecterns. If the lecterns are connected each other by means of a network, information shared among lecterns can be used to define some new and very interesting applications, such as:

- lecterns for orchestras with an automatic and synchronous mechanism for turning pages and for cooperative manipulation of music scores,
- cooperative editing of music scores for music publishers, and
- interactive and constrained cooperative music editing for teaching music composition and execution in schools of music.

The main obstacle that we found to adopting the available commercial music editors in this way is the lack of a formal model of music. In fact, without a formal model, all relationships among visual notation constructs are difficult to maintain. In some cases, the visual syntax may change on the basis of the context and thus of the semantics of the statement under construction.
A distributed system with the above features must be capable of showing music in different formats and at the same time must support cooperative work of editing on different formats, showing the changes of one operator to the other in real time. Therefore, a model of music is needed to define and implement algorithms for the automatic:

1. (i) Placement of attributes of the music notation by means a visual parser based on grammatical rules of music notation;
2. (ii) Formatting of symbols when changes are made, for instance, when another symbol is added;
3. (iii) Rapid conversion of a visualization mode to another depending on the user/musician that is reading the score or fo the score page dimension. Typically, scores for musicians and for the conductor are formatted differently.

This approach allowed the evolution of our research towards very new applications of music modeling.
We started with the definition of an object-oriented model and framework. This was initially used for building music editors for musicians and conductors.
The present version is used as a basis for two main projects:

- MOODS (Music Object-Oriented Distributed System) ESPRIT HPCN. The project has, among its goals, the implementation of a distributed system of lecterns for orchestras, publishers and schools of music. Partners of the MOODS consortium are: the well-known Teatro alla Scala of Milan, BMG Ricordi as music publisher, the School of Music of Fiesole, Shylock Projects as experts of music score databases (see projects CANTATE and HARMONICA), ELSEL as builder of computer-based lecterns, and DSI (Department of Systems and Informatics) as project coordinator.
- O3MR (Object Oriented Optical Music Recognition), a project concerned with building an optical music recognition system for converting paper versions of music scores in a suitable format for music editors. O3MR is based on the adoption of the neural network for low-level recognition of symbols, while at high-level the constructs of music notation are recognized by using the object-oriented model of music discussed in this paper.

The activity on music at the Department of Systems and Informatics is partially supported by Hewlett Packard Italy.

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Interesting WWW Sites on Music

A great part of this collection has been extracted from Harmonica

International Sites

- Music In Italy http://www.music.it
- ARA Music Technology An excellent collection of links and information about music notation technolgy and the people who use it.
- Computer Music Journal An academic journal covering research in computers and music.
- Electronic Music Software Price Guide A list of street prices of music software and hardware.
- Harmony Central A big trailblazer site for music and music products.
- Music Resources on the Internet The Indiana University Music Library trailblazer page of music sites.
- The Music Studio An on-line magazine covering MIDI, music notation, and other music issues.
- WWW Music Sources Page The UC DAVIS Music Department Library tr
- SMDL
- CEC MUSIC http://www2.echo.lu/libraries/en/music.html
- Teatro alla scala http://lascala.milano.it/
- BMG Ricordi:
- Great music web sites links for all categories http://www.netzone.com/~tjason/jmusic.html
- Sites Collection Harmony Central Internet Beatles Archive Internet Resources for Music Scholars Javascript Guitar Chord Chart The Jazz Web Kyle's Virtual Guitar Lesson Music http://houck.salkeiz.k12.or.us/Houck.Website/Cool.Sites/cool.sites.music.html

Music programs

- SCORE Music and in General for Music Notation Site http://www.ymusic.com/Forums/Notation/
- Stanford Music Site http://ccrma-www.stanford.edu/
- Harmonica Music Site http://www.svb.nl/project/harmonica/harm_survey.htm
- Humdrum Music Editor Site and UNICODE http://www.lib.virginia.edu/dmmc/Music/Humdrum/index.html
- Coda inc., producer of FINALE: http://www.codamusic.com
- Cmusic language and model http://www.mathuab.edu/home/xin/cmusic.html
- Graphire language and model http://www.sover.net/~graphire
- Braille Music http://www.netaxs.com/~ddtos
- Java MIDI http://www.interport.net/~mash/javamidi.html
- Coda Music Technology Makers of the Finale music notation program.
- Emagic Makers of the Logic sequencing/notation program. This is a user-maintained site.
- Mark of the Unicorn Makers of MIDI software and hardware and the Mosaic music notation program.
- Midisoft Makers of sound and music software for Windows.
- Opcode Systems Makers of MIDI software and hardware and the Overture music notation program.

- Sibelius Software Makers of the Sibelius 7 music notation program.
- SCORE on the Internet A user's group connection for the SCORE music notation program.
- Musicware, Inc. Makers of the Nightingale music notation and NoteScan music scanning programs. This is a distributor's site.

Other Selected Sites from Sound and Music Programs Page (to be rearranged)

- Calliope - Music notation, graphical based
- Cmusic --> CARL
- Common Lisp Music - Music synthesis and signal processing compiler
- Common Music - Object-oriented music composition environment
- Common Music Notation - Music notation, list based
- InstrumentBuilder - A graphical instrument editor for cmusic
- LPCView - Edit LPC analysis files
- MediaStation - A Multimedia database
- Meter - Monitor the output level of the sound driver
- MidiExamples - An Intel port of NeXT's MIDI programming examples
- MixView - Graphics-based soundfile editing
- MusicKit - An object-oriented software system for building music, sound, signal processing, and MIDI applications
- NoteAbility - Music notation, graphic based
- Nutation - Music notation, graphic based
- ScoreAndSound - Programming demo for handling music and sound simultaneously
- ScorePlayer - Plays Scorefiles in real time on the DSP and Midi
- SOX - A utility for converting soundfile formats
- Spasm - Experiment with voice synthesis
- Spectro - Spectrum analyzer

International Associations

- IAMIC - International Association of Music Information Centres
- IAML - International Association of Music Libraries (UK Homepage). See also International Index
- IASPM - International Association for the Study of Popular Music
- ICCM - International Center for Choral Music
- IFCM - International Federation for Choral Music
- RISM - Répertoire International des Sources Musicales
- American Composers Forum One of the largest composer's organizations in the country.
- CCARH: Center for Computer Assisted Research in the Humanities A research group concerned with applications in music; publishers of the Computing in Musicology yearbook which among other things shows examples of music produced by notation software. (Music Press output appeared in Volume 9, 1993-4 of this publication.)
- CCRMA: Center for Computer Research in Music and Acoustics A Stanford University research group concerned with applications in music and sound.

Notation Interchange File Format (NIFF) Information about the NIFF project to develop a standard for music notation interchange and archival.

General Resources

- Aardvark's Archive of General Musical Interest - A fun and educational resource from St Louis spotlighting all things musical on the Web
- Ana & Luca's music pages - An interesting site presenting unpublished classical and operatic works by Mayr, Pacini, Donizetti, Cimarosa, Zingarelli includingcomplete operas and free download: Midi files, libretti, musical scores
- Centre d'Art Polyphonique d'Alsace - Information on the Musica service for choral music
- Centre de Solutions Musicales: A project which aims more particularly to promote the qualities and specific characters of European musical know-how as well as the very rich European musical heritage
- Choir Links - An attempt to link choirs by listing their URLs
- ChoralNet - The Internet centre for choral music linking nearly all known websites related to choral music as well as related subjects
- Harmony Music List - UC San Diego Music Library
- IRCAM - The homepage of the Institut de Recherche et Coordination Acoustique/Musique at the Pompidou Centre
- McGill University Faculty of Music and the Music Library of the Future project
- MCPS - Mechanical Copyright Protection Society
- Moscow State Conservatory - A comprehensive overview of departments and services are now available in English
- Music Homepages of the World - Maintained by Biblioteca Braidense
- Music Pavilion - A few hi-tech links from the Internet 1996 World Exposition
- Music Resources: Academic Sites - Links, including several interesting European sites maintained by the University of Indiana
- PATRON - An eLib project from the UK for developing on-demand audio, video, scores and text for music and dance.
- SBN databases - These include the music database of 200,000 items as well as the national sound archive database
- Sibelius Academy - Extremely well structured list of links covering most aspects of music
- Sonances - A new Canadian journal on music supported by an interesting site on the music scene worldwide (also available in French)
- University of Michigan Music Library - Contains many interesting links to internal and external info
- University of Washington Libraries - The page on music libraries projects contains a number of interesting links
- Variations Project - From the School of Music at the University of Indiana: aims to set up improved access to music including CD quality on-line network delivery
- Virtual Library - Music - WWW virtual library
- Music at UCC - The University College Cork's resources for study and research in music

Music Information Centres country by country

- Australia: Australian Music Centre
- Belgium: CeBeDeM, Belgian Documentation Centre for Serious Contemporary Music
- Brazil: Centro de Documentação de Música Contemporânea
- Canada: Canadian Music Centre
- Czech Republic: Czech Music Information Centre
- Denmark: Musik Information Danmark
- France: IRCAM - Centre de Documentation de la Musique Contemporaine

- Iceland: the Icelandic Music Page
- Ireland: contemparary music centre
- Italy: Biblioteca Braidense, and Music In Italy
- Netherlands: Donemus and Gaudeamus
- Norway: Norsk Musikkinformasjon
- Scotland: Scottish Music Information Centre
- Slovakia: Music Information Centre of the Music Fund
- Spain: Directory of Catalan Music - Information on Catalan composers, performers, etc., with some interesting links to other international sites
- Sweden: Svensk Musik
- United States: American Music Information Center

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http://www.dsi.unifi.it/~moods

Florence 1/2/2000

Dear Tester and Evaluator

This is the first distribution of MOODS editor for windows NT and 98.
It has been better tested on windows NT rather than on Windows 98.
An equivalent LINUX version is available under request.
A much more complete version is available on LINUX and can be
demonstrate at DSI. The present version is the result of the porting
from LINUX and Windonws NT. Under LINUX, MOODS is the only available
cooperative editor of music in the world, see
http://www.dsi.unifi.it/~moods

Please refer to MOODS-User-Manual-v-3-5.DOC for the user manual
of the editor. That document is included in the package in a separate file.

It will become the WEDELMUSIC editor and Integrator
and the WEDELMUSIC Viewer and Listener by including all aspects that
will be identified during the specification and use cases.

To install it you have to install MOODS editor and the ghost view
for printing the music sheets.

1) To install the moods editor please click on the executable file

moodsv-1.exe

chose a disk in which you would like to install it, for instance C:\ or D:\
The intallation will create a directory called MOODS in which
all executable files and examples will be located.
If you click twice on the file

MOODS-EXECUTE.bat

the moods editor will appear.

2) to install the ghost view for printing support please click twice on the file

gsv26550.exe

Please install it on C:\gstools as suggested by the installation.
Please answer with yes to all questions to arrive at the end of installation.

Compliment you have completed the installation.!
Good work with MOODS editor.

Please refer any problem or suggestion to:

moods@dsi.unifi.it

reporting the version at which they are refered.
The version can be recovered cliking on the about button in the menu file.
Please send also the MDS files if some problems arise in loading
or saving files.

New versions including the following points will be available soon as
their porting or implementation will be performed.

YOU CAN DISTRIBUTE THIS moodsv-1.exe and this file without restriction
providing that this file and the document will be distributed together.

Thanks a lot,
MOODS team

Implementation planning during WEDELMUSIC project

) Giustification: linear and logarithmic
) inclusion of new symbols
) Management of ACL under NT
) 3rd and 4th Layer/voice in the model
) general drive for printing braille
) general drive for producing speech music
) Dialog Boxes and mechanisms for classification data
replication automatic of that information on parts,
) editing parts of the main score, opening the single parts in different windows
) editing single part score
) modeling music with more than one staff: 2 or 3 at maximum
) playing audio from wave
) sync/play audio with symbolic

) sync/play audio with image score
) integrating image score with symbolic
) only image version, main or single score
) printing with watermark
) printing with fingher print (depends on 7)
) setting watermark information
) setting permissions for each wedel object
) font selectable for each text
) inclusion of lyric
) inclusion of tablature
) inclusion of Guitar Chords
) managing wedel components
) note head of different type
) finale converter
) score converter

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http://hpcn.dsi.unifi.it/~wedelmusic
wedellist@dsi.unifi.it

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(♩= 96)
clarinet in A
violino I
violino II
viola
violoncello
9
3
Pizz.
Pizz.
Pizz.
18
Arco
Arco
Arco


26
clarinet in A
violino I
violino II
fp
viola
fp
violoncello
p
34
clarinet in A
p
violino I
p
violino II
p
viola
p
violoncello
p
42
clarinet in A
3
violino I
rf
rf
violino II
rf
rf
viola
rf
rf
violoncello
rf
rf


50
clarinet in A
violino I
violino II
viola
violoncello
p
p
p
p
Menuetto D.C. senza replica

```
BP
FRM MOODS
LVL 1 REL 2
SCAL 10
DIMS 15
DIMF 15
TPMG 30.000000
LTMG 0.000000
BMG 0.000000
SRC 1.mozart_trio-4.mds
SRC 2.mozart_trio-4.mds
SRC 3.mozart_trio-4.mds
SRC 4.mozart_trio-4.mds
SRC 5.mozart_trio-4.mds
BRA SQ (1,5) 1
EP
```

```
BPR
LVL 1 REL 2
"clarinet in A"
BM 1,1
	NP 0,0,0
	CLEF TRB NRM
	KS DOM
	TEM 3/4		MOV("",N4,FL,96)
		LAYER 1
			BB 22
			NB 17
			N8			S DWN
			HN 5
						TDIN(TDP,DWN)
			NB 20
			SX(15)

			NB 21
			N8			S DWN
			HN 7
						EB
		LAYER 2
		BF 17			SX(15)

		EF
		BF 20			SX(15)

		EF
		BF 21			SX(15)

		EF
	BL SGL
EM
BM 2,2
	NP 0,0,0
	CLEF TRB NRM
	KS DOM
	TEM 3/4			LAYER 1
			BB 25
			NB 1
			N8			S DWN
```

```
        HN 9
                    NB 5
        N8             S DWN
        HN 7
                    EB
    BF 9         N4              S DWN
        HN 12
                EF
    BF 16         SX(15)

    EF
        BB 26
        NB 17
        N8             S DWN
        HN 9
                    NB 21
        N8             S DWN
        HN 7
                    EB
    LAYER 2
    BF 1         SX(15)

    EF
    BF 5         SX(15)

    EF
    BF 9         SX(15)

    EF
    BF 16         SX(15)

    EF
    BF 17         SX(15)

    EF
    BF 21         SX(15)

    EF
  BL SGL
EM
BM 3,3
```

```
NP 0,0,0
CLEF TRB NRM
KS DOM
TEM 3/4            LAYER 1
          BB 25
          NB 1
          N8                S DWN
          HN 6
                          NB 5
          N8                S DWN
          HN 8
                          EB
     BF 9            N4                S DWN
          HN 10
                     EF
     BF 16            SX(15)

     EF
          BB 26
          NB 17
          N8                S DWN
          HN 8
                          NB 21
          N8                S DWN
          HN 6
                          EB
     LAYER 2
     BF 1            SX(15)

     EF
     BF 5            SX(15)

     EF
     BF 9            SX(15)

     EF
     BF 16            SX(15)

     EF
     BF 17            SX(15)
```

```
        EF
        BF 21              SX(15)

        EF
    BL SGL
EM
BM 4,4
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4            LAYER 1
            BB 28
            NB 1
            N8                 S DWN
            HN 5
                            NB 5
            N8                 S DWN
            HN 4
                            NB 9
            N8                 S DWN
            HN 7
                            NB 13
            N8                 S DWN
            HN 6
                            NB 17
            N8                 S DWN
            HN 9
                            NB 21
            N8                 S DWN
            HN 8
                            EB
        LAYER 2
        BF 1               SX(15)

        EF
        BF 5               SX(15)

        EF
        BF 9               SX(15)

        EF
```

```
            BF 13           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 5,5
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4         LAYER 1
            BF 26           SX(15)

            EF
            BF 1            N4              S DWN
                HN 6
                                BA
                SH
                EA
            EF
            BF 8            SX(15)

            EF
            BF 9            N4              S DWN
                HN 7
                        EF
            BF 16           SX(15)

            EF
                BB 25
                NB 17
                N8              S DWN
                HN 5
                            NB 21
                N8              S DWN
                HN 7
```

```
                                EB
               LAYER 2
               BF 22               SX(15)

               EF
               BF 1                SX(15)

               EF
               BF 8                SX(15)

               EF
               BF 9                SX(15)

               EF
               BF 16               SX(15)

               EF
               BF 17               SX(15)

               EF
               BF 21               SX(15)

               EF
           BL SGL
       EM
       BM 6,6
           NP 0,0,0
           CLEF TRB NRM
           KS DOM
           TEM 3/4           LAYER 1
                   BB 25
                   NB 1
                   N8             S DWN
                   HN 9
                               NB 5
                   N8             S DWN
                   HN 7
                               EB
               BF 9          N4             S DWN
                   HN 12
                           EF
```

```
        BF 16           SX(15)

        EF
            BB 26
            NB 17
            N8              S DWN
            HN 9
                          NB 21
            N8              S DWN
            HN 7
                          EB
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 7,7
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4         LAYER 1
            BB 25
            NB 1
            N8              S DWN
            HN 6
```

```
                        BA
        NAT
        EA
        NB 5
        N8                S DWN
        HN 8
                        EB
BF 9               N4                 S DWN
        HN 10
                EF
BF 16               SX(15)

EF
BF 17               R4                 HN 1
EF
BF 20               SX(15)

EF
BF 21               SX(15)

EF
LAYER 2
BF 1               SX(15)

EF
BF 5               SX(15)

EF
BF 9               SX(15)

EF
BF 16               SX(15)

EF
BF 17               SX(15)

EF
BF 20               SX(15)

EF
BF 21               SX(15)
```

```
        EF
    BL SGL
EM
BM 8,8
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4          LAYER 1
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 22           RW             HN 6
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 16           SX(15)
```

```
                EF
                BF 17                   SX(15)

                EF
                BF 20                   SX(15)

                EF
                BF 21                   SX(15)

                EF
        BL SGL
EM
BM 9,9
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4         NMM 9
                LAYER 1
                BF 40                   R4                      HN 1
                EF
                BF 5                    SX(15)

                EF
                BF 41                   R4                      HN 1
                EF
                BF 16                   SX(15)

                EF
                        BB 48
                        NB 43
                        N8                      S UP
                        HN -1
                                        NB 44
                        N8                      S UP
                        HN -4
                                        NB 46
                        N8                      S UP
                        HN -6
                                        EB
                LAYER 2
                BF 1                    SX(15)
```

```
            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 16            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 18            SX(15)

            EF
            BF 19            SX(15)

            EF
        BL SGL
    EM
    BM 10,10
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4            LAYER 1
                BB 32
                NB 27
                N8            S UP
                HN -4
                        NB 6
                N8            S UP
                HN -1
                        BE
                EX(STA,DWN)
                EE
                NB 10
                N8            S UP
                HN 1
                        BE
```

```
        EX(STA,DWN)
        EE
        NB 14
        N8                  S UP
        HN 3
                          BE
        EX(STA,DWN)
        EE
        NB 18
        N8                  S UP
        HN 6
                          BE
        EX(STA,DWN)
        EE
        NB 22
        N8                  S UP
        HN 8
                          BE
        EX(STA,DWN)
        EE
        EB
    LAYER 2
    BF 1                SX(15)

    EF
    BF 4                SX(15)

    EF
    BF 8                SX(15)

    EF
    BF 12               SX(15)

    EF
    BF 16               SX(15)

    EF
    BF 20               SX(15)

    EF
BL SGL
```

```
EM
BM 11,11
     NP 0,0,0
     CLEF TRB NRM
     KS DOM
     TEM 3/4          LAYER 1
          BB 28
          NB 1
          N8                S DWN
          HN 10
                          NB 5
          N8                S DWN
          HN 9
                          NB 9
          N8                S DWN
          HN 8
                          NB 13
          N8                S DWN
          HN 7
                          NB 17
          N8                S DWN
          HN 8
                          NB 21
          N8                S DWN
          HN 6
                          EB
       LAYER 2
       BF 1              SX(15)

       EF
       BF 5              SX(15)

       EF
       BF 9              SX(15)

       EF
       BF 13              SX(15)

       EF
       BF 17              SX(15)
```

```
            EF
            BF 21                   SX(15)

            EF
        BL SGL
    EM
    BM 12,12
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4                LAYER 1
            BF 1                 N2                  S DWN
                HN 5
                                EF
            BF 5                 SX(15)

            EF
            BF 9                 SX(15)

            EF
            BF 13                SX(15)

            EF
                BB 25
                NB 17
                N8                     S DWN
                HN 7
                                    NB 21
                N8                     S DWN
                HN 6
                                    EB
            LAYER 2
            BF 1                 SX(15)

            EF
            BF 5                 SX(15)

            EF
            BF 9                 SX(15)

            EF
```

```
        BF 13               SX(15)

        EF
        BF 17               SX(15)

        EF
        BF 21               SX(15)

        EF
    BL SGL
EM
BM 13,13
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4             LAYER 1
        BF 1               N4                 S DWN
            HN 5
                          EF
        BF 8               SX(15)

        EF
        BF 25               R4                 HN 1
        EF
        BF 16               SX(15)

        EF
        LAYER 2
        BF 1               SX(15)

        EF
        BF 8               SX(15)

        EF
        BF 9               SX(15)

        EF
        BF 16               SX(15)

        EF
    BL STF
```

```
EM
BM 14,125
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4                 LAYER 1
                BF 25                   R4                      HN 1
                EF
                BF 21                   SX(15)

                EF
                LAYER 2
                BF 17                   SX(15)

                EF
                BF 21                   SX(15)

                EF
        BL SGL
EM
BM 15,14
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4                 LAYER 1
                BF 1                    SX(15)

                EF
                BF 5                    SX(15)

                EF
                BF 9                    R2                      HN 4
                EF
                BF 10                   SX(15)

                EF
                BF 17                   SX(15)

                EF
                BF 21                   SX(15)
```

```
        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 10           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 16,15
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4         LAYER 1
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            R2          HN 4
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
```

```
            BF 21          SX(15)

            EF
            LAYER 2
            BF 1           SX(15)

            EF
            BF 5           SX(15)

            EF
            BF 9           SX(15)

            EF
            BF 16          SX(15)

            EF
            BF 17          SX(15)

            EF
            BF 21          SX(15)

            EF
        BL SGL
    EM
    BM 17,16
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4        LAYER 1
            BF 1           SX(15)

            EF
            BF 5           SX(15)

            EF
            BF 9           R2             HN 4
            EF
            BF 13          SX(15)

            EF
            BF 17          SX(15)
```

```
        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 18,17
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4     NMM 18
        LAYER 1
        BF 25           R4          HN 1
        EF
        BF 5            SX(15)

        EF
        BF 26           R4          HN 1
        EF
        BF 16           SX(15)
```

```
        EF
        BF 17          N4            S DWN
            HN 9
                    EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 19,18
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4            LAYER 1
        BF 1           N2            S DWN
            HN 11
                    EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)
```

```
        EF
        BF 16              SX(15)

        EF
        BF 17              N4             S DWN
            HN 9
                        EF
        BF 21              SX(15)

        EF
        LAYER 2
        BF 1               SX(15)

        EF
        BF 5               SX(15)

        EF
        BF 9               SX(15)

        EF
        BF 16              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 21              SX(15)

        EF
    BL SGL
EM
BM 20,19
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4         LAYER 1
        BF 1               N2             S DWN
            HN 12
                        EF
        BF 5               SX(15)
```

```
          EF
          BF 9              SX(15)

          EF
          BF 16             SX(15)

          EF
          BF 17             N4                S DWN
               HN 9
                         EF
          BF 21             SX(15)

          EF
          LAYER 2
          BF 1              SX(15)

          EF
          BF 5              SX(15)

          EF
          BF 9              SX(15)

          EF
          BF 16             SX(15)

          EF
          BF 17             SX(15)

          EF
          BF 21             SX(15)

          EF
     BL SGL
EM
BM 21,20
     NP 0,0,0
     CLEF TRB NRM
     KS DOM
     TEM 3/4             LAYER 1
          BF 1              N2                S DWN
               HN 8
```

```
                        EF
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 13               SX(15)

EF
BF 27               SX(15)

EF
BF 25               N4              S DWN
        HN 7
                      BA
        FLT
        EA
EF
BF 21               SX(15)

EF
LAYER 2
BF 1                SX(15)

EF
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 13               SX(15)

EF
BF 22               SX(15)

EF
BF 17               SX(15)

EF
```

```
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 22,21
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4           LAYER 1
            BF 1               N2                S DWN
                HN 6
                        EF
            BF 5               SX(15)

            EF
            BF 9               SX(15)

            EF
            BF 16               SX(15)

            EF
                BB 25
                NB 17
                N8                 S DWN
                HN 11
                            NB 21
                N8                 S DWN
                HN 9
                            EB
            LAYER 2
            BF 1               SX(15)

            EF
            BF 5               SX(15)

            EF
            BF 9               SX(15)

            EF
            BF 16               SX(15)
```

```
            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 23,22
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4              LAYER 1
            BF 39                SX(15)

            EF
                BB 37
                NB 28
                N8                   S DWN
                HN 8
                                   BA
                SH
                EA
                NB 29
                N8                   S DWN
                HN 10
                                   EB
            BF 36                N4                   S DWN
                HN 12
                             EF
            BF 33                SX(15)

            EF
                BB 38
                NB 32
                N8                   S DWN
                HN 10
                                   NB 31
                N8                   S DWN
```

```
                HN 8
                                EB
            LAYER 2
            BF 25           SX(15)

            EF
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 24,23
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4         LAYER 1
                BB 25
                NB 1
                N8              S DWN
                HN 9
                                NB 5
                N8              S DWN
                HN 11
                                EB
            BF 9            N4          S DWN
                HN 6
```

```
                        EF
            BF 10                SX(15)

            EF
                BB 26
                NB 17
                N8                   S DWN
                HN 11
                                  NB 21
                N8                   S DWN
                HN 9
                                  EB
            LAYER 2
            BF 1                 SX(15)

            EF
            BF 5                 SX(15)

            EF
            BF 9                 SX(15)

            EF
            BF 10                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 25,24
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4             LAYER 1
            BF 29                SX(15)

            EF
```

```
        BB 25
        NB 1
        N8                S DWN
        HN 8
                        BA
        SH
        EA
        NB 5
        N8                S DWN
        HN 10
                        EB
BF 9           N4                S DWN
        HN 12
                EF
BF 16          SX(15)

EF
        BB 26
        NB 17
        N8                S DWN
        HN 10
                        NB 21
        N8                S DWN
        HN 8
                        EB
LAYER 2
BF 22          SX(15)

EF
BF 1           SX(15)

EF
BF 5           SX(15)

EF
BF 9           SX(15)

EF
BF 16          SX(15)

EF
```

```
            BF 17                 SX(15)

            EF
            BF 21                 SX(15)

            EF
        BL SGL
    EM
    BM 26,25
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4        NMM 26
            LAYER 1
                BB 29
                NB 1
                N8                    S DWN
                HN 9
                                  NB 5
                N8                    S DWN
                HN 11
                                  NB 9
                N8                    S DWN
                HN 6
                                  NB 13
                N8                    S DWN
                HN 12
                                  NB 17
                N8                    S DWN
                HN 10
                                  NB 28
                SX(15)

                NB 21
                N8                    S DWN
                HN 8
                                  BA
                SH
                EA
                EB
            LAYER 2
```

```
        BF 1              SX(15)

        EF
        BF 5              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 13              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 22              SX(15)

        EF
        BF 21              SX(15)

        EF
    BL SGL
EM
BM 27,26
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4           LAYER 1
            BB 29
            NB 1
            N8               S DWN
            HN 9
                            NB 5
            N8               S DWN
            HN 11
                            NB 9
            N8               S DWN
            HN 6
                            NB 13
            N8               S DWN
            HN 12
```

```
                        NB 17
            N8              S DWN
            HN 10
                        NB 28
            SX(15)

            NB 21
            N8              S DWN
            HN 8
                        BA
            SH
            EA
            EB
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 22           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 28,27
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
```

```
TEM 3/4          LAYER 1
    BF 1           N4           S DWN
        HN 9
                EF
    BF 5           SX(15)

    EF
    BF 22           R4           HN 1
    EF
    BF 13           SX(15)

    EF
    BF 23           R4           HN 1
    EF
    BF 20           SX(15)

    EF
    BF 21           SX(15)

    EF
    LAYER 2
    BF 1           SX(15)

    EF
    BF 5           SX(15)

    EF
    BF 9           SX(15)

    EF
    BF 13           SX(15)

    EF
    BF 17           SX(15)

    EF
    BF 20           SX(15)

    EF
    BF 21           SX(15)
```

```
            EF
        BL SGL
    EM
    BM 29,28
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4            LAYER 1
            BF 1               SX(15)

            EF
            BF 5               SX(15)

            EF
            BF 9               SX(15)

            EF
            BF 22              RW                  HN 6
            EF
            BF 17              SX(15)

            EF
            BF 20              SX(15)

            EF
            BF 21              SX(15)

            EF
            LAYER 2
            BF 1               SX(15)

            EF
            BF 5               SX(15)

            EF
            BF 9               SX(15)

            EF
            BF 13              SX(15)

            EF
```

```
        BF 17           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 30,29
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4         LAYER 1
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 18           RW              HN 6
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)
```

```
            EF
            BF 17                   SX(15)

            EF
        BL SGL
EM
BM 31,30
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4              LAYER 1
            BF 19                   SX(15)

            EF
            BF 1                    SX(15)

            EF
            BF 8                    SX(15)

            EF
            BF 18                   RW                      HN 6
            EF
            BF 16                   SX(15)

            EF
            BF 17                   SX(15)

            EF
            LAYER 2
            BF 18                   SX(15)

            EF
            BF 1                    SX(15)

            EF
            BF 8                    SX(15)

            EF
            BF 9                    SX(15)
```

```
            EF
            BF 16               SX(15)

            EF
            BF 17               SX(15)

            EF
        BL SGL
    EM
    BM 32,31
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4             LAYER 1
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 18               RW                  HN 6
            EF
            BF 16               SX(15)

            EF
            BF 17               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16               SX(15)

            EF
```

```
        BF 17           SX(15)

        EF
    BL SGL
EM
BM 33,32
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4         LAYER 1
        BF 26           SX(15)

        EF
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 27           RW              HN 6
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 25           SX(15)

        EF
        LAYER 2
        BF 26           SX(15)

        EF
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)
```

```
        EF
        BF 16              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 25              SX(15)

        EF
    BL SGL
EM
BM 34,33
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4      NMM 34
        LAYER 1
        BF 1               SX(15)

        EF
        BF 8               SX(15)

        EF
        BF 25              RW               HN 6
        EF
        BF 16              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 18              SX(15)

        EF
        LAYER 2
        BF 1               SX(15)

        EF
        BF 8               SX(15)
```

```
        EF
        BF 9              SX(15)

        EF
        BF 16             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 18             SX(15)

        EF
    BL SGL
EM
BM 35,34
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4          LAYER 1
        BF 1              SX(15)

        EF
        BF 5              SX(15)

        EF
        BF 25             RW              HN 6
        EF
        BF 16             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 21             SX(15)

        EF
        LAYER 2
        BF 1              SX(15)
```

```
        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 36,35
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4           LAYER 1
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 25            RW              HN 6
        EF
        BF 13            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
        LAYER 2
```

```
            BF 1              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 13              SX(15)

            EF
            BF 17              SX(15)

            EF
            BF 21              SX(15)

            EF
        BL SGL
    EM
    BM 37,36
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4            LAYER 1
            BF 25              R4              HN 1
            EF
            BF 8              SX(15)

            EF
            BF 26              R4              HN 1
            EF
            BF 28              SX(15)

            EF
                BB 32
                NB 30
                N8              S DWN
                HN 5
                                TDIN(TDP,DWN)
                NB 31
```

```
                N8                  S DWN
                HN 7
                                 EB
        LAYER 2
        BF 1                SX(15)

        EF
        BF 8                SX(15)

        EF
        BF 9                SX(15)

        EF
        BF 25                SX(15)

        EF
        BF 17                SX(15)

        EF
        BF 21                SX(15)

        EF
    BL SGL
EM
BM 38,37
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4             LAYER 1
                BB 25
                NB 1
                N8                  S DWN
                HN 9
                                 NB 5
                N8                  S DWN
                HN 7
                                 EB
        BF 9                N4                  S DWN
                HN 12
                             EF
        BF 10                SX(15)
```

```
        EF
            BB 26
            NB 17
            N8              S DWN
            HN 9
                          NB 21
            N8              S DWN
            HN 7
                          EB
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 10            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 39,38
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4          LAYER 1
            BB 25
            NB 1
            N8              S DWN
            HN 6
                          NB 5
```

```
          N8              S DWN
          HN 8
                        EB
      BF 9            N4              S DWN
          HN 10
                    EF
      BF 16            SX(15)

      EF
          BB 26
          NB 17
          N8              S DWN
          HN 8
                        NB 21
          N8              S DWN
          HN 6
                        EB
      LAYER 2
      BF 1            SX(15)

      EF
      BF 5            SX(15)

      EF
      BF 9            SX(15)

      EF
      BF 16            SX(15)

      EF
      BF 17            SX(15)

      EF
      BF 21            SX(15)

      EF
   BL SGL
EM
BM 40,39
   NP 0,0,0
   CLEF TRB NRM
```

```
KS DOM
TEM 3/4            LAYER 1
          BB 28
          NB 1
          N8                S DWN
          HN 5
                          NB 5
          N8                S DWN
          HN 4
                          NB 9
          N8                S DWN
          HN 7
                          NB 13
          N8                S DWN
          HN 6
                          NB 17
          N8                S DWN
          HN 9
                          NB 21
          N8                S DWN
          HN 8
                          EB
     LAYER 2
     BF 1               SX(15)

     EF
     BF 5               SX(15)

     EF
     BF 9               SX(15)

     EF
     BF 13              SX(15)

     EF
     BF 17              SX(15)

     EF
     BF 21              SX(15)

     EF
```

```
        BL SGL
    EM
    BM 41,40
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4          LAYER 1
            BF 26          SX(15)

            EF
            BF 1          N4           S DWN
                HN 6
                            BA
                SH
                EA
            EF
            BF 8          SX(15)

            EF
            BF 9          N4           S DWN
                HN 7
                        EF
            BF 16          SX(15)

            EF
                BB 25
                NB 17
                N8            S DWN
                HN 5
                            NB 21
                N8            S DWN
                HN 7
                            EB
            LAYER 2
            BF 22          SX(15)

            EF
            BF 1          SX(15)

            EF
            BF 8          SX(15)
```

```
            EF
            BF 9            SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 42,41
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4     NMM 42
            LAYER 1
                BB 25
                NB 1
                N8              S DWN
                HN 9
                            NB 5
                N8              S DWN
                HN 7
                            EB
            BF 9            N4              S DWN
                HN 12
                        EF
            BF 16           SX(15)

            EF
                BB 26
                NB 17
                N8              S DWN
                HN 9
                            NB 21
```

```
                N8                S DWN
                HN 7
                               EB
            LAYER 2
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 16            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 43,42
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4           LAYER 1
                BB 25
                NB 1
                N8                S DWN
                HN 6
                               BA
                NAT
                EA
                NB 5
                N8                S DWN
                HN 8
                               EB
            BF 9            N4              S DWN
```

```
                HN 10
                        EF
            BF 16             SX(15)

            EF
            BF 17             R4             HN 1
            EF
            BF 20             SX(15)

            EF
            BF 21             SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 16             SX(15)

            EF
            BF 17             SX(15)

            EF
            BF 20             SX(15)

            EF
            BF 21             SX(15)

            EF
        BL SGL
    EM
    BM 44,43
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
```

```
TEM 3/4            LAYER 1
      BF 1               SX(15)

      EF
      BF 5               SX(15)

      EF
      BF 25               RW                HN 6
      EF
      BF 13               SX(15)

      EF
      BF 17               SX(15)

      EF
      BF 20               SX(15)

      EF
      BF 21               SX(15)

      EF
      LAYER 2
      BF 1               SX(15)

      EF
      BF 5               SX(15)

      EF
      BF 9               SX(15)

      EF
      BF 13               SX(15)

      EF
      BF 17               SX(15)

      EF
      BF 20               SX(15)

      EF
      BF 21               SX(15)
```

```
        EF
    BL SGL
EM
BM 45,44
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4         LAYER 1
        BF 33         R4            HN 1
        EF
        BF 5          SX(15)

        EF
        BF 34         R4            HN 1
        EF
        BF 16         SX(15)

        EF
            BB 35
            NB 28
            N8            S UP
            HN -1
                        NB 29
            N8            S UP
            HN -4
                        NB 31
            N8            S UP
            HN -6
                        EB
        LAYER 2
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 16         SX(15)
```

```
        EF
        BF 17           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 23           SX(15)

        EF
    BL SGL
EM
BM 46,45
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4          LAYER 1
            BB 31
            NB 27
            N8              S UP
            HN -4
                        BE
            EX(STA,DWN)
            EE
            NB 6
            N8              S UP
            HN -1
                        BE
            EX(STA,DWN)
            EE
            NB 10
            N8              S UP
            HN 1
                        BE
            EX(STA,DWN)
            EE
            NB 14
            N8              S UP
            HN 3
                        BE
```

```
            EX(STA,DWN)
            EE
            NB 18
            N8                 S UP
            HN 6
                             BE
            EX(STA,DWN)
            EE
            NB 22
            N8                 S UP
            HN 8
                             BE
            EX(STA,DWN)
            EE
            EB
        LAYER 2
        BF 1               SX(15)

        EF
        BF 4               SX(15)

        EF
        BF 8               SX(15)

        EF
        BF 12               SX(15)

        EF
        BF 16               SX(15)

        EF
        BF 20               SX(15)

        EF
    BL SGL
EM
BM 47,46
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4            LAYER 1
```

```
        BF 1            N4              S DWN
            HN 10
                    EF
        BF 5            SX(15)

        EF
        BF 9            R4              HN 1
        EF
        BF 16            SX(15)

        EF
            BB 25
            NB 17
            N8                S UP
            HN -7
                            NB 21
            N8                S UP
            HN -5
                            EB
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 48,47
```

```
NP 0,0,0
CLEF TRB NRM
KS DOM
TEM 3/4             LAYER 1
          BB 28
          NB 1
          N8                S UP
          HN -2
                         NB 5
          N8                S UP
          HN 0
                         NB 9
          N8                S UP
          HN 2
                         NB 13
          N8                S UP
          HN 5
                         EB
          BB 27
          NB 17
          N8                S DWN
          HN 7
                         NB 21
          N8                S DWN
          HN 9
                         EB
     LAYER 2
     BF 1              SX(15)

     EF
     BF 5              SX(15)

     EF
     BF 9              SX(15)

     EF
     BF 13              SX(15)

     EF
     BF 17              SX(15)
```

```
            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 49,48
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4               LAYER 1
            BF 31                SX(15)

            EF
            BF 26                N4                  S DWN
                HN 11
                                   BA
                FLT
                EA
            EF
            BF 5                SX(15)

            EF
            BF 9                R4                  HN 1
            EF
            BF 16                SX(15)

            EF
                BB 27
                NB 17
                N8                  S UP
                HN -6
                                   NB 21
                N8                  S UP
                HN -4
                                   EB
            LAYER 2
            BF 22                SX(15)

            EF
            BF 1                SX(15)
```

```
        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 50,49
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 3/4     NMM 50
        LAYER 1
            BB 29
            NB 1
            N8              S UP
            HN -2
                          NB 5
            N8              S UP
            HN 1
                          NB 9
            N8              S UP
            HN 3
                          NB 13
            N8              S UP
            HN 5
                          NB 17
            N8              S UP
            HN 8
```

```
                        NB 21
         N8                S UP
         HN 10
                        EB
      LAYER 2
      BF 1              SX(15)

      EF
      BF 5              SX(15)

      EF
      BF 9              SX(15)

      EF
      BF 13              SX(15)

      EF
      BF 17              SX(15)

      EF
      BF 21              SX(15)

      EF
   BL SGL
EM
BM 51,50
   NP 0,0,0
   CLEF TRB NRM
   KS DOM
   TEM 3/4          LAYER 1
         BB 28
         NB 1
         N8                S DWN
         HN 12
                        NB 4
         SX(15)

         NB 5
         N8                S DWN
         HN 9
                        BA
```

```
            SH
            EA
            NB 9
            N8                  S DWN
            HN 10
                              NB 13
            N8                  S DWN
            HN 7
                              NB 17
            N8                  S DWN
            HN 8
                              NB 21
            N8                  S DWN
            HN 6
                              EB
        LAYER 2
        BF 1                SX(15)

        EF
        BF 4                SX(15)

        EF
        BF 5                SX(15)

        EF
        BF 9                SX(15)

        EF
        BF 13                SX(15)

        EF
        BF 17                SX(15)

        EF
        BF 21                SX(15)

        EF
    BL SGL
EM
BM 52,51
    NP 0,0,0
```

```
CLEF TRB NRM
KS DOM
TEM 3/4                LAYER 1
        BF 1               N2                  S DWN
               HN 5
                        EF
        BF 5               SX(15)

        EF
        BF 9               SX(15)

        EF
        BF 13               SX(15)

        EF
               BB 25
               NB 17
               N8                 S DWN
               HN 7
                              NB 21
               N8                 S DWN
               HN 6
                              EB
        LAYER 2
        BF 1               SX(15)

        EF
        BF 5               SX(15)

        EF
        BF 9               SX(15)

        EF
        BF 13               SX(15)

        EF
        BF 17               SX(15)

        EF
        BF 21               SX(15)
```

```
            EF
        BL SGL
    EM
    BM 53,52
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 3/4              LAYER 1
            BF 1                N4                S DWN
                HN 5
                            EF
            BF 8                SX(15)

            EF
            BF 26               R4                HN 1
            EF
            BF 25               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 25               SX(15)

            EF
        BL FNLR
    EM
    BI 8
        SQSL,3 NOL ,DWN
            ST(9,1,48,43,0)
            END(9,1,48,46,0)
    EI
    BI 9
        SLR,UP
```

```
            ST(1,1,22,17,0)
            END(2,1,9,0,0)
    EI
    BI 10
        SLR,UP
            ST(2,1,26,17,0)
            END(3,1,9,0,0)
    EI
    BI 11
        SLR,UP
            ST(3,1,26,17,0)
            END(4,1,28,21,0)
    EI
    BI 12
        SLR,UP
            ST(5,1,1,0,0)
            END(5,1,9,0,0)
    EI
    BI 13
        SLR,UP
            ST(5,1,25,17,0)
            END(6,1,9,0,0)
    EI
    BI 14
        SLR,UP
            ST(6,1,26,17,0)
            END(7,1,9,0,0)
    EI
    BI 15
        SLR,DWN
            ST(9,1,48,43,0)
            END(10,1,32,27,0)
    EI
    BI 16
        SLR,UP
            ST(11,1,28,1,0)
            END(11,1,28,21,0)
    EI
    BI 17
        SLR,UP
            ST(12,1,1,0,0)
```

```
            END(12,1,25,21,0)
    EI
    BI 19
        SLR,UP
            ST(18,1,1,0,0)
            END(19,1,1,0,0)
    EI
    BI 20
        SLR,UP
            ST(20,1,1,0,0)
            END(20,1,25,0,0)
    EI
    BI 22
        SLR,UP
            ST(21,1,25,17,0)
            END(22,1,38,31,0)
    EI
    BI 23
        SLR,UP
            ST(36,1,32,30,0)
            END(37,1,9,0,0)
    EI
    BI 24
        SLR,UP
            ST(37,1,26,17,0)
            END(38,1,9,0,0)
    EI
    BI 25
        SLR,UP
            ST(38,1,26,17,0)
            END(39,1,28,21,0)
    EI
    BI 26
        SLR,UP
            ST(40,1,1,0,0)
            END(40,1,9,0,0)
    EI
    BI 27
        SLR,UP
            ST(40,1,25,17,0)
            END(41,1,9,0,0)
```

```
EI
BI 28
        SLR,UP
                ST(41,1,26,17,0)
                END(42,1,9,0,0)
EI
BI 29
        SQSL,3 NOL ,DWN
                ST(44,1,35,28,0)
                END(44,1,35,31,0)
EI
BI 30
        SLR,DWN
                ST(44,1,35,28,0)
                END(45,1,31,27,0)
EI
BI 31
        SLR,UP
                ST(50,1,28,1,0)
                END(50,1,28,21,0)
EI
BI 32
        SLR,UP
                ST(51,1,1,0,0)
                END(51,1,25,21,0)
EI
BI 34
        SLR,UP
                ST(23,1,25,1,0)
                END(23,1,26,21,0)
EI
BI 35
        SLR,UP
                ST(24,1,25,1,0)
                END(24,1,26,21,0)
EI
BI 36
        SLR,UP
                ST(25,1,29,1,0)
                END(25,1,29,21,0)
EI
```

```
BI 37
	SLR,UP
		ST(26,1,29,1,0)
		END(26,1,29,21,0)
EI
EPR
```

```
BPR
LVL 1 REL 2
"violino I"
BM 1,1
	NP 0,0,0
	CLEF TRB NRM
	KS LAM
	TEM 3/4		MOV("",N4,FL,96)
		LAYER 1
		BF 22		R4		HN 1
		EF
		BF 20		SX(15)

		EF
		BF 21		SX(15)

		EF
		LAYER 2
		BF 17		SX(15)

		EF
		BF 20		SX(15)

		EF
		BF 21		SX(15)

		EF
	BL SGL
EM
BM 2,2
	NP 0,0,0
	CLEF TRB NRM
	KS LAM
	TEM 3/4		LAYER 1
		BF 1		R4		HN 1
		EF
		BF 5		SX(15)

		EF
		BF 9		N4		S UP
			HN 3
```

```
                                TDIN(TDP,DWN)
                EF
                BF 16              SX(15)

                EF
                BF 17              N4                 S UP
                    HN 3
                            EF
                BF 21              SX(15)

                EF
                LAYER 2
                BF 1               SX(15)

                EF
                BF 5               SX(15)

                EF
                BF 9               SX(15)

                EF
                BF 16              SX(15)

                EF
                BF 17              SX(15)

                EF
                BF 21              SX(15)

                EF
            BL SGL
        EM
        BM 3,3
            NP 0,0,0
            CLEF TRB NRM
            KS LAM
            TEM 3/4            LAYER 1
                BF 1               R4                 HN 1
                EF
                BF 5               SX(15)
```

```
        EF
        BF 9            N4             S UP
            HN 3
                    EF
        BF 16           SX(15)

        EF
        BF 17           N4             S UP
            HN 3
                    EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 4,4
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            R4             HN 1
        EF
```

```
        BF 5            SX(15)

        EF
        BF 9            N4            S UP
          HN 2
                    EF
        BF 13           SX(15)

        EF
        BF 17           N4            S UP
          HN 2
                    EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
      BL SGL
    EM
    BM 5,5
      NP 0,0,0
      CLEF TRB NRM
      KS LAM
      TEM 3/4          LAYER 1
```

```
BF 22             SX(15)

EF
BF 1              R4              HN 1
EF
BF 8              SX(15)

EF
BF 9              N4              S UP
     HN 3
             EF
BF 16             SX(15)

EF
BF 17             N4              S UP
     HN 3
             EF
BF 21             SX(15)

EF
LAYER 2
BF 22             SX(15)

EF
BF 1              SX(15)

EF
BF 8              SX(15)

EF
BF 9              SX(15)

EF
BF 16             SX(15)

EF
BF 17             SX(15)

EF
BF 21             SX(15)
```

```
            EF
        BL SGL
    EM
    BM 6,6
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1             R4              HN 1
            EF
            BF 5             SX(15)

            EF
            BF 9             N4              S UP
                HN 3
                        EF
            BF 16             SX(15)

            EF
            BF 17             N4              S UP
                HN 3
                        EF
            BF 21             SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 16             SX(15)

            EF
            BF 17             SX(15)

            EF
```

```
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 7,7
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1           N4           S UP
                HN 1
                        EF
            BF 5           SX(15)

            EF
            BF 9           R4           HN 1
            EF
            BF 16           SX(15)

            EF
                BB 25
                NB 17
                N8             S DWN
                HN 5
                            NB 20
                SX(15)

                NB 21
                N8             S DWN
                HN 3
                            BA
                SH
                EA
                EB
            LAYER 2
            BF 1           SX(15)

            EF
            BF 5           SX(15)
```

```
            EF
            BF 9            SX(15)

            EF
            BF 16            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 20            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 8,8
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4            LAYER 1
                BB 25
                NB 1
                N8            S DWN
                HN 4
                            NB 5
                N8            S DWN
                HN 6
                            EB
            BF 9            N4            S DWN
                HN 8
                        EF
            BF 16            SX(15)

            EF
                BB 26
                NB 17
                N8            S DWN
                HN 5
```

```
                        NB 20
          SX(15)

          NB 21
          N8               S DWN
          HN 3
                        BA
          SH
          EA
          EB
       LAYER 2
       BF 1             SX(15)

       EF
       BF 5             SX(15)

       EF
       BF 9             SX(15)

       EF
       BF 16             SX(15)

       EF
       BF 17             SX(15)

       EF
       BF 20             SX(15)

       EF
       BF 21             SX(15)

       EF
    BL SGL
EM
BM 9,9
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
          BB 25
          NB 1
```

```
        N8                  S DWN
        HN 4
                          NB 5
        N8                  S DWN
        HN 6
                          EB
BF 9                N4                  S DWN
        HN 8
                  EF
BF 16                SX(15)

EF
BF 17                R4                  HN 1
EF
BF 18                SX(15)

EF
BF 19                SX(15)

EF
LAYER 2
BF 1                SX(15)

EF
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 16                SX(15)

EF
BF 17                SX(15)

EF
BF 18                SX(15)

EF
BF 19                SX(15)
```

```
            EF
        BL SGL
    EM
    BM 10,10
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                SX(15)

            EF
            BF 4                SX(15)

            EF
            BF 29               RW                  HN 6
            EF
            BF 12               SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 20               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 4                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 12               SX(15)

            EF
            BF 16               SX(15)

            EF
```

```
        BF 20          SX(15)

        EF
    BL SGL
EM
BM 11,11
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 22          RW             HN 6
        EF
        BF 13          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 13          SX(15)

        EF
        BF 17          SX(15)
```

```
            EF
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 12,12
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
                BB 29
                NB 1
                N8                  S UP
                HN -2
                            NB 5
                N8                  S UP
                HN 0
                            NB 9
                N8                  S UP
                HN -2
                            NB 13
                N8                  S UP
                HN 0
                            NB 17
                N8                  S UP
                HN -1
                            NB 21
                N8                  S UP
                HN 0
                            EB
            LAYER 2
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)
```

```
            EF
            BF 13              SX(15)

            EF
            BF 17              SX(15)

            EF
            BF 21              SX(15)

            EF
        BL SGL
    EM
    BM 13,13
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4            LAYER 1
            BF 1              N4                 S UP
                HN -2
                            EF
            BF 8              SX(15)

            EF
            BF 9              R4                 HN 1
            EF
            BF 16              SX(15)

            EF
            LAYER 2
            BF 1              SX(15)

            EF
            BF 8              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 16              SX(15)

            EF
```

```
        BL STF
    EM
    BM 14,125
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
                BB 26
                NB 17
                N8            S UP
                HN 0
                            NB 21
                N8            S UP
                HN 2
                            EB
            LAYER 2
            BF 17          SX(15)

            EF
            BF 21          SX(15)

            EF
        BL SGL
    EM
    BM 15,14
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
                BB 27
                NB 1
                N8            S UP
                HN 4
                            NB 5
                N8            S UP
                HN 2
                            EB
            BF 9           N4            S DWN
                HN 7
                        EF
            BF 10          SX(15)
```

```
            EF
                BB 28
                NB 17
                N8              S UP
                HN 0
                            NB 21
                N8              S UP
                HN 3
                            EB
            LAYER 2
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 10           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 16,15
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4         LAYER 1
                BB 27
                NB 1
                N8              S UP
                HN 5
                            NB 5
```

```
            N8                S UP
            HN 3
                           EB
        BF 9           N4                S DWN
            HN 7
                      EF
        BF 16           SX(15)

        EF
            BB 28
            NB 17
            N8                S UP
            HN 0
                           NB 21
            N8                S UP
            HN 4
                           EB
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 17,16
    NP 0,0,0
    CLEF TRB NRM
```

```
KS LAM
TEM 3/4            LAYER 1
          BB 28
          NB 1
          N8                S DWN
          HN 6
                         NB 5
          N8                S DWN
          HN 4
                         NB 9
          N8                S DWN
          HN 7
                         NB 13
          N8                S DWN
          HN 6
                         NB 17
          N8                S DWN
          HN 5
                         NB 21
          N8                S DWN
          HN 3
                         EB
     LAYER 2
     BF 1                SX(15)

     EF
     BF 5                SX(15)

     EF
     BF 9                SX(15)

     EF
     BF 13               SX(15)

     EF
     BF 17               SX(15)

     EF
     BF 21               SX(15)

     EF
```

```
        BL SGL
EM
BM 18,17
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
                BB 27
                NB 1
                N8                  S UP
                HN 2
                                NB 5
                N8                  S UP
                HN 4
                                EB
            BF 9            N4                  S DWN
                HN 7
                        EF
            BF 16            SX(15)

            EF
                BB 28
                NB 17
                N8                  S UP
                HN 0
                                NB 21
                N8                  S UP
                HN 2
                                EB
            LAYER 2
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 16            SX(15)
```

```
                EF
                BF 17                   SX(15)

                EF
                BF 21                   SX(15)

                EF
        BL SGL
EM
BM 19,18
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4                 LAYER 1
                        BB 29
                        NB 1
                        N8                  S UP
                        HN 4
                                        NB 5
                        N8                  S UP
                        HN 2
                                        EB
                BF 9                N4                  S DWN
                        HN 7
                                EF
                BF 16                   SX(15)

                EF
                        BB 30
                        NB 17
                        N8                  S UP
                        HN 0
                                        NB 21
                        N8                  S UP
                        HN 3
                                        EB
                LAYER 2
                BF 1                    SX(15)

                EF
                BF 5                    SX(15)
```

```
        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 20,19
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
            BB 29
            NB 28
            N8              S DWN
            HN 5
                        BA
            NAT
            EA
            NB 5
            N8              S DWN
            HN 3
                        EB
        BF 9            N4              S DWN
            HN 7
                        BA
            NAT
            EA
        EF
        BF 16           SX(15)

        EF
```

```
                BB 31
                NB 17
                N8                S UP
                HN 0
                                NB 21
                N8                S UP
                HN 4
                                EB
            LAYER 2
            BF 1              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 16             SX(15)

            EF
            BF 17             SX(15)

            EF
            BF 21             SX(15)

            EF
        BL SGL
    EM
    BM 21,20
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4           LAYER 1
                BB 32
                NB 1
                N8                S DWN
                HN 6
                                NB 5
                N8                S DWN
                HN 4
```

```
                        NB 9
        N8                 S DWN
        HN 7
                        NB 13
        N8                 S DWN
        HN 6
                        NB 33
        SX(15)

        NB 28
        N8                 S DWN
        HN 5
                        BA
        NAT
        EA
        NB 21
        N8                 S DWN
        HN 3
                        EB
LAYER 2
BF 1                SX(15)

EF
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 13                SX(15)

EF
BF 22                SX(15)

EF
BF 17                SX(15)

EF
BF 21                SX(15)

EF
```

```
        BL SGL
    EM
    BM 22,21
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
                BB 26
                NB 1
                N8          S UP
                HN 2
                            NB 5
                N8          S UP
                HN 4
                            EB
            BF 9        N4          S DWN
                HN 7
                        EF
            BF 16        SX(15)

            EF
            BF 17        R4          HN 1
            EF
            BF 21        SX(15)

            EF
            LAYER 2
            BF 1         SX(15)

            EF
            BF 5         SX(15)

            EF
            BF 9         SX(15)

            EF
            BF 16        SX(15)

            EF
            BF 17        SX(15)
```

```
                EF
                BF 21               SX(15)

                EF
        BL SGL
EM
BM 23,22
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
                BF 25               SX(15)

                EF
                BF 1                N4                  S UP
                        HN 3
                                EF
                BF 5                SX(15)

                EF
                BF 9                N4                  S UP
                        HN 1
                                EF
                BF 16               SX(15)

                EF
                BF 17               N4                  S UP
                        HN 3
                                EF
                BF 21               SX(15)

                EF
                LAYER 2
                BF 25               SX(15)

                EF
                BF 1                SX(15)

                EF
                BF 5                SX(15)
```

```
            EF
            BF 9                SX(15)

            EF
            BF 16                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 24,23
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                N2                  S UP
                HN 2
                                PVAL 1
            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 10                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
            LAYER 2
            BF 1                SX(15)
```

```
            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 10              SX(15)

            EF
            BF 17              SX(15)

            EF
            BF 21              SX(15)

            EF
        BL SGL
    EM
    BM 25,24
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4            LAYER 1
            BF 22              SX(15)

            EF
            BF 1              N4              S UP
                HN 3
                        EF
            BF 5              SX(15)

            EF
            BF 9              N4              S UP
                HN 1
                        EF
            BF 16              SX(15)

            EF
            BF 17              N4              S UP
                HN 3
```

```
                              EF
             BF 21                  SX(15)

             EF
             LAYER 2
             BF 22                  SX(15)

             EF
             BF 1                   SX(15)

             EF
             BF 5                   SX(15)

             EF
             BF 9                   SX(15)

             EF
             BF 16                  SX(15)

             EF
             BF 17                  SX(15)

             EF
             BF 21                  SX(15)

             EF
         BL SGL
     EM
     BM 26,25
         NP 0,0,0
         CLEF TRB NRM
         KS LAM
         TEM 3/4            LAYER 1
             BF 1                   N4              S UP
                 HN 2
                              EF
             BF 5                   SX(15)

             EF
             BF 23                  N2              S DWN
                 HN 4
```

```
                        EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 27            SX(15)

            EF
            BF 21            SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 22            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 27,26
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
```

```
TEM 3/4            LAYER 1
      BF 22              N2                 S DWN
            HN 4
                           PVAL 1
      EF
      BF 5              SX(15)

      EF
      BF 9              SX(15)

      EF
      BF 13              SX(15)

      EF
      BF 17              SX(15)

      EF
      BF 28              SX(15)

      EF
      BF 21              SX(15)

      EF
      LAYER 2
      BF 1              SX(15)

      EF
      BF 5              SX(15)

      EF
      BF 9              SX(15)

      EF
      BF 13              SX(15)

      EF
      BF 17              SX(15)

      EF
      BF 22              SX(15)
```

```
            EF
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 28,27
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
                BB 28
                NB 1
                N8                S DWN
                HN 7
                              NB 5
                N8                S DWN
                HN 9
                              NB 9
                N8                S DWN
                HN 4
                              NB 13
                N8                S DWN
                HN 10
                              NB 17
                N8                S DWN
                HN 8
                              NB 20
                SX(15)

                NB 21
                N8                S DWN
                HN 6
                              BA
                SH
                EA
                EB
            LAYER 2
            BF 1                SX(15)

            EF
```

```
                BF 5                SX(15)

                EF
                BF 9                SX(15)

                EF
                BF 13                SX(15)

                EF
                BF 17                SX(15)

                EF
                BF 20                SX(15)

                EF
                BF 21                SX(15)

                EF
            BL SGL
        EM
        BM 29,28
            NP 0,0,0
            CLEF TRB NRM
            KS LAM
            TEM 3/4              LAYER 1
                    BB 28
                    NB 1
                    N8                S DWN
                    HN 7
                                    NB 5
                    N8                S DWN
                    HN 9
                                    NB 9
                    N8                S DWN
                    HN 4
                                    NB 13
                    N8                S DWN
                    HN 10
                                    NB 17
                    N8                S DWN
                    HN 8
```

```
                        NB 20
               SX(15)

               NB 21
               N8                S DWN
               HN 6
                        BA
               SH
               EA
               EB
          LAYER 2
          BF 1            SX(15)

          EF
          BF 5            SX(15)

          EF
          BF 9            SX(15)

          EF
          BF 13            SX(15)

          EF
          BF 17            SX(15)

          EF
          BF 20            SX(15)

          EF
          BF 21            SX(15)

          EF
     BL SGL
EM
BM 30,29
     NP 0,0,0
     CLEF TRB NRM
     KS LAM
     TEM 3/4          LAYER 1
          BF 1            N4              S DWN
               HN 7
```

```
                        BE
        EX(STA,UP)
        EE
EF
BF 8                SX(15)

EF
BF 9                N4                      S DWN
        HN 7
                        BE
        EX(STA,UP)
        EE
EF
BF 16                SX(15)

EF
        BAC 17
        N4                      S DWN
        FING UP
        NA 25
        HN 6
                        BA
        SH
        EA
        NA 26
        HN 7

        EAC
LAYER 2
BF 1                SX(15)

EF
BF 8                SX(15)

EF
BF 9                SX(15)

EF
BF 16                SX(15)

EF
```

```
        BF 17          SX(15)

        EF
    BL SGL
EM
BM 31,30
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4            LAYER 1
        BF 22          SX(15)

        EF
            BAC 1
            N4             S DWN
            FING UP
            NA 9
            HN 6
                       BA
            NAT
            EA
            NA 10
            HN 7

            EAC
        BF 8           SX(15)

        EF
            BAC 11
            N4             S DWN
            FING UP
            NA 19
            HN 6
                       NA 20
            HN 7

            EAC
        BF 18          SX(15)

        EF
            BAC 21
```

```
                N4                      S DWN
                FING UP
                NA 29
                HN 6
                                     NA 30
                HN 7

                EAC
            LAYER 2
            BF 18                SX(15)

            EF
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16                SX(15)

            EF
            BF 17                SX(15)

            EF
        BL SGL
    EM
    BM 32,31
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4              LAYER 1
                BAC 1
                N4                      S DWN
                FING UP
                NA 9
                HN 6
                                     NA 10
                HN 7
```

```
        EAC
    BF 8            SX(15)

    EF
        BAC 11
        N4              S DWN
        FING UP
        NA 19
        HN 6
                    NA 20
        HN 7

        EAC
    BF 18           SX(15)

    EF
    BF 21           N4              S DWN
        HN 7
                EF
    LAYER 2
    BF 1            SX(15)

    EF
    BF 8            SX(15)

    EF
    BF 9            SX(15)

    EF
    BF 16           SX(15)

    EF
    BF 17           SX(15)

    EF
  BL SGL
EM
BM 33,32
  NP 0,0,0
  CLEF TRB NRM
```

```
KS LAM
TEM 3/4            LAYER 1
    BF 30              SX(15)

    EF
        BAC 1
        N4                 S DWN
        FING UP
        NA 9
        HN 6
                         NA 10
        HN 7

        EAC
    BF 8               SX(15)

    EF
        BAC 11
        N4                 S DWN
        FING UP
        NA 19
        HN 6
                         NA 20
        HN 7

        EAC
    BF 18              SX(15)

    EF
        BAC 21
        N4                 S DWN
        FING UP
        NA 29
        HN 6
                         NA 30
        HN 7

        EAC
    BF 29              SX(15)

    EF
```

```
        LAYER 2
        BF 26            SX(15)

        EF
        BF 1             SX(15)

        EF
        BF 8             SX(15)

        EF
        BF 9             SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 25            SX(15)

        EF
      BL SGL
    EM
    BM 34,33
      NP 0,0,0
      CLEF TRB NRM
      KS LAM
      TEM 3/4          LAYER 1
          BAC 1
          N2               S DWN
          FING UP
          NA 25
          HN 6
                        NA 26
          HN 7
                                  PVAL 1

          EAC
        BF 8             SX(15)
```

```
        EF
        BF 9           SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 18          SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 8           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 18          SX(15)

        EF
    BL SGL
EM
BM 35,34
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4        LAYER 1
            BAC 1
            N2           S DWN
```

```
        FING UP
        NA 17
        HN 6
                        NA 18
        HN 7

        EAC
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 16               SX(15)

EF
        BAC 19
        N4                 S DWN
        FING UP
        NA 27
        HN 6
                        NA 28
        HN 7

        EAC
BF 23               SX(15)

EF
LAYER 2
BF 1                SX(15)

EF
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 16               SX(15)

EF
```

```
            BF 17                  SX(15)

            EF
            BF 21                  SX(15)

            EF
        BL SGL
    EM
    BM 36,35
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4                LAYER 1
                BAC 1
                N4                       S DWN
                FING UP
                NA 9
                HN 6
                                        NA 10
                HN 7

                EAC
            BF 5                   SX(15)

            EF
                BAC 11
                N4                       S DWN
                FING UP
                NA 19
                HN 6
                                        NA 20
                HN 7

                EAC
            BF 15                  SX(15)

            EF
                BAC 21
                N4                       S DWN
                FING UP
                NA 29
```

```
                HN 6
                            NA 30
                HN 7

                EAC
            BF 25            SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 37,36
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
                BAC 1
                N4             S DWN
                FING UP
                NA 9
                HN 6
                            NA 10
                HN 7
```

```
            EAC
        BF 8            SX(15)

        EF
        BF 28            R4            HN 1
        EF
        BF 27            SX(15)

        EF
        BF 29            R4            HN 1
        EF
        BF 23            SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 25            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 38,37
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4            LAYER 1
```

```
        BF 1          R4          HN 1
        EF
        BF 5          SX(15)

        EF
        BF 9          N4          S UP
          HN 3
                        TDIN(TDP,DWN)
        EF
        BF 10          SX(15)

        EF
        BF 17          N4          S UP
          HN 3
                      EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 10          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
      BL SGL
    EM
    BM 39,38
      NP 0,0,0
```

```
    CLEF TRB NRM
    KS LAM
    TEM 3/4            LAYER 1
        BF 1              R4              HN 1
        EF
        BF 5              SX(15)

        EF
        BF 9              N4              S UP
            HN 3
                        EF
        BF 16             SX(15)

        EF
        BF 17             N4              S UP
            HN 3
                        EF
        BF 21             SX(15)

        EF
        LAYER 2
        BF 1              SX(15)

        EF
        BF 5              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 16             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 21             SX(15)

        EF
    BL SGL
EM
```

```
BM 40,39
     NP 0,0,0
     CLEF TRB NRM
     KS LAM
     TEM 3/4             LAYER 1
          BF 1              R4                HN 1
          EF
          BF 5              SX(15)

          EF
          BF 9              N4                S UP
               HN 2
                         EF
          BF 13             SX(15)

          EF
          BF 17             N4                S UP
               HN 2
                         EF
          BF 21             SX(15)

          EF
          LAYER 2
          BF 1              SX(15)

          EF
          BF 5              SX(15)

          EF
          BF 9              SX(15)

          EF
          BF 13             SX(15)

          EF
          BF 17             SX(15)

          EF
          BF 21             SX(15)

          EF
```

```
        BL SGL
    EM
    BM 41,40
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4           LAYER 1
            BF 22             SX(15)

            EF
            BF 1             R4              HN 1
            EF
            BF 8             SX(15)

            EF
            BF 9             N4              S UP
                HN 3
                        EF
            BF 16             SX(15)

            EF
            BF 17             N4              S UP
                HN 3
                        EF
            BF 21             SX(15)

            EF
            LAYER 2
            BF 22             SX(15)

            EF
            BF 1             SX(15)

            EF
            BF 8             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 16             SX(15)
```

```
        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 42,41
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1            R4            HN 1
        EF
        BF 5            SX(15)

        EF
        BF 9            N4            S UP
            HN 3
                     EF
        BF 16           SX(15)

        EF
        BF 17           N4            S UP
            HN 3
                     EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)
```

```
        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 43,42
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1           N4             S UP
            HN 1
                    EF
        BF 5           SX(15)

        EF
        BF 9           R4             HN 1
        EF
        BF 16          SX(15)

        EF
            BB 25
            NB 17
            N8            S DWN
            HN 5
                        NB 20
            SX(15)

            NB 21
            N8            S DWN
            HN 3
                        BA
            SH
            EA
```

```
            EB
        LAYER 2
        BF 1                SX(15)

        EF
        BF 5                SX(15)

        EF
        BF 9                SX(15)

        EF
        BF 16                SX(15)

        EF
        BF 17                SX(15)

        EF
        BF 20                SX(15)

        EF
        BF 21                SX(15)

        EF
    BL SGL
EM
BM 44,43
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4             LAYER 1
            BB 28
            NB 1
            N8                S DWN
            HN 4
                        NB 5
            N8                S DWN
            HN 6
                        NB 9
            N8                S DWN
            HN 8
                        NB 13
```

```
        N8              S DWN
        HN 6
                      NB 17
        N8              S DWN
        HN 5
                      NB 20
        SX(15)

        NB 21
        N8              S DWN
        HN 3
                      BA
        SH
        EA
        EB
      LAYER 2
      BF 1            SX(15)

      EF
      BF 5            SX(15)

      EF
      BF 9            SX(15)

      EF
      BF 13            SX(15)

      EF
      BF 17            SX(15)

      EF
      BF 20            SX(15)

      EF
      BF 21            SX(15)

      EF
    BL SGL
  EM
  BM 45,44
    NP 0,0,0
```

```
CLEF TRB NRM
KS LAM
TEM 3/4         LAYER 1
        BB 25
        NB 1
        N8            S DWN
        HN 4
                    NB 5
        N8            S DWN
        HN 6
                    EB
    BF 9          N4            S DWN
        HN 8
                EF
    BF 16          SX(15)

    EF
    BF 17          R4            HN 1
    EF
    BF 20          SX(15)

    EF
    BF 23          SX(15)

    EF
    LAYER 2
    BF 1          SX(15)

    EF
    BF 5          SX(15)

    EF
    BF 9          SX(15)

    EF
    BF 16          SX(15)

    EF
    BF 17          SX(15)

    EF
```

```
            BF 20            SX(15)

            EF
            BF 23            SX(15)

            EF
        BL SGL
    EM
    BM 46,45
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1             SX(15)

            EF
            BF 4             SX(15)

            EF
            BF 25            RW                  HN 6
            EF
            BF 12            SX(15)

            EF
            BF 16            SX(15)

            EF
            BF 20            SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 4             SX(15)

            EF
            BF 8             SX(15)

            EF
            BF 12            SX(15)
```

```
        EF
        BF 16            SX(15)

        EF
        BF 20            SX(15)

        EF
    BL SGL
EM
BM 47,46
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
            BB 25
            NB 1
            N8               S DWN
            HN 8
                           TDIN(TDRF,DWN)
            NB 5
            N8               S DWN
            HN 6
                           EB
        BF 9            N4               S DWN
            HN 5
                       EF
        BF 16            SX(15)

        EF
        BF 17            R4               HN 1
        EF
        BF 21            SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)
```

```
            EF
            BF 9                 SX(15)

            EF
            BF 16                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 48,47
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4              LAYER 1
            BF 1                 SX(15)

            EF
            BF 5                 SX(15)

            EF
            BF 25                RW                   HN 6
            EF
            BF 13                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
            LAYER 2
            BF 1                 SX(15)

            EF
```

```
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 13                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 49,48
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4                LAYER 1
            BF 33                SX(15)

            EF
                BB 28
                NB 27
                N8                S DWN
                HN 9
                            BA
                NAT
                EA
                TDIN(TDRF,DWN)
                NB 5
                N8                S DWN
                HN 7
                            EB
            BF 9                N4                S DWN
                HN 6
                        EF
            BF 16                SX(15)
```

```
            EF
            BF 17           R4            HN 1
            EF
            BF 21           SX(15)

            EF
            LAYER 2
            BF 22           SX(15)

            EF
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 50,49
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1            SX(15)

            EF
            BF 5            SX(15)
```

```
        EF
        BF 9           SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 26           RW           HN 6
        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 51,50
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4        LAYER 1
        BF 1           N2           S UP
            HN 3
                        PVAL 1
```

```
        TDIN(TDP,DWN)
    EF
    BF 4                 SX(15)

    EF
    BF 5                 SX(15)

    EF
    BF 9                 SX(15)

    EF
    BF 13                SX(15)

    EF
    BF 17                SX(15)

    EF
    BF 21                SX(15)

    EF
    LAYER 2
    BF 1                 SX(15)

    EF
    BF 4                 SX(15)

    EF
    BF 5                 SX(15)

    EF
    BF 9                 SX(15)

    EF
    BF 13                SX(15)

    EF
    BF 17                SX(15)

    EF
    BF 21                SX(15)
```

```
            EF
        BL SGL
    EM
    BM 52,51
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4                 LAYER 1
            BF 1                    N2                  S UP
                HN 3
                                EF
            BF 5                    SX(15)

            EF
            BF 9                    SX(15)

            EF
            BF 13                   SX(15)

            EF
            BF 17                   N4                  S UP
                HN 2
                                    BA
                SH
                EA
            EF
            BF 21                   SX(15)

            EF
            LAYER 2
            BF 1                    SX(15)

            EF
            BF 5                    SX(15)

            EF
            BF 9                    SX(15)

            EF
            BF 13                   SX(15)
```

```
            EF
            BF 17               SX(15)

            EF
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 53,52
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                N4                  S UP
                HN 3
                            EF
            BF 8                SX(15)

            EF
            BF 27               R4                  HN 1
            EF
            BF 26               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 25               SX(15)

            EF
        BL FNLR
    EM
    BI 3
```

```
        SLR,UP
            ST(7,1,25,17,0)
            END(8,1,9,0,0)
    EI
    BI 4
        SLR,UP
            ST(8,1,26,17,0)
            END(9,1,9,0,0)
    EI
    BI 5
        SLR,DWN
            ST(12,1,29,1,0)
            END(12,1,29,21,0)
    EI
    BI 6
        SLR,UP
            ST(125,1,26,17,0)
            END(14,1,9,0,0)
    EI
    BI 7
        SLR,UP
            ST(14,1,28,17,0)
            END(15,1,9,0,0)
    EI
    BI 8
        SLR,UP
            ST(15,1,28,17,0)
            END(16,1,28,21,0)
    EI
    BI 9
        SLR,UP
            ST(17,1,27,1,0)
            END(17,1,9,0,0)
    EI
    BI 10
        SLR,UP
            ST(17,1,28,17,0)
            END(18,1,9,0,0)
    EI
    BI 11
        SLR,UP
```

```
        ST(19,1,31,17,0)
        END(20,1,32,21,0)
EI
BI 12
    SLR,UP
        ST(21,1,26,1,0)
        END(21,1,9,0,0)
EI
BI 13
    SLR,DWN
        ST(22,1,1,0,0)
        END(22,1,17,0,0)
EI
BI 14
    SLR,DWN
        ST(24,1,1,0,0)
        END(24,1,17,0,0)
EI
BI 16
    SLR,UP
        ST(27,1,28,1,0)
        END(28,1,28,21,0)
EI
BI 17
    TIE,DWN
        ST(29,1,17,25,0)
        END(30,1,1,9,0)
EI
BI 18
    TIE,UP
        ST(29,1,17,26,0)
        END(30,1,1,10,0)
EI
BI 19
    TIE,DWN
        ST(33,1,1,25,0)
        END(34,1,1,17,0)
EI
BI 20
    TIE,UP
        ST(33,1,1,26,0)
```

```
        END(34,1,1,18,0)
EI
BI 21
    SLR,DWN
        ST(41,1,17,0,0)
        END(42,1,1,0,0)
EI
BI 22
    SLR,UP
        ST(42,1,25,17,0)
        END(43,1,28,21,0)
EI
BI 23
    SLR,UP
        ST(44,1,25,1,0)
        END(44,1,9,0,0)
EI
BI 24
    SLR,UP
        ST(46,1,25,1,0)
        END(46,1,9,0,0)
EI
BI 25
    SLR,UP
        ST(48,1,28,27,0)
        END(48,1,9,0,0)
EI
BI 28
    TIE,DWN
        ST(50,1,1,0,0)
        END(51,1,1,0,0)
EI
BI 29
    SLR,DWN
        ST(51,1,1,0,0)
        END(51,1,17,0,0)
EI
BI 30
    SLR,UP
        ST(25,1,1,0,0)
        END(25,1,23,0,0)
```

```
EI
BI 31
	SLR,UP
		ST(25,1,23,0,0)
		END(26,1,22,0,0)
EI
EPR
```

```
BPR
LVL 1 REL 2
"violino II"
BM 1,1
	NP 0,0,0
	CLEF TRB NRM
	KS LAM
	TEM 3/4		MOV("",N4,FL,96)
		LAYER 1
		BF 22			R4			HN 1
		EF
		BF 20			SX(15)

		EF
		BF 21			SX(15)

		EF
		LAYER 2
		BF 17			SX(15)

		EF
		BF 20			SX(15)

		EF
		BF 21			SX(15)

		EF
	BL SGL
EM
BM 2,2
	NP 0,0,0
	CLEF TRB NRM
	KS LAM
	TEM 3/4			LAYER 1
		BF 1			R4			HN 1
		EF
		BF 5			SX(15)

		EF
		BF 9			N4			S UP
			HN 0
```

```
                                TDIN(TDP,DWN)
                EF
                BF 16           SX(15)

                EF
                BF 17           N4              S UP
                    HN 0
                            EF
                BF 21           SX(15)

                EF
                LAYER 2
                BF 1            SX(15)

                EF
                BF 5            SX(15)

                EF
                BF 9            SX(15)

                EF
                BF 16           SX(15)

                EF
                BF 17           SX(15)

                EF
                BF 21           SX(15)

                EF
            BL SGL
        EM
        BM 3,3
            NP 0,0,0
            CLEF TRB NRM
            KS LAM
            TEM 3/4             LAYER 1
                BF 1            R4              HN 1
                EF
                BF 5            SX(15)
```

```
            EF
            BF 9          N4          S UP
                HN 1
                        EF
            BF 16          SX(15)

            EF
            BF 17          N4          S UP
                HN 1
                        EF
            BF 21          SX(15)

            EF
            LAYER 2
            BF 1          SX(15)

            EF
            BF 5          SX(15)

            EF
            BF 9          SX(15)

            EF
            BF 16          SX(15)

            EF
            BF 17          SX(15)

            EF
            BF 21          SX(15)

            EF
        BL SGL
    EM
    BM 4,4
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1          R4          HN 1
            EF
```

```
        BF 5            SX(15)

        EF
        BF 9            N4            S UP
            HN -1
                    EF
        BF 13           SX(15)

        EF
        BF 17           N4            S UP
            HN -1
                    EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 5,5
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
```

```
BF 22            SX(15)

EF
BF 1             R4             HN 1
EF
BF 8             SX(15)

EF
BF 9             N4             S UP
    HN -2
            EF
BF 16            SX(15)

EF
BF 17            N4             S UP
    HN -2
            EF
BF 21            SX(15)

EF
LAYER 2
BF 22            SX(15)

EF
BF 1             SX(15)

EF
BF 8             SX(15)

EF
BF 9             SX(15)

EF
BF 16            SX(15)

EF
BF 17            SX(15)

EF
BF 21            SX(15)
```

```
            EF
        BL SGL
    EM
    BM 6,6
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                R4                  HN 1
            EF
            BF 5                SX(15)

            EF
            BF 9                N4                  S UP
                HN 0
                            EF
            BF 16               SX(15)

            EF
            BF 17               N4                  S UP
                HN 0
                            EF
            BF 21               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 17               SX(15)

            EF
```

```
                BF 21               SX(15)

                EF
        BL SGL
EM
BM 7,7
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4                LAYER 1
                BF 1               N4                   S UP
                        HN -1
                                        EF
                BF 5               SX(15)

                EF
                BF 9               R4                   HN 1
                EF
                BF 16               SX(15)

                EF
                BF 22               N4                   S UP
                        HN 2
                                        BA
                        NAT
                        EA
                EF
                BF 20               SX(15)

                EF
                BF 21               SX(15)

                EF
                LAYER 2
                BF 1               SX(15)

                EF
                BF 5               SX(15)

                EF
                BF 9               SX(15)
```

```
        EF
        BF 16             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 20             SX(15)

        EF
        BF 21             SX(15)

        EF
    BL SGL
EM
BM 8,8
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4           LAYER 1
        BF 1              N2            S UP
            HN 1
                      EF
        BF 5              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 16             SX(15)

        EF
        BF 22             N4            S UP
            HN 2
                              BA
            NAT
            EA
        EF
        BF 20             SX(15)
```

```
        EF
        BF 21         SX(15)

        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 16         SX(15)

        EF
        BF 17         SX(15)

        EF
        BF 20         SX(15)

        EF
        BF 21         SX(15)

        EF
    BL SGL
EM
BM 9,9
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1          N2          S UP
            HN 1
                    EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)
```

```
            EF
            BF 16               SX(15)

            EF
            BF 17               R4                  HN 1
            EF
            BF 18               SX(15)

            EF
            BF 19               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 17               SX(15)

            EF
            BF 18               SX(15)

            EF
            BF 19               SX(15)

            EF
        BL SGL
    EM
    BM 10,10
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
```

```
        BF 1          SX(15)

        EF
        BF 4          SX(15)

        EF
        BF 29          RW          HN 6
        EF
        BF 12          SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 20          SX(15)

        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 4          SX(15)

        EF
        BF 8          SX(15)

        EF
        BF 12          SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 20          SX(15)

        EF
    BL SGL
EM
BM 11,11
    NP 0,0,0
    CLEF TRB NRM
```

```
    KS LAM
    TEM 3/4          LAYER 1
        BF 1             SX(15)

        EF
        BF 5             SX(15)

        EF
        BF 22             RW              HN 6
        EF
        BF 13             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 21             SX(15)

        EF
        LAYER 2
        BF 1             SX(15)

        EF
        BF 5             SX(15)

        EF
        BF 9             SX(15)

        EF
        BF 13             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 21             SX(15)

        EF
    BL SGL
EM
BM 12,12
```

```
NP 0,0,0
CLEF TRB NRM
KS LAM
TEM 3/4            LAYER 1
      BF 1             N2              S UP
            HN -4
                        EF
      BF 5             SX(15)

      EF
      BF 9             SX(15)

      EF
      BF 13            SX(15)

      EF
      BF 17            N4              S UP
            HN -5
                             BA
            SH
            EA
      EF
      BF 21            SX(15)

      EF
      LAYER 2
      BF 1             SX(15)

      EF
      BF 5             SX(15)

      EF
      BF 9             SX(15)

      EF
      BF 13            SX(15)

      EF
      BF 17            SX(15)

      EF
```

```
            BF 21          SX(15)

            EF
        BL SGL
    EM
    BM 13,13
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4        LAYER 1
            BF 1           N4             S UP
                HN -4
                        EF
            BF 8           SX(15)

            EF
            BF 25          R4             HN 1
            EF
            BF 16          SX(15)

            EF
            LAYER 2
            BF 1           SX(15)

            EF
            BF 8           SX(15)

            EF
            BF 9           SX(15)

            EF
            BF 16          SX(15)

            EF
        BL STF
    EM
    BM 14,125
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4        LAYER 1
```

```
        BF 25           R4          HN 1
        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
     BL SGL
  EM
  BM 15,14
     NP 0,0,0
     CLEF TRB NRM
     KS LAM
     TEM 3/4         LAYER 1
           BAC 1
           N4              S UP
           FING UP
           NA 9
           HN -3
                        NA 10
           HN 2
                                     BS
           PIZ,UP
           ES
           TDIN(TDP,DWN)

           EAC
        BF 5            SX(15)

        EF
           BAC 11
           N4              S UP
           FING UP
           NA 19
           HN -3
                        NA 20
```

```
            HN 2

            EAC
        BF 12              SX(15)

        EF
        BF 21              R4             HN 1
        EF
        BF 25              SX(15)

        EF
        LAYER 2
        BF 1               SX(15)

        EF
        BF 5               SX(15)

        EF
        BF 9               SX(15)

        EF
        BF 10              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 21              SX(15)

        EF
    BL SGL
EM
BM 16,15
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
            BAC 1
            N4          S UP
            FING UP
            NA 9
```

```
        HN -4
                        NA 10
        HN 3

        EAC
BF 5                SX(15)

EF
        BAC 11
        N4                    S UP
        FING UP
        NA 19
        HN -4
                        NA 20
        HN 3

        EAC
BF 18               SX(15)

EF
BF 21               R4                 HN 1
EF
BF 25               SX(15)

EF
LAYER 2
BF 1                SX(15)

EF
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 16               SX(15)

EF
BF 17               SX(15)

EF
```

```
            BF 21                  SX(15)

            EF
        BL SGL
EM
BM 17,16
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4                LAYER 1
                BAC 1
                N4                     S UP
                FING UP
                NA 9
                HN 2
                                        NA 10
                HN 4

                EAC
            BF 5                    SX(15)

            EF
                BAC 11
                N4                     S UP
                FING UP
                NA 19
                HN 2
                                        NA 20
                HN 4

                EAC
            BF 15                  SX(15)

            EF
                BAC 21
                N4                     S UP
                FING UP
                NA 29
                HN 3
                                        NA 30
                HN 5
```

```
        EAC
    BF 25           SX(15)

    EF
    LAYER 2
    BF 1            SX(15)

    EF
    BF 5            SX(15)

    EF
    BF 9            SX(15)

    EF
    BF 13           SX(15)

    EF
    BF 17           SX(15)

    EF
    BF 21           SX(15)

    EF
  BL SGL
EM
BM 18,17
  NP 0,0,0
  CLEF TRB NRM
  KS LAM
  TEM 3/4         LAYER 1
        BAC 1
        N4              S UP
        FING UP
        NA 9
        HN 2
                      NA 10
        HN 4

        EAC
    BF 5            SX(15)
```

```
        EF
            BAC 11
            N4              S UP
            FING UP
            NA 19
            HN 2
                        NA 20
            HN 4

            EAC
        BF 18           SX(15)

        EF
        BF 21           R4              HN 1
        EF
        BF 25           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 19,18
```

```
NP 0,0,0
CLEF TRB NRM
KS LAM
TEM 3/4          LAYER 1
        BAC 1
        N4            S UP
        FING UP
        NA 9
        HN -3
                    NA 10
        HN 2

        EAC
    BF 5          SX(15)

    EF
        BAC 11
        N4            S UP
        FING UP
        NA 19
        HN -3
                    NA 20
        HN 2

        EAC
    BF 18          SX(15)

    EF
    BF 21          R4            HN 1
    EF
    BF 25          SX(15)

    EF
    LAYER 2
    BF 1          SX(15)

    EF
    BF 5          SX(15)

    EF
    BF 9          SX(15)
```

```
        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 20,19
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
            BAC 1
            N4              S UP
            FING UP
            NA 9
            HN -4
                        NA 10
            HN 3

            EAC
        BF 5             SX(15)

        EF
            BAC 11
            N4              S UP
            FING UP
            NA 19
            HN -4
                        NA 20
            HN 3

            EAC
        BF 18            SX(15)
```

```
        EF
        BF 21          R4           HN 1
        EF
        BF 25          SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 21,20
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
            BAC 1
            N4             S UP
            FING UP
            NA 9
            HN 2
                        NA 10
            HN 4

            EAC
```

```
BF 5                SX(15)

EF
      BAC 11
      N4                  S UP
      FING UP
      NA 19
      HN 2
                        NA 20
      HN 4

      EAC
BF 15               SX(15)

EF
BF 40               SX(15)

EF
      BAC 38
      N4                  S UP
      FING UP
      NA 39
      HN 3
                        NA 38
      HN 5
                        BA
      NAT
      EA

      EAC
BF 25               SX(15)

EF
LAYER 2
BF 1                SX(15)

EF
BF 5                SX(15)

EF
BF 9                SX(15)
```

```
        EF
        BF 13           SX(15)

        EF
        BF 22           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 22,21
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
            BAC 1
            N4              S UP
            FING UP
            NA 9
            HN 2
                        NA 10
            HN 4

            EAC
        BF 5            SX(15)

        EF
        BF 28           R4          HN 1
        EF
        BF 18           SX(15)

        EF
        BF 29           R4          HN 1
        EF
        BF 23           SX(15)
```

```
        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 23,22
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4        LAYER 1
        BF 25            SX(15)

        EF
        BF 1            N4            S UP
            HN 1
                        BS
            ARC(UP,TR)
            ES
        EF
        BF 5            SX(15)

        EF
        BF 9            N4            S UP
```

```
                HN -1
                                BA
                SH
                EA
            EF
            BF 16           SX(15)

            EF
            BF 17           N4          S UP
                HN 1
                        EF
            BF 21           SX(15)

            EF
            LAYER 2
            BF 25           SX(15)

            EF
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 24,23
        NP 0,0,0
        CLEF TRB NRM
```

```
KS LAM
TEM 3/4          LAYER 1
    BF 1           N2          S UP
        HN 0
                     PVAL 1
    EF
    BF 5           SX(15)

    EF
    BF 9           SX(15)

    EF
    BF 10          SX(15)

    EF
    BF 17          SX(15)

    EF
    BF 21          SX(15)

    EF
    LAYER 2
    BF 1           SX(15)

    EF
    BF 5           SX(15)

    EF
    BF 9           SX(15)

    EF
    BF 10          SX(15)

    EF
    BF 17          SX(15)

    EF
    BF 21          SX(15)

    EF
BL SGL
```

```
EM
BM 25,24
          NP 0,0,0
          CLEF TRB NRM
          KS LAM
          TEM 3/4               LAYER 1
                    BF 22                SX(15)

                    EF
                    BF 1                 N4                  S UP
                              HN 1
                                      EF
                    BF 5                 SX(15)

                    EF
                    BF 9                 N4                  S UP
                              HN -1
                                                BA
                              SH
                              EA
                    EF
                    BF 16                SX(15)

                    EF
                    BF 17                N4                  S UP
                              HN 1
                                      EF
                    BF 21                SX(15)

                    EF
                    LAYER 2
                    BF 22                SX(15)

                    EF
                    BF 1                 SX(15)

                    EF
                    BF 5                 SX(15)

                    EF
                    BF 9                 SX(15)
```

```
            EF
            BF 16                   SX(15)

            EF
            BF 17                   SX(15)

            EF
            BF 21                   SX(15)

            EF
        BL SGL
    EM
    BM 26,25
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4              LAYER 1
            BF 1                N4                      S UP
                HN 2
                                   PVAL 1
            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 13                N8                      S UP
                HN 1
                            EF
            BF 17                N4                      S UP
                HN 3
                            EF
            BF 22                SX(15)

            EF
            BF 21                SX(15)

            EF
            LAYER 2
```

```
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 13          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 22          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 27,26
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1          N4          S UP
            HN 2
                        PVAL 1
        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 13          N8          S UP
            HN 1
                    EF
```

```
        BF 17          N4            S UP
            HN 3
                    EF
        BF 22          SX(15)

        EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 13          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 22          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 28,27
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4            LAYER 1
        BF 1           N4            S UP
            HN 2
                          PVAL 1
```

```
EF
BF 5            SX(15)

EF
BF 9            SX(15)

EF
BF 13            N8            S UP
    HN 1
            EF
BF 17            N4            S UP
    HN 3
            EF
BF 20            SX(15)

EF
BF 21            SX(15)

EF
LAYER 2
BF 1            SX(15)

EF
BF 5            SX(15)

EF
BF 9            SX(15)

EF
BF 13            SX(15)

EF
BF 17            SX(15)

EF
BF 20            SX(15)

EF
BF 21            SX(15)

EF
```

```
        BL SGL
EM
BM 29,28
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4                 LAYER 1
                BF 1                N4                  S UP
                        HN 2
                                        PVAL 1
                EF
                BF 5                SX(15)

                EF
                BF 9                SX(15)

                EF
                BF 13               N8                  S UP
                        HN 1
                                EF
                BF 17               N4                  S UP
                        HN 3
                                EF
                BF 20               SX(15)

                EF
                BF 21               SX(15)

                EF
                LAYER 2
                BF 1                SX(15)

                EF
                BF 5                SX(15)

                EF
                BF 9                SX(15)

                EF
                BF 13               SX(15)
```

```
          EF
          BF 17              SX(15)

          EF
          BF 20              SX(15)

          EF
          BF 21              SX(15)

          EF
      BL SGL
  EM
  BM 30,29
      NP 0,0,0
      CLEF TRB NRM
      KS LAM
      TEM 3/4            LAYER 1
          BF 1              N4              S UP
              HN 2
                          EF
          BF 8              SX(15)

          EF
          BF 18              R4              HN 1
          EF
          BF 16              SX(15)

          EF
          BF 19              R4              HN 1
          EF
          LAYER 2
          BF 1              SX(15)

          EF
          BF 8              SX(15)

          EF
          BF 9              SX(15)

          EF
          BF 16              SX(15)
```

```
        EF
        BF 17           SX(15)

        EF
    BL SGL
EM
BM 31,30
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 18           SX(15)

        EF
        BF 19           R4          HN 1
        EF
        BF 8            SX(15)

        EF
        BF 20           R4          HN 1
        EF
        BF 16           SX(15)

        EF
        BF 17           N4          S UP
            HN 3
                         BA
            SH
            EA
            TDIN(TDFP,DWN)
        EF
        LAYER 2
        BF 18           SX(15)

        EF
        BF 1            SX(15)

        EF
        BF 8            SX(15)
```

```
        EF
        BF 9            SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
    BL SGL
EM
BM 32,31
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 18            N2            S DWN
            HN 4
                           PVAL 1
        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)
```

```
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
    BL SGL
EM
BM 33,32
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 26           SX(15)

        EF
        BF 33           N2              S DWN
            HN 4
                         PVAL 1
        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 25           SX(15)

        EF
        LAYER 2
        BF 26           SX(15)

        EF
```

```
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 25           SX(15)

        EF
    BL SGL
EM
BM 34,33
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 21           N4          S DWN
            HN 4
                    EF
        BF 8            SX(15)

        EF
        BF 20           N4          S DWN
            HN 4
                    EF
        BF 16           SX(15)

        EF
        BF 19           N4          S DWN
            HN 4
                    EF
        BF 18           SX(15)
```

```
        EF
        LAYER 2
        BF 1              SX(15)

        EF
        BF 8              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 16              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 18              SX(15)

        EF
    BL SGL
EM
BM 35,34
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4            LAYER 1
        BF 24              N4              S DWN
            HN 4
                        EF
        BF 5              SX(15)

        EF
        BF 23              N4              S DWN
            HN 4
                        EF
        BF 16              SX(15)

        EF
        BF 22              N4              S DWN
```

```
            HN 4
                  EF
         BF 21          SX(15)

         EF
         LAYER 2
         BF 1           SX(15)

         EF
         BF 5           SX(15)

         EF
         BF 9           SX(15)

         EF
         BF 16          SX(15)

         EF
         BF 17          SX(15)

         EF
         BF 21          SX(15)

         EF
      BL SGL
   EM
   BM 36,35
      NP 0,0,0
      CLEF TRB NRM
      KS LAM
      TEM 3/4        LAYER 1
         BF 25          N4          S DWN
            HN 4
                  EF
         BF 5           SX(15)

         EF
         BF 24          N4          S DWN
            HN 4
                  EF
         BF 13          SX(15)
```

```
        EF
        BF 23           N4            S DWN
            HN 4
                      EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 37,36
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 28           N4            S DWN
            HN 4
                      EF
        BF 8           SX(15)

        EF
        BF 26           R4            HN 1
```

```
            EF
            BF 25                SX(15)

            EF
            BF 27                R4                  HN 1
            EF
            BF 21                SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 25                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 38,37
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                R4                  HN 1
            EF
            BF 5                SX(15)

            EF
            BF 9                N4                  S UP
```

```
                HN 0
                                TDIN(TDP,DWN)
            EF
            BF 10           SX(15)

            EF
            BF 17           N4              S UP
                HN 0
                            EF
            BF 21           SX(15)

            EF
            LAYER 2
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 10           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 39,38
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1            R4              HN 1
            EF
            BF 5            SX(15)
```

```
        EF
        BF 9              N4              S UP
            HN 1
                        EF
        BF 16              SX(15)

        EF
        BF 17              N4              S UP
            HN 1
                        EF
        BF 21              SX(15)

        EF
        LAYER 2
        BF 1              SX(15)

        EF
        BF 5              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 16              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 21              SX(15)

        EF
    BL SGL
EM
BM 40,39
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4              LAYER 1
        BF 1              R4              HN 1
```

```
        EF
        BF 5          SX(15)

        EF
        BF 9          N4          S UP
          HN -1
                    EF
        BF 13          SX(15)

        EF
        BF 17          N4          S UP
          HN -1
                    EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 13          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 41,40
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
```

```
TEM 3/4              LAYER 1
        BF 22              SX(15)

        EF
        BF 1              R4                 HN 1
        EF
        BF 8              SX(15)

        EF
        BF 9              N4                 S UP
                HN -2
                                EF
        BF 16              SX(15)

        EF
        BF 17              N4                 S UP
                HN -2
                                EF
        BF 21              SX(15)

        EF
        LAYER 2
        BF 22              SX(15)

        EF
        BF 1              SX(15)

        EF
        BF 8              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 16              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 21              SX(15)
```

```
            EF
        BL SGL
    EM
    BM 42,41
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4                LAYER 1
            BF 1                   R4                   HN 1
            EF
            BF 5                   SX(15)

            EF
            BF 9                   N4                   S UP
                HN 0
                                EF
            BF 16                  SX(15)

            EF
            BF 17                  N4                   S UP
                HN 0
                                EF
            BF 21                  SX(15)

            EF
            LAYER 2
            BF 1                   SX(15)

            EF
            BF 5                   SX(15)

            EF
            BF 9                   SX(15)

            EF
            BF 16                  SX(15)

            EF
            BF 17                  SX(15)
```

```
        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 43,42
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            N4          S UP
            HN -1
                    EF
        BF 5            SX(15)

        EF
        BF 9            R4          HN 1
        EF
        BF 16           SX(15)

        EF
        BF 25           N4          S UP
            HN 2
                        BA
            NAT
            EA
        EF
        BF 20           SX(15)

        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
```

```
        BF 9          SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 20          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 44,43
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1          N4          S UP
            HN 1
                    EF
        BF 5          SX(15)

        EF
        BF 9          N4          S UP
            HN 1
                    EF
        BF 13          SX(15)

        EF
        BF 25          N4          S UP
            HN 2
                        BA
            NAT
            EA
        EF
        BF 20          SX(15)
```

```
        EF
        BF 21              SX(15)

        EF
        LAYER 2
        BF 1               SX(15)

        EF
        BF 5               SX(15)

        EF
        BF 9               SX(15)

        EF
        BF 13              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 20              SX(15)

        EF
        BF 21              SX(15)

        EF
    BL SGL
EM
BM 45,44
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4            LAYER 1
        BF 1               N2           S UP
            HN 1
                       EF
        BF 5               SX(15)

        EF
        BF 9               SX(15)
```

```
        EF
        BF 16           SX(15)

        EF
        BF 17           R4          HN 1
        EF
        BF 20           SX(15)

        EF
        BF 23           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 23           SX(15)

        EF
    BL SGL
EM
BM 46,45
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
```

```
        TEM 3/4             LAYER 1
            BF 1                SX(15)

            EF
            BF 4                SX(15)

            EF
            BF 25                RW                 HN 6
            EF
            BF 12                SX(15)

            EF
            BF 16                SX(15)

            EF
            BF 20                SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 4                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 12                SX(15)

            EF
            BF 16                SX(15)

            EF
            BF 20                SX(15)

            EF
        BL SGL
    EM
    BM 47,46
        NP 0,0,0
```

```
CLEF TRB NRM
KS LAM
TEM 3/4             LAYER 1
     BF 25               N4                S DWN
          HN 4
                           TDIN(TDRF,DWN)
     EF
     BF 5               SX(15)

     EF
     BF 9               N4                S DWN
          HN 5
                    EF
     BF 16               SX(15)

     EF
     BF 17               R4                HN 1
     EF
     BF 21               SX(15)

     EF
     LAYER 2
     BF 1               SX(15)

     EF
     BF 5               SX(15)

     EF
     BF 9               SX(15)

     EF
     BF 16               SX(15)

     EF
     BF 17               SX(15)

     EF
     BF 21               SX(15)

     EF
BL SGL
```

```
EM
BM 48,47
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
                BF 1            SX(15)

                EF
                BF 5            SX(15)

                EF
                BF 25           RW              HN 6
                EF
                BF 13           SX(15)

                EF
                BF 17           SX(15)

                EF
                BF 21           SX(15)

                EF
                LAYER 2
                BF 1            SX(15)

                EF
                BF 5            SX(15)

                EF
                BF 9            SX(15)

                EF
                BF 13           SX(15)

                EF
                BF 17           SX(15)

                EF
                BF 21           SX(15)
```

```
            EF
        BL SGL
    EM
    BM 49,48
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 22               SX(15)

            EF
            BF 1                N4              S DWN
                HN 5
                                 TDIN(TDRF,DWN)
            EF
            BF 5                SX(15)

            EF
            BF 9                N4              S DWN
                HN 6
                            EF
            BF 16               SX(15)

            EF
            BF 17               R4              HN 1
            EF
            BF 21               SX(15)

            EF
            LAYER 2
            BF 22               SX(15)

            EF
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)
```

```
            EF
            BF 16              SX(15)

            EF
            BF 17              SX(15)

            EF
            BF 21              SX(15)

            EF
        BL SGL
EM
BM 50,49
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 13              SX(15)

            EF
            BF 17              SX(15)

            EF
            BF 21              SX(15)

            EF
            LAYER 2
            BF 1              SX(15)

            EF
            BF 5              SX(15)
```

```
            EF
            BF 26            RW             HN 6
            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 51,50
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1             N2             S UP
                HN 1
                                PVAL 1
                TDIN(TDP,DWN)
            EF
            BF 4             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)
```

```
        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 4            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 52,51
    NP 0,0,0
    CLEF TRB NRM
    KS LAM
    TEM 3/4         LAYER 1
            BB 28
            NB 1
            N8             S UP
            HN 0
                        NB 5
            N8             S UP
            HN -2
                        NB 9
            N8             S UP
            HN 0
                        NB 13
```

```
                N8              S UP
                HN -2
                              NB 17
                N8              S UP
                HN 0
                              NB 21
                N8              S UP
                HN -1
                              EB
            LAYER 2
            BF 1              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 13              SX(15)

            EF
            BF 17              SX(15)

            EF
            BF 21              SX(15)

            EF
        BL SGL
    EM
    BM 53,52
        NP 0,0,0
        CLEF TRB NRM
        KS LAM
        TEM 3/4            LAYER 1
            BF 1              N4              S UP
                HN -2
                           EF
            BF 8              SX(15)

            EF
```

```
        BF 26           R4            HN 1
        EF
        BF 25           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 25           SX(15)

        EF
    BL FNLR
EM
BI 4
    SLR,DWN
        ST(7,1,22,0,0)
        END(9,1,1,0,0)
EI
BI 5
    SLR,DWN
        ST(12,1,1,0,0)
        END(12,1,17,0,0)
EI
BI 6
    SLR,DWN
        ST(22,1,1,0,0)
        END(22,1,17,0,0)
EI
BI 7
    SLR,DWN
        ST(24,1,1,0,0)
        END(24,1,17,0,0)
EI
BI 8
```

```
        SLR,DWN
            ST(25,1,1,0,0)
            END(25,1,17,0,0)
    EI
    BI 9
        SLR,DWN
            ST(26,1,1,0,0)
            END(26,1,17,0,0)
    EI
    BI 10
        SLR,DWN
            ST(27,1,1,0,0)
            END(27,1,17,0,0)
    EI
    BI 11
        SLR,DWN
            ST(28,1,1,0,0)
            END(28,1,17,0,0)
    EI
    BI 16
        SLR,DWN
            ST(41,1,17,0,0)
            END(42,1,1,0,0)
    EI
    BI 17
        SLR,DWN
            ST(42,1,25,0,0)
            END(43,1,1,0,0)
    EI
    BI 18
        SLR,DWN
            ST(43,1,9,0,0)
            END(43,1,25,0,0)
    EI
    BI 19
        SLR,UP
            ST(46,1,25,0,0)
            END(46,1,9,0,0)
    EI
    BI 20
        SLR,UP
```

```
        ST(48,1,1,0,0)
        END(48,1,9,0,0)
EI
BI 21
    TIE,UP
        ST(31,1,18,0,0)
        END(32,1,33,0,0)
EI
BI 22
    TIE,UP
        ST(32,1,33,0,0)
        END(33,1,21,0,0)
EI
BI 23
    SLR,UP
        ST(30,1,17,0,0)
        END(31,1,18,0,0)
EI
EPR
```

```
BPR
LVL 1 REL 2
"viola"
BM 1,1
	NP 0,0,0
	CLEF CC NRM
	KS LAM
	TEM 3/4		MOV("",N4,FL,96)
		LAYER 1
		BF 22		R4		HN 1
		EF
		BF 20		SX(15)

		EF
		BF 21		SX(15)

		EF
		LAYER 2
		BF 17		SX(15)

		EF
		BF 20		SX(15)

		EF
		BF 21		SX(15)

		EF
	BL SGL
EM
BM 2,2
	NP 0,0,0
	CLEF CC NRM
	KS LAM
	TEM 3/4			LAYER 1
		BF 1		R4		HN 1
		EF
		BF 5		SX(15)

		EF
		BF 23		N4		S DWN
			HN 4
```

```
                                TDIN(TDP,DWN)
               EF
               BF 16              SX(15)

               EF
               BF 22              N4              S DWN
                   HN 4
                           EF
               BF 21              SX(15)

               EF
               LAYER 2
               BF 1               SX(15)

               EF
               BF 5               SX(15)

               EF
               BF 9               SX(15)

               EF
               BF 16              SX(15)

               EF
               BF 17              SX(15)

               EF
               BF 21              SX(15)

               EF
           BL SGL
       EM
       BM 3,3
           NP 0,0,0
           CLEF CC NRM
           KS LAM
           TEM 3/4             LAYER 1
               BF 1               R4              HN 1
               EF
               BF 5               SX(15)
```

```
          EF
          BF 9                N4                S UP
               HN 3
                         EF
          BF 16               SX(15)

          EF
          BF 17               N4                S UP
               HN 3
                         EF
          BF 21               SX(15)

          EF
          LAYER 2
          BF 1                SX(15)

          EF
          BF 5                SX(15)

          EF
          BF 9                SX(15)

          EF
          BF 16               SX(15)

          EF
          BF 17               SX(15)

          EF
          BF 21               SX(15)

          EF
     BL SGL
EM
BM 4,4
     NP 0,0,0
     CLEF CC NRM
     KS LAM
     TEM 3/4             LAYER 1
          BF 1                R4                HN 1
          EF
```

```
        BF 5          SX(15)

        EF
        BF 9          N4          S UP
          HN 3
                EF
        BF 13          SX(15)

        EF
        BF 17          N4          S UP
          HN 3
                EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 13          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
      BL SGL
    EM
    BM 5,5
      NP 0,0,0
      CLEF CC NRM
      KS LAM
      TEM 3/4          LAYER 1
```

```
BF 22           SX(15)

EF
BF 1            R4            HN 1
EF
BF 8            SX(15)

EF
BF 9            N4            S UP
    HN 2
            EF
BF 16           SX(15)

EF
BF 17           N4            S UP
    HN 2
            EF
BF 21           SX(15)

EF
LAYER 2
BF 22           SX(15)

EF
BF 1            SX(15)

EF
BF 8            SX(15)

EF
BF 9            SX(15)

EF
BF 16           SX(15)

EF
BF 17           SX(15)

EF
BF 21           SX(15)
```

```
            EF
        BL SGL
    EM
    BM 6,6
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4           LAYER 1
            BF 1              R4                HN 1
            EF
            BF 5              SX(15)

            EF
            BF 24             N4                S DWN
                HN 4
                          EF
            BF 16             SX(15)

            EF
            BF 25             N4                S DWN
                HN 4
                          EF
            BF 21             SX(15)

            EF
            LAYER 2
            BF 1              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 16             SX(15)

            EF
            BF 17             SX(15)

            EF
```

```
            BF 21              SX(15)

            EF
        BL SGL
    EM
    BM 7,7
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1              N4              S UP
                HN 3
                            EF
            BF 5              SX(15)

            EF
            BF 9              R4              HN 1
            EF
            BF 16              SX(15)

            EF
            BF 17              N4              S DWN
                HN 6
                            EF
            BF 20              SX(15)

            EF
            BF 21              SX(15)

            EF
            LAYER 2
            BF 1              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 16              SX(15)
```

```
            EF
            BF 17               SX(15)

            EF
            BF 20               SX(15)

            EF
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 8,8
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                N2                  S DWN
                HN 5
                            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 17               N4                  S DWN
                HN 6
                            EF
            BF 20               SX(15)

            EF
            BF 21               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)
```

```
                EF
                BF 5              SX(15)

                EF
                BF 9              SX(15)

                EF
                BF 16              SX(15)

                EF
                BF 17              SX(15)

                EF
                BF 20              SX(15)

                EF
                BF 21              SX(15)

                EF
            BL SGL
        EM
        BM 9,9
            NP 0,0,0
            CLEF CC NRM
            KS LAM
            TEM 3/4           LAYER 1
                BF 1              N2              S DWN
                    HN 5
                                EF
                BF 5              SX(15)

                EF
                BF 9              SX(15)

                EF
                BF 16              SX(15)

                EF
                BF 17              R4              HN 1
                EF
```

```
            BF 18               SX(15)

            EF
            BF 19               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 17               SX(15)

            EF
            BF 18               SX(15)

            EF
            BF 19               SX(15)

            EF
        BL SGL
    EM
    BM 10,10
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                SX(15)

            EF
            BF 4                SX(15)

            EF
```

```
            BF 29           RW            HN 6
            EF
            BF 12           SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 20           SX(15)

            EF
            LAYER 2
            BF 1            SX(15)

            EF
            BF 4            SX(15)

            EF
            BF 8            SX(15)

            EF
            BF 12           SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 20           SX(15)

            EF
        BL SGL
    EM
    BM 11,11
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1            SX(15)

            EF
            BF 5            SX(15)
```

```
          EF
          BF 22          RW          HN 6
          EF
          BF 13          SX(15)

          EF
          BF 17          SX(15)

          EF
          BF 21          SX(15)

          EF
          LAYER 2
          BF 1          SX(15)

          EF
          BF 5          SX(15)

          EF
          BF 9          SX(15)

          EF
          BF 13          SX(15)

          EF
          BF 17          SX(15)

          EF
          BF 21          SX(15)

          EF
     BL SGL
EM
BM 12,12
     NP 0,0,0
     CLEF CC NRM
     KS LAM
     TEM 3/4          LAYER 1
          BF 1          N2          S UP
               HN -1
```

```
                                PVAL 1
                EF
                BF 5              SX(15)

                EF
                BF 9              SX(15)

                EF
                BF 13              SX(15)

                EF
                BF 17              SX(15)

                EF
                BF 21              SX(15)

                EF
                LAYER 2
                BF 1              SX(15)

                EF
                BF 5              SX(15)

                EF
                BF 9              SX(15)

                EF
                BF 13              SX(15)

                EF
                BF 17              SX(15)

                EF
                BF 21              SX(15)

                EF
        BL SGL
    EM
    BM 13,13
        NP 0,0,0
        CLEF CC NRM
```

```
        KS LAM
        TEM 3/4         LAYER 1
            BF 1             N4            S UP
                HN -1
                        EF
            BF 8             SX(15)

            EF
            BF 25            R4            HN 1
            EF
            BF 16            SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 8             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 16            SX(15)

            EF
        BL STF
    EM
    BM 14,125
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 25            R4            HN 1
            EF
            BF 21            SX(15)

            EF
            LAYER 2
            BF 17            SX(15)
```

```
            EF
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 15,14
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4             LAYER 1
                BAC 1
                N4                  S DWN
                FING UP
                NA 9
                HN 5
                                NA 10
                HN 6
                                                BS
                PIZ,UP
                ES
                TDIN(TDP,DWN)

                EAC
            BF 5                SX(15)

            EF
                BAC 11
                N4                  S DWN
                FING UP
                NA 19
                HN 5
                                NA 20
                HN 6

                EAC
            BF 12               SX(15)

            EF
            BF 21               R4              HN 1
            EF
```

```
        BF 25           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 10           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 16,15
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
            BAC 1
            N4              S DWN
            FING UP
            NA 9
            HN 4
                        NA 10
            HN 6

            EAC
        BF 5            SX(15)

        EF
```

```
            BAC 11
            N4              S DWN
            FING UP
            NA 19
            HN 4
                        NA 20
            HN 6

            EAC
        BF 18             SX(15)

        EF
        BF 21             R4              HN 1
        EF
        BF 25             SX(15)

        EF
        LAYER 2
        BF 1              SX(15)

        EF
        BF 5              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 16             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 21             SX(15)

        EF
    BL SGL
EM
BM 17,16
    NP 0,0,0
    CLEF CC NRM
```

```
    KS LAM
    TEM 3/4         LAYER 1
      BF 1            N4           S DWN
        HN 6
                    EF
      BF 5            SX(15)

      EF
      BF 9            N4           S DWN
        HN 6
                    EF
      BF 13           SX(15)

      EF
      BF 17           N4           S DWN
        HN 6
                    EF
      BF 21           SX(15)

      EF
      LAYER 2
      BF 1            SX(15)

      EF
      BF 5            SX(15)

      EF
      BF 9            SX(15)

      EF
      BF 13           SX(15)

      EF
      BF 17           SX(15)

      EF
      BF 21           SX(15)

      EF
    BL SGL
  EM
```

```
BM 18,17
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4               LAYER 1
                BF 1              N4                 S DWN
                        HN 6
                              EF
                BF 5              SX(15)

                EF
                BF 9              N4                 S DWN
                        HN 6
                              EF
                BF 16              SX(15)

                EF
                BF 17              R4                 HN 1
                EF
                BF 21              SX(15)

                EF
                LAYER 2
                BF 1              SX(15)

                EF
                BF 5              SX(15)

                EF
                BF 9              SX(15)

                EF
                BF 16              SX(15)

                EF
                BF 17              SX(15)

                EF
                BF 21              SX(15)

                EF
```

```
        BL SGL
    EM
    BM 19,18
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4            LAYER 1
                BAC 1
                N4              S DWN
                FING UP
                NA 9
                HN 5
                            NA 10
                HN 6

                EAC
            BF 5            SX(15)

            EF
                BAC 11
                N4              S DWN
                FING UP
                NA 19
                HN 5
                            NA 20
                HN 6

                EAC
            BF 18           SX(15)

            EF
            BF 21           R4          HN 1
            EF
            BF 25           SX(15)

            EF
            LAYER 2
            BF 1            SX(15)

            EF
            BF 5            SX(15)
```

```
        EF
        BF 9            SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 20,19
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4          LAYER 1
            BAC 29
            N4              S DWN
            FING UP
            NA 30
            HN 4
                        BA
            NAT
            EA
            NA 29
            HN 6

            EAC
        BF 5            SX(15)

        EF
            BAC 32
            N4              S DWN
            FING UP
            NA 33
            HN 4
```

```
                         NA 32
               HN 6

               EAC
            BF 18              SX(15)

            EF
            BF 21              R4              HN 1
            EF
            BF 25              SX(15)

            EF
            LAYER 2
            BF 1               SX(15)

            EF
            BF 5               SX(15)

            EF
            BF 9               SX(15)

            EF
            BF 16              SX(15)

            EF
            BF 17              SX(15)

            EF
            BF 21              SX(15)

            EF
        BL SGL
    EM
    BM 21,20
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4            LAYER 1
            BF 1               N4              S DWN
               HN 6
                     EF
```

```
        BF 5              SX(15)

        EF
        BF 9              N4             S DWN
            HN 6
                        EF
        BF 13             SX(15)

        EF
        BF 22             SX(15)

        EF
        BF 17             N4             S DWN
            HN 6
                        EF
        BF 21             SX(15)

        EF
        LAYER 2
        BF 1              SX(15)

        EF
        BF 5              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 13             SX(15)

        EF
        BF 22             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 21             SX(15)

        EF
    BL SGL
```

```
EM
BM 22,21
          NP 0,0,0
          CLEF CC NRM
          KS LAM
          TEM 3/4                LAYER 1
                    BF 1              N4                 S DWN
                              HN 6
                                   EF
                    BF 5              SX(15)

                    EF
                    BF 25              R4                 HN 1
                    EF
                    BF 16              SX(15)

                    EF
                    BF 26              R4                 HN 1
                    EF
                    BF 21              SX(15)

                    EF
                    LAYER 2
                    BF 1              SX(15)

                    EF
                    BF 5              SX(15)

                    EF
                    BF 9              SX(15)

                    EF
                    BF 16              SX(15)

                    EF
                    BF 17              SX(15)

                    EF
                    BF 21              SX(15)

                    EF
```

```
        BL SGL
    EM
    BM 23,22
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 25               SX(15)

            EF
            BF 1               N2                      S UP
                HN 3
                                    BS
                ARC(UP,TR)
                ES
                PVAL 1
            EF
            BF 5               SX(15)

            EF
            BF 9               SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 17               SX(15)

            EF
            BF 21               SX(15)

            EF
            LAYER 2
            BF 25               SX(15)

            EF
            BF 1               SX(15)

            EF
            BF 5               SX(15)
```

```
                EF
                BF 9                SX(15)

                EF
                BF 16               SX(15)

                EF
                BF 17               SX(15)

                EF
                BF 21               SX(15)

                EF
            BL SGL
        EM
        BM 24,23
            NP 0,0,0
            CLEF CC NRM
            KS LAM
            TEM 3/4             LAYER 1
                BF 1                N2              S UP
                    HN 3
                                PVAL 1
                EF
                BF 5                SX(15)

                EF
                BF 9                SX(15)

                EF
                BF 10               SX(15)

                EF
                BF 17               SX(15)

                EF
                BF 21               SX(15)

                EF
                LAYER 2
                BF 1                SX(15)
```

```
            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 10               SX(15)

            EF
            BF 17               SX(15)

            EF
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 25,24
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 22               SX(15)

            EF
            BF 1                N2              S UP
                HN 3
                                    PVAL 1
            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 17               SX(15)
```

```
        EF
        BF 21            SX(15)

        EF
        LAYER 2
        BF 22            SX(15)

        EF
        BF 1             SX(15)

        EF
        BF 5             SX(15)

        EF
        BF 9             SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 26,25
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1             N4           S DWN
            HN 6
                           PVAL 1
        EF
        BF 5             SX(15)

        EF
```

```
    BF 9          SX(15)

    EF
    BF 13          N8          S DWN
        HN 5
                    BA
        SH
        EA
    EF
    BF 17          N4          S DWN
        HN 7
                EF
    BF 22          SX(15)

    EF
    BF 21          SX(15)

    EF
    LAYER 2
    BF 1          SX(15)

    EF
    BF 5          SX(15)

    EF
    BF 9          SX(15)

    EF
    BF 13          SX(15)

    EF
    BF 17          SX(15)

    EF
    BF 22          SX(15)

    EF
    BF 21          SX(15)

    EF
BL SGL
```

```
EM
BM 27,26
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4                 LAYER 1
                BF 1                N4                  S DWN
                        HN 6
                                        PVAL 1
                EF
                BF 5                SX(15)

                EF
                BF 9                SX(15)

                EF
                BF 13               N8                  S DWN
                        HN 5
                                        BA
                        SH
                        EA
                EF
                BF 17               N4                  S DWN
                        HN 7
                                EF
                BF 22               SX(15)

                EF
                BF 21               SX(15)

                EF
                LAYER 2
                BF 1                SX(15)

                EF
                BF 5                SX(15)

                EF
                BF 9                SX(15)

                EF
```

```
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 22           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 28,27
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            N4          S DWN
            HN 6
                          PVAL 1
        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13           N8          S DWN
            HN 5
                          BA
            SH
            EA
        EF
        BF 17           N4          S DWN
            HN 7
                       EF
        BF 20           SX(15)

        EF
```

```
        BF 21       SX(15)

        EF
        LAYER 2
        BF 1        SX(15)

        EF
        BF 5        SX(15)

        EF
        BF 9        SX(15)

        EF
        BF 13       SX(15)

        EF
        BF 17       SX(15)

        EF
        BF 20       SX(15)

        EF
        BF 21       SX(15)

        EF
    BL SGL
EM
BM 29,28
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1        N4          S DWN
            HN 6
                      PVAL 1
        EF
        BF 5        SX(15)

        EF
        BF 9        SX(15)
```

```
        EF
        BF 13          N8          S DWN
            HN 5
                         BA
            SH
            EA
        EF
        BF 17          N4          S DWN
            HN 7
                    EF
        BF 20          SX(15)

        EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 13          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 20          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 30,29
```

```
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4                 LAYER 1
            BF 1                N4                  S DWN
                HN 6
                              EF
            BF 8                SX(15)

            EF
            BF 18               R4                  HN 1
            EF
            BF 16               SX(15)

            EF
            BF 19               R4                  HN 1
            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 17               SX(15)

            EF
        BL SGL
    EM
    BM 31,30
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4                 LAYER 1
            BF 18               SX(15)
```

```
        EF
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 19           RW          HN 6
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        LAYER 2
        BF 18           SX(15)

        EF
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
    BL SGL
EM
BM 32,31
    NP 0,0,0
    CLEF CC NRM
    KS LAM
```

```
        TEM 3/4              LAYER 1
            BF 18                R4                  HN 1
            EF
            BF 8                SX(15)

            EF
            BF 19                R4                  HN 1
            EF
            BF 16                SX(15)

            EF
            BF 17                N4                  S DWN
                HN 8
                                  BA
                NAT
                EA
                TDIN(TDFP,DWN)
            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16                SX(15)

            EF
            BF 17                SX(15)

            EF
        BL SGL
    EM
    BM 33,32
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4              LAYER 1
```

```
BF 26         SX(15)

EF
BF 1          N2          S DWN
    HN 8
              BA
    SH
    EA
    PVAL 1
EF
BF 8          SX(15)

EF
BF 9          SX(15)

EF
BF 16         SX(15)

EF
BF 17         SX(15)

EF
BF 25         SX(15)

EF
LAYER 2
BF 26         SX(15)

EF
BF 1          SX(15)

EF
BF 8          SX(15)

EF
BF 9          SX(15)

EF
BF 16         SX(15)

EF
```

```
            BF 17            SX(15)

            EF
            BF 25            SX(15)

            EF
        BL SGL
    EM
    BM 34,33
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1            N4            S DWN
                HN 8
                         EF
            BF 8            SX(15)

            EF
            BF 9            N4            S DWN
                HN 8
                         EF
            BF 16            SX(15)

            EF
            BF 17            N4            S DWN
                HN 8
                         EF
            BF 18            SX(15)

            EF
            LAYER 2
            BF 1            SX(15)

            EF
            BF 8            SX(15)

            EF
            BF 9            SX(15)

            EF
```

```
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 18           SX(15)

        EF
    BL SGL
EM
BM 35,34
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            N4              S DWN
            HN 8
                        EF
        BF 5            SX(15)

        EF
        BF 9            N4              S DWN
            HN 8
                        EF
        BF 16           SX(15)

        EF
        BF 17           N4              S DWN
            HN 8
                        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
```

```
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 36,35
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            N4              S DWN
            HN 8
                        EF
        BF 5            SX(15)

        EF
        BF 9            N4              S DWN
            HN 8
                        EF
        BF 13           SX(15)

        EF
        BF 17           N4              S DWN
            HN 8
                        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
```

```
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 37,36
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4            LAYER 1
        BF 1            N4            S DWN
            HN 8
                        EF
        BF 8            SX(15)

        EF
        BF 26            R4            HN 1
        EF
        BF 25            SX(15)

        EF
        BF 27            R4            HN 1
        EF
        BF 21            SX(15)

        EF
        LAYER 2
        BF 1            SX(15)
```

```
            EF
            BF 8                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 25                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 38,37
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4                LAYER 1
            BF 1                R4                HN 1
            EF
            BF 5                SX(15)

            EF
            BF 23                N4                S DWN
                HN 4
                                 TDIN(TDP,DWN)
            EF
            BF 10                SX(15)

            EF
            BF 22                N4                S DWN
                HN 4
                            EF
            BF 21                SX(15)

            EF
```

```
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 10           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 39,38
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            R4              HN 1
        EF
        BF 5            SX(15)

        EF
        BF 9            N4              S UP
            HN 3
                    EF
        BF 16           SX(15)

        EF
        BF 17           N4              S UP
            HN 3
                    EF
        BF 21           SX(15)
```

```
        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 40,39
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1          R4          HN 1
        EF
        BF 5          SX(15)

        EF
        BF 9          N4          S UP
            HN 3
                    EF
        BF 13          SX(15)

        EF
        BF 17          N4          S UP
            HN 3
```

```
                        EF
            BF 21            SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 41,40
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 22            SX(15)

            EF
            BF 1             R4            HN 1
            EF
            BF 8             SX(15)

            EF
            BF 9             N4            S UP
                HN 2
                        EF
```

```
            BF 16           SX(15)

            EF
            BF 17           N4            S UP
                HN 2
                        EF
            BF 21           SX(15)

            EF
            LAYER 2
            BF 22           SX(15)

            EF
            BF 1            SX(15)

            EF
            BF 8            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 42,41
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1            R4            HN 1
            EF
            BF 5            SX(15)
```

```
        EF
        BF 26          N4           S DWN
            HN 4
                    EF
        BF 16          SX(15)

        EF
        BF 27          N4           S DWN
            HN 4
                    EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 43,42
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1           N4           S UP
```

```
        HN 3
                        EF
BF 5                SX(15)

EF
BF 9                R4                HN 1
EF
BF 16               SX(15)

EF
BF 17               N4                S DWN
        HN 6
                        EF
BF 20               SX(15)

EF
BF 21               SX(15)

EF
LAYER 2
BF 1                SX(15)

EF
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 16               SX(15)

EF
BF 17               SX(15)

EF
BF 20               SX(15)

EF
BF 21               SX(15)

EF
```

```
        BL SGL
EM
BM 44,43
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4                LAYER 1
                BF 1                N4                S DWN
                        HN 5
                                EF
                BF 5                SX(15)

                EF
                BF 9                N4                S DWN
                        HN 5
                                EF
                BF 13                SX(15)

                EF
                BF 17                N4                S DWN
                        HN 6
                                EF
                BF 20                SX(15)

                EF
                BF 21                SX(15)

                EF
                LAYER 2
                BF 1                SX(15)

                EF
                BF 5                SX(15)

                EF
                BF 9                SX(15)

                EF
                BF 13                SX(15)

                EF
```

```
            BF 17            SX(15)

            EF
            BF 20            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 45,44
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1             N2            S DWN
                HN 5
                        EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 16            SX(15)

            EF
            BF 17            R4            HN 1
            EF
            BF 20            SX(15)

            EF
            BF 23            SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 5             SX(15)
```

```
            EF
            BF 9            SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 20           SX(15)

            EF
            BF 23           SX(15)

            EF
        BL SGL
    EM
    BM 46,45
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1            SX(15)

            EF
            BF 4            SX(15)

            EF
            BF 25           RW              HN 6
            EF
            BF 12           SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 20           SX(15)

            EF
```

```
        LAYER 2
        BF 1          SX(15)

        EF
        BF 4          SX(15)

        EF
        BF 8          SX(15)

        EF
        BF 12          SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 20          SX(15)

        EF
    BL SGL
EM
BM 47,46
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1          N4          S DWN
            HN 7
                        TDIN(TDRF,DWN)
        EF
        BF 5          SX(15)

        EF
        BF 9          N4          S DWN
            HN 8
                        BA
            NAT
            EA
        EF
        BF 16          SX(15)
```

```
            EF
            BF 17            R4            HN 1
            EF
            BF 21            SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 16            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 48,47
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 25            RW            HN 6
            EF
            BF 13            SX(15)
```

```
        EF
        BF 17              SX(15)

        EF
        BF 21              SX(15)

        EF
        LAYER 2
        BF 1               SX(15)

        EF
        BF 5               SX(15)

        EF
        BF 9               SX(15)

        EF
        BF 13              SX(15)

        EF
        BF 17              SX(15)

        EF
        BF 21              SX(15)

        EF
    BL SGL
EM
BM 49,48
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4            LAYER 1
        BF 36              N2              S UP
            HN 9
            SN TR           EF
        BF 29              N4              S DWN
            HN 8
                             BA
            NAT
```

```
            EA
            TDIN(TDRF,DWN)
        EF
        BF 5                SX(15)

        EF
        BF 30               N4              S DWN
            HN 7
                    EF
        BF 18               SX(15)

        EF
        BF 21               R4              HN 1
        EF
        BF 25               SX(15)

        EF
        LAYER 2
        BF 31               SX(15)

        EF
        BF 25               SX(15)

        EF
        BF 5                SX(15)

        EF
        BF 9                SX(15)

        EF
        BF 16               SX(15)

        EF
        BF 17               SX(15)

        EF
        BF 21               SX(15)

        EF
    BL SGL
EM
```

```
BM 50,49
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1             SX(15)

        EF
        BF 5             SX(15)

        EF
        BF 9             SX(15)

        EF
        BF 13            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
        LAYER 2
        BF 1             SX(15)

        EF
        BF 5             SX(15)

        EF
        BF 26            RW              HN 6
        EF
        BF 13            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
```

```
        BL SGL
    EM
    BM 51,50
        NP 0,0,0
        CLEF CC NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1            N2          S UP
                HN 3
                            PVAL 1
                TDIN(TDP,DWN)
            EF
            BF 4            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 13           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
            LAYER 2
            BF 1            SX(15)

            EF
            BF 4            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)
```

```
        EF
        BF 13                SX(15)

        EF
        BF 17                SX(15)

        EF
        BF 21                SX(15)

        EF
    BL SGL
EM
BM 52,51
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1                N4               S UP
            HN 4
                    EF
        BF 5                SX(15)

        EF
        BF 9                N4               S UP
            HN 2
                    EF
        BF 13                SX(15)

        EF
        BF 17                N4               S UP
            HN -1
                    EF
        BF 21                SX(15)

        EF
        LAYER 2
        BF 1                SX(15)

        EF
        BF 5                SX(15)
```

```
        EF
        BF 9          SX(15)

        EF
        BF 13          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
BM 53,52
    NP 0,0,0
    CLEF CC NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1          N4            S UP
            HN -1
                    EF
        BF 8          SX(15)

        EF
        BF 26          R4            HN 1
        EF
        BF 25          SX(15)

        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 8          SX(15)

        EF
        BF 9          SX(15)
```

```
        EF
        BF 25            SX(15)

        EF
    BL FNLR
EM
BI 1
    TIE,UP
        ST(32,1,1,0,0)
        END(33,1,1,0,0)
EI
BI 9
    SLR,UP
        ST(7,1,17,0,0)
        END(9,1,1,0,0)
EI
BI 12
    SLR,DWN
        ST(12,1,1,0,0)
        END(13,1,1,0,0)
EI
BI 13
    SLR,DWN
        ST(22,1,1,0,0)
        END(23,1,1,0,0)
EI
BI 14
    SLR,DWN
        ST(23,1,1,0,0)
        END(24,1,1,0,0)
EI
BI 15
    SLR,UP
        ST(25,1,1,0,0)
        END(25,1,17,0,0)
EI
BI 16
    SLR,UP
        ST(26,1,1,0,0)
        END(26,1,17,0,0)
EI
```

```
BI 17
	SLR,UP
		ST(27,1,1,0,0)
		END(27,1,17,0,0)
EI
BI 18
	SLR,UP
		ST(28,1,1,0,0)
		END(28,1,17,0,0)
EI
BI 19
	SLR,UP
		ST(31,1,17,0,0)
		END(32,1,1,0,0)
EI
BI 20
	SLR,UP
		ST(41,1,27,0,0)
		END(42,1,1,0,0)
EI
BI 21
	SLR,UP
		ST(42,1,17,0,0)
		END(43,1,1,0,0)
EI
BI 22
	SLR,UP
		ST(43,1,9,0,0)
		END(43,1,17,0,0)
EI
BI 23
	SLR,UP
		ST(46,1,1,0,0)
		END(46,1,9,0,0)
EI
BI 24
	SLR,DWN
		ST(48,1,29,0,0)
		END(48,1,30,0,0)
EI
BI 25
```

```
    SLR,DWN
        ST(51,1,1,0,0)
        END(51,1,17,0,0)
EI
EPR
```

```
BPR
LVL 1 REL 2
"violoncello"
BM 1,1
	NP 0,0,0
	CLEF BAS NRM
	KS LAM
	TEM 3/4		MOV("",N4,FL,96)
		LAYER 1
		BF 17		R4		HN 1
		EF
		BF 20		SX(15)

		EF
		BF 21		SX(15)

		EF
		LAYER 2
		BF 17		SX(15)

		EF
		BF 20		SX(15)

		EF
		BF 21		SX(15)

		EF
	BL SGL
EM
BM 2,2
	NP 0,0,0
	CLEF BAS NRM
	KS LAM
	TEM 3/4			LAYER 1
		BF 1		N4		S DWN
			HN 8
					TDIN(TDP,DWN)
		EF
		BF 5		SX(15)

		EF
```

```
        BF 22        R4        HN 1
        EF
        BF 16        SX(15)

        EF
        BF 23        R4        HN 1
        EF
        BF 21        SX(15)

        EF
        LAYER 2
        BF 1        SX(15)

        EF
        BF 5        SX(15)

        EF
        BF 9        SX(15)

        EF
        BF 16        SX(15)

        EF
        BF 17        SX(15)

        EF
        BF 21        SX(15)

        EF
    BL SGL
EM
BM 3,3
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4        LAYER 1
        BF 22        N4        S DWN
            HN 4
                    EF
        BF 5        SX(15)
```

```
          EF
          BF 23              R4                 HN 1
          EF
          BF 16              SX(15)

          EF
          BF 24              R4                 HN 1
          EF
          BF 21              SX(15)

          EF
          LAYER 2
          BF 1               SX(15)

          EF
          BF 5               SX(15)

          EF
          BF 9               SX(15)

          EF
          BF 16              SX(15)

          EF
          BF 17              SX(15)

          EF
          BF 21              SX(15)

          EF
     BL SGL
EM
BM 4,4
     NP 0,0,0
     CLEF BAS NRM
     KS LAM
     TEM 3/4            LAYER 1
          BF 1               N4                 S DWN
               HN 5
                            EF
          BF 5               SX(15)
```

```
        EF
        BF 22       R4      HN 1
        EF
        BF 13       SX(15)

        EF
        BF 23       R4      HN 1
        EF
        BF 21       SX(15)

        EF
        LAYER 2
        BF 1        SX(15)

        EF
        BF 5        SX(15)

        EF
        BF 9        SX(15)

        EF
        BF 13       SX(15)

        EF
        BF 17       SX(15)

        EF
        BF 21       SX(15)

        EF
    BL SGL
EM
BM 5,5
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 24       SX(15)

        EF
```

```
        BF 1          N4          S DWN
          HN 6
                    EF
        BF 8          SX(15)

        EF
        BF 22          R4          HN 1
        EF
        BF 16          SX(15)

        EF
        BF 23          R4          HN 1
        EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 22          SX(15)

        EF
        BF 1          SX(15)

        EF
        BF 8          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
      BL SGL
    EM
    BM 6,6
```

```
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 24          N4           S UP
            HN 3
                     EF
        BF 5          SX(15)

        EF
        BF 22          R4           HN 1
        EF
        BF 16          SX(15)

        EF
        BF 23          R4           HN 1
        EF
        BF 21          SX(15)

        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 16          SX(15)

        EF
        BF 17          SX(15)

        EF
        BF 21          SX(15)

        EF
    BL SGL
EM
```

```
BM 7,7
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 22         N4           S DWN
            HN 4
                EF
        BF 5          SX(15)

        EF
        BF 23         R4           HN 1
        EF
        BF 16         SX(15)

        EF
        BF 24         R4           HN 1
        EF
        BF 20         SX(15)

        EF
        BF 21         SX(15)

        EF
        LAYER 2
        BF 1          SX(15)

        EF
        BF 5          SX(15)

        EF
        BF 9          SX(15)

        EF
        BF 16         SX(15)

        EF
        BF 17         SX(15)

        EF
        BF 20         SX(15)
```

```
        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 8,8
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 27           RW            HN 6
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)
```

```
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 9,9
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 29           RW          HN 6
        EF
        BF 25           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 18           SX(15)

        EF
        BF 19           SX(15)

        EF
        LAYER 2
```

```
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 18                SX(15)

            EF
            BF 19                SX(15)

            EF
        BL SGL
    EM
    BM 10,10
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                SX(15)

            EF
            BF 4                SX(15)

            EF
            BF 30                RW                  HN 6
            EF
            BF 25                SX(15)

            EF
            BF 16                SX(15)
```

```
        EF
        BF 20           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 4            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 12           SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 20           SX(15)

        EF
    BL SGL
EM
BM 11,11
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 29           RW              HN 6
        EF
        BF 13           SX(15)

        EF
```

```
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 5             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 12,12
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 25            N4              S UP
                HN -2
                                BE
                EX(STA,DWN)
                EE
            EF
            BF 5             SX(15)

            EF
```

```
        BF 26           N4              S UP
            HN -2
                        BE
            EX(STA,DWN)
            EE
        EF
        BF 13           SX(15)

        EF
        BF 28           N4              S UP
            HN -2
                        BE
            EX(STA,DWN)
            EE
        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 13,13
    NP 0,0,0
```

```
        CLEF BAS NRM
        KS LAM
        TEM 3/4           LAYER 1
            BF 27             N4              S UP
                HN 1
                        EF
            BF 8             SX(15)

            EF
            BF 25             R4              HN 1
            EF
            BF 16             SX(15)

            EF
            LAYER 2
            BF 1             SX(15)

            EF
            BF 8             SX(15)

            EF
            BF 9             SX(15)

            EF
            BF 16             SX(15)

            EF
        BL STF
    EM
    BM 14,124
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4           LAYER 1
            BF 17             R4              HN 1
            EF
            BF 21             SX(15)

            EF
            LAYER 2
            BF 17             SX(15)
```

```
            EF
            BF 21                SX(15)

            EF
        BL SGL
    EM
    BM 15,14
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4              LAYER 1
            BF 1                 N4                     S DWN
                HN 5
                                   BS
                PIZ,UP
                ES
                TDIN(TDP,DWN)
            EF
            BF 5                 SX(15)

            EF
            BF 9                 N4                     S DWN
                HN 5
                              EF
            BF 10                SX(15)

            EF
            BF 17                R4                     HN 1
            EF
            BF 21                SX(15)

            EF
            LAYER 2
            BF 1                 SX(15)

            EF
            BF 5                 SX(15)

            EF
            BF 9                 SX(15)
```

```
        EF
        BF 10            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 16,15
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 1            N4            S DWN
            HN 5
                    EF
        BF 5            SX(15)

        EF
        BF 9            N4            S DWN
            HN 5
                    EF
        BF 16            SX(15)

        EF
        BF 17            R4            HN 1
        EF
        BF 21            SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)
```

```
            EF
            BF 9            SX(15)

            EF
            BF 16           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 17,16
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1            N4              S DWN
                HN 5
                        EF
            BF 5            SX(15)

            EF
            BF 9            N4              S DWN
                HN 5
                        EF
            BF 13           SX(15)

            EF
            BF 17           N4              S DWN
                HN 5
                        EF
            BF 21           SX(15)

            EF
            LAYER 2
            BF 1            SX(15)
```

```
            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 18,17
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1            N4            S DWN
                HN 5
                        EF
            BF 5            SX(15)

            EF
            BF 22            N4            S UP
                HN -2
                        EF
            BF 16            SX(15)

            EF
            BF 23            R4            HN 1
            EF
            BF 21            SX(15)

            EF
            LAYER 2
```

```
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 19,18
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4           LAYER 1
        BF 1            N4            S DWN
            HN 5
                      EF
        BF 5            SX(15)

        EF
        BF 9            N4            S DWN
            HN 5
                      EF
        BF 16            SX(15)

        EF
        BF 17            R4            HN 1
        EF
        BF 21            SX(15)
```

```
            EF
            LAYER 2
            BF 1              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 16              SX(15)

            EF
            BF 17              SX(15)

            EF
            BF 21              SX(15)

            EF
        BL SGL
    EM
    BM 20,19
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1              N4              S DWN
                HN 5
                            EF
            BF 5              SX(15)

            EF
            BF 9              N4              S DWN
                HN 5
                            EF
            BF 16              SX(15)

            EF
            BF 17              R4              HN 1
            EF
```

```
            BF 21          SX(15)

            EF
            LAYER 2
            BF 1           SX(15)

            EF
            BF 5           SX(15)

            EF
            BF 9           SX(15)

            EF
            BF 16          SX(15)

            EF
            BF 17          SX(15)

            EF
            BF 21          SX(15)

            EF
        BL SGL
    EM
    BM 21,20
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4        LAYER 1
            BF 1           N4            S DWN
                HN 5
                           EF
            BF 5           SX(15)

            EF
            BF 9           N4            S DWN
                HN 5
                           EF
            BF 13          SX(15)

            EF
```

```
            BF 22           SX(15)

            EF
            BF 17           N4             S DWN
                HN 5
                        EF
            BF 21           SX(15)

            EF
            LAYER 2
            BF 1           SX(15)

            EF
            BF 5           SX(15)

            EF
            BF 9           SX(15)

            EF
            BF 13           SX(15)

            EF
            BF 22           SX(15)

            EF
            BF 17           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 22,21
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4          LAYER 1
            BF 1           N4             S DWN
                HN 5
                        EF
```

```
        BF 5         SX(15)

        EF
        BF 25         R4          HN 1
        EF
        BF 16         SX(15)

        EF
        BF 26         R4          HN 1
        EF
        BF 21         SX(15)

        EF
        LAYER 2
        BF 1         SX(15)

        EF
        BF 5         SX(15)

        EF
        BF 9         SX(15)

        EF
        BF 16         SX(15)

        EF
        BF 17         SX(15)

        EF
        BF 21         SX(15)

        EF
    BL SGL
EM
BM 23,22
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 26         SX(15)
```

```
EF
BF 25                   N2                          S UP
        HN -2
                           BS
        ARC(UP,TR)
        ES
        PVAL 1
EF
BF 5                   SX(15)

EF
BF 9                   SX(15)

EF
BF 16                   SX(15)

EF
BF 17                   SX(15)

EF
BF 21                   SX(15)

EF
LAYER 2
BF 25                   SX(15)

EF
BF 1                   SX(15)

EF
BF 5                   SX(15)

EF
BF 9                   SX(15)

EF
BF 16                   SX(15)

EF
BF 17                   SX(15)
```

```
                EF
                BF 21                   SX(15)

                EF
        BL SGL
EM
BM 24,23
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4                LAYER 1
                BF 25                   N2                      S UP
                        HN -2
                                        PVAL 1
                EF
                BF 5                    SX(15)

                EF
                BF 9                    SX(15)

                EF
                BF 10                   SX(15)

                EF
                BF 17                   SX(15)

                EF
                BF 21                   SX(15)

                EF
                LAYER 2
                BF 1                    SX(15)

                EF
                BF 5                    SX(15)

                EF
                BF 9                    SX(15)

                EF
                BF 10                   SX(15)
```

```
        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 25,24
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 31           SX(15)

        EF
        BF 25           N2            S UP
            HN -2
                         PVAL 1
        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 22           SX(15)

        EF
```

```
        BF 1                SX(15)

        EF
        BF 5                SX(15)

        EF
        BF 9                SX(15)

        EF
        BF 16                SX(15)

        EF
        BF 17                SX(15)

        EF
        BF 21                SX(15)

        EF
    BL SGL
EM
BM 26,25
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4             LAYER 1
        BF 22                N4                S UP
            HN -2
                        EF
        BF 5                SX(15)

        EF
        BF 24                R4                HN 1
        EF
        BF 13                SX(15)

        EF
        BF 23                N4                S UP
            HN 2
                        EF
        BF 28                SX(15)
```

```
        EF
        BF 21             SX(15)

        EF
        LAYER 2
        BF 1              SX(15)

        EF
        BF 5              SX(15)

        EF
        BF 9              SX(15)

        EF
        BF 13             SX(15)

        EF
        BF 17             SX(15)

        EF
        BF 22             SX(15)

        EF
        BF 21             SX(15)

        EF
    BL SGL
EM
BM 27,26
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4           LAYER 1
        BF 1              N4              S DWN
            HN 5
                     EF
        BF 5              SX(15)

        EF
        BF 22             R4              HN 1
        EF
```

```
        BF 13           SX(15)

        EF
        BF 23           N4            S UP
            HN 2
                      EF
        BF 26           SX(15)

        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 22           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 28,27
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4           LAYER 1
```

```
BF 1                N4                  S DWN
      HN 5
                  EF
BF 5                SX(15)

EF
BF 9                R4                  HN 1
EF
BF 13                SX(15)

EF
BF 17                N4                  S DWN
      HN 9
                  EF
BF 20                SX(15)

EF
BF 21                SX(15)

EF
LAYER 2
BF 1                SX(15)

EF
BF 5                SX(15)

EF
BF 9                SX(15)

EF
BF 13                SX(15)

EF
BF 17                SX(15)

EF
BF 20                SX(15)

EF
BF 21                SX(15)
```

```
        EF
    BL SGL
EM
BM 29,28
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4            LAYER 1
        BF 1             N4            S DWN
            HN 5
                       EF
        BF 5             SX(15)

        EF
        BF 9             R4            HN 1
        EF
        BF 13            SX(15)

        EF
        BF 17            N4            S DWN
            HN 9
                       EF
        BF 20            SX(15)

        EF
        BF 21            SX(15)

        EF
        LAYER 2
        BF 1             SX(15)

        EF
        BF 5             SX(15)

        EF
        BF 9             SX(15)

        EF
        BF 13            SX(15)

        EF
```

```
            BF 17           SX(15)

            EF
            BF 20           SX(15)

            EF
            BF 21           SX(15)

            EF
        BL SGL
    EM
    BM 30,29
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1            N4          S DWN
                HN 5
                        EF
            BF 8            SX(15)

            EF
            BF 18           R4          HN 1
            EF
            BF 16           SX(15)

            EF
            BF 19           R4          HN 1
            EF
            LAYER 2
            BF 1            SX(15)

            EF
            BF 8            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 16           SX(15)
```

```
        EF
        BF 17           SX(15)

        EF
    BL SGL
EM
BM 31,30
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
        BF 18           SX(15)

        EF
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 19           RW              HN 6
        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        LAYER 2
        BF 18           SX(15)

        EF
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
```

```
            BF 16              SX(15)

            EF
            BF 17              SX(15)

            EF
        BL SGL
    EM
    BM 32,31
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4            LAYER 1
            BF 1               SX(15)

            EF
            BF 8               SX(15)

            EF
            BF 18              RW                 HN 6
            EF
            BF 16              SX(15)

            EF
            BF 17              SX(15)

            EF
            LAYER 2
            BF 1               SX(15)

            EF
            BF 8               SX(15)

            EF
            BF 9               SX(15)

            EF
            BF 16              SX(15)

            EF
            BF 17              SX(15)
```

```
            EF
        BL SGL
    EM
    BM 33,32
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4                LAYER 1
            BF 32                SX(15)

            EF
            BF 26                R4                HN 1
            EF
            BF 8                SX(15)

            EF
            BF 27                R4                HN 1
            EF
            BF 16                SX(15)

            EF
                BB 31
                NB 29
                N8                S UP
                HN -2
                            TDIN(TDP,DWN)
                NB 30
                N8                S UP
                HN 0
                            EB
            LAYER 2
            BF 26                SX(15)

            EF
            BF 1                SX(15)

            EF
            BF 8                SX(15)

            EF
```

```
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 25           SX(15)

        EF
    BL SGL
EM
BM 34,33
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
            BB 33
            NB 26
            N8              S UP
            HN 2
                        NB 27
            N8              S UP
            HN 0
                        EB
        BF 30           N4              S DWN
            HN 5
                    EF
        BF 16           SX(15)

        EF
            BB 34
            NB 28
            N8              S UP
            HN 2
                        NB 29
            N8              S UP
            HN 5
                        EB
```

```
        LAYER 2
        BF 1            SX(15)

        EF
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 18           SX(15)

        EF
    BL SGL
EM
BM 35,34
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4         LAYER 1
            BB 25
            NB 1
            N8              S DWN
            HN 7
                        NB 5
            N8              S DWN
            HN 5
                        EB
        BF 9            N4              S DWN
            HN 9
                    EF
        BF 16           SX(15)

        EF
            BB 26
```

```
            NB 17
            N8                S DWN
            HN 7
                            NB 21
            N8                S DWN
            HN 9
                            EB
        LAYER 2
        BF 1                SX(15)

        EF
        BF 5                SX(15)

        EF
        BF 9                SX(15)

        EF
        BF 16               SX(15)

        EF
        BF 17               SX(15)

        EF
        BF 21               SX(15)

        EF
    BL SGL
EM
BM 36,35
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4              LAYER 1
            BB 29
            NB 1
            N8                S DWN
            HN 12
                            NB 5
            N8                S DWN
            HN 9
                            NB 9
```

```
                  N8                 S DWN
                  HN 12
                               NB 13
                  N8                 S DWN
                  HN 14
                               NB 17
                  N8                 S DWN
                  HN 16
                               NB 21
                  N8                 S DWN
                  HN 14
                               EB
              LAYER 2
              BF 1           SX(15)

              EF
              BF 5           SX(15)

              EF
              BF 9           SX(15)

              EF
              BF 13          SX(15)

              EF
              BF 17          SX(15)

              EF
              BF 21          SX(15)

              EF
          BL SGL
      EM
      BM 37,36
          NP 0,0,0
          CLEF BAS NRM
          KS LAM
          TEM 3/4          LAYER 1
              BF 1           N4            S DWN
                  HN 12
                         EF
```

```
            BF 8            SX(15)

            EF
            BF 26            R4            HN 1
            EF
            BF 25            SX(15)

            EF
            BF 27            R4            HN 1
            EF
            BF 21            SX(15)

            EF
            LAYER 2
            BF 1            SX(15)

            EF
            BF 8            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 25            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 38,37
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4            LAYER 1
            BF 1            N4            S DWN
                HN 8
```

```
                                TDIN(TDP,DWN)
                EF
                BF 5                SX(15)

                EF
                BF 25                R4                  HN 1
                EF
                BF 10                SX(15)

                EF
                BF 26                R4                  HN 1
                EF
                BF 21                SX(15)

                EF
                LAYER 2
                BF 1                SX(15)

                EF
                BF 5                SX(15)

                EF
                BF 9                SX(15)

                EF
                BF 10                SX(15)

                EF
                BF 17                SX(15)

                EF
                BF 21                SX(15)

                EF
        BL SGL
EM
BM 39,38
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4                LAYER 1
```

```
        BF 25           N4            S DWN
            HN 4
                    EF
        BF 5           SX(15)

        EF
        BF 26           R4            HN 1
        EF
        BF 16           SX(15)

        EF
        BF 27           R4            HN 1
        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1           SX(15)

        EF
        BF 5           SX(15)

        EF
        BF 9           SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 40,39
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
```

```
TEM 3/4             LAYER 1
      BF 1              N4              S DWN
            HN 5
                  EF
      BF 5              SX(15)

      EF
      BF 25             R4              HN 1
      EF
      BF 13             SX(15)

      EF
      BF 26             R4              HN 1
      EF
      BF 21             SX(15)

      EF
      LAYER 2
      BF 1              SX(15)

      EF
      BF 5              SX(15)

      EF
      BF 9              SX(15)

      EF
      BF 13             SX(15)

      EF
      BF 17             SX(15)

      EF
      BF 21             SX(15)

      EF
BL SGL
EM
BM 41,40
      NP 0,0,0
      CLEF BAS NRM
```

```
KS LAM
TEM 3/4                LAYER 1
    BF 29                SX(15)

    EF
    BF 1                 N4                   S DWN
        HN 6
                        EF
    BF 8                 SX(15)

    EF
    BF 25                R4                   HN 1
    EF
    BF 16                SX(15)

    EF
    BF 26                R4                   HN 1
    EF
    BF 21                SX(15)

    EF
    LAYER 2
    BF 22                SX(15)

    EF
    BF 1                 SX(15)

    EF
    BF 8                 SX(15)

    EF
    BF 9                 SX(15)

    EF
    BF 16                SX(15)

    EF
    BF 17                SX(15)

    EF
    BF 21                SX(15)
```

```
            EF
        BL SGL
    EM
    BM 42,41
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4                LAYER 1
            BF 25              N4               S UP
                HN 3
                        EF
            BF 5              SX(15)

            EF
            BF 26              R4               HN 1
            EF
            BF 16              SX(15)

            EF
            BF 27              R4               HN 1
            EF
            BF 21              SX(15)

            EF
            LAYER 2
            BF 1              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 16              SX(15)

            EF
            BF 17              SX(15)

            EF
```

```
            BF 21                   SX(15)

            EF
        BL SGL
EM
BM 43,42
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4                LAYER 1
            BF 25               N4                    S DWN
                HN 4
                        EF
            BF 5                SX(15)

            EF
            BF 26               R4                    HN 1
            EF
            BF 16               SX(15)

            EF
            BF 27               R4                    HN 1
            EF
            BF 20               SX(15)

            EF
            BF 21               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 16               SX(15)
```

```
        EF
        BF 17           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 21           SX(15)

        EF
    BL SGL
EM
BM 44,43
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 25           RW              HN 6
        EF
        BF 13           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 21           SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
```

```
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 20            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 45,44
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4         LAYER 1
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 26            RW            HN 6
            EF
            BF 16            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 20            SX(15)
```

```
            EF
            BF 23                SX(15)

            EF
            LAYER 2
            BF 1                 SX(15)

            EF
            BF 5                 SX(15)

            EF
            BF 9                 SX(15)

            EF
            BF 16                SX(15)

            EF
            BF 17                SX(15)

            EF
            BF 20                SX(15)

            EF
            BF 23                SX(15)

            EF
        BL SGL
    EM
    BM 46,45
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4              LAYER 1
            BF 1                 SX(15)

            EF
            BF 4                 SX(15)

            EF
            BF 25                RW                  HN 6
            EF
```

```
            BF 12               SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 20               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 4                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 12               SX(15)

            EF
            BF 16               SX(15)

            EF
            BF 20               SX(15)

            EF
        BL SGL
    EM
    BM 47,46
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                N4              S DWN
                HN 11
                                TDIN(TDRF,DWN)
            EF
            BF 5                SX(15)
```

```
                EF
                BF 9                    N4                          S DWN
                        HN 12
                                        EF
                BF 16                    SX(15)

                EF
                BF 17                    R4                          HN 1
                EF
                BF 21                    SX(15)

                EF
                LAYER 2
                BF 1                    SX(15)

                EF
                BF 5                    SX(15)

                EF
                BF 9                    SX(15)

                EF
                BF 16                    SX(15)

                EF
                BF 17                    SX(15)

                EF
                BF 21                    SX(15)

                EF
        BL SGL
EM
BM 48,47
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4                 LAYER 1
                BF 1                    SX(15)

                EF
```

```
            BF 5            SX(15)

            EF
            BF 25            RW            HN 6
            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
            LAYER 2
            BF 1            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 9            SX(15)

            EF
            BF 13            SX(15)

            EF
            BF 17            SX(15)

            EF
            BF 21            SX(15)

            EF
        BL SGL
    EM
    BM 49,48
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4            LAYER 1
            BF 22            SX(15)
```

```
EF
BF 1            N4            S DWN
    HN 12
                TDIN(TDRF,DWN)
EF
BF 5            SX(15)

EF
BF 9            N4            S DWN
    HN 13
              EF
BF 16           SX(15)

EF
BF 17           R4            HN 1
EF
BF 21           SX(15)

EF
LAYER 2
BF 22           SX(15)

EF
BF 1            SX(15)

EF
BF 5            SX(15)

EF
BF 9            SX(15)

EF
BF 16           SX(15)

EF
BF 17           SX(15)

EF
BF 21           SX(15)
```

```
            EF
        BL SGL
    EM
    BM 50,49
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 13               SX(15)

            EF
            BF 17               SX(15)

            EF
            BF 21               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 25               RW              HN 6
            EF
            BF 13               SX(15)

            EF
            BF 17               SX(15)

            EF
```

```
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 51,50
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 1                SX(15)

            EF
            BF 4                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 13               SX(15)

            EF
            BF 17               SX(15)

            EF
            BF 21               SX(15)

            EF
            LAYER 2
            BF 25               N2                  S DWN
                HN 4
                                    PVAL 1
                TDIN(TDP,DWN)
            EF
            BF 4                SX(15)

            EF
            BF 5                SX(15)
```

```
        EF
        BF 9            SX(15)

        EF
        BF 13            SX(15)

        EF
        BF 17            SX(15)

        EF
        BF 21            SX(15)

        EF
    BL SGL
EM
BM 52,51
    NP 0,0,0
    CLEF BAS NRM
    KS LAM
    TEM 3/4          LAYER 1
        BF 1            N4           S DWN
            HN 5
                      EF
        BF 5            SX(15)

        EF
        BF 9            N4           S DWN
            HN 5
                      EF
        BF 13            SX(15)

        EF
        BF 17            N4           S DWN
            HN 5
                      EF
        BF 21            SX(15)

        EF
        LAYER 2
        BF 1            SX(15)
```

```
            EF
            BF 5                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 13               SX(15)

            EF
            BF 17               SX(15)

            EF
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 53,52
        NP 0,0,0
        CLEF BAS NRM
        KS LAM
        TEM 3/4             LAYER 1
            BF 26               N4                  S UP
                HN 1
                                  TAGOG("Menuetto D.C. senza replica",DWN)
            EF
            BF 8                SX(15)

            EF
            BF 9                N4                  S DWN
                HN 8
                            EF
            BF 25               SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
```

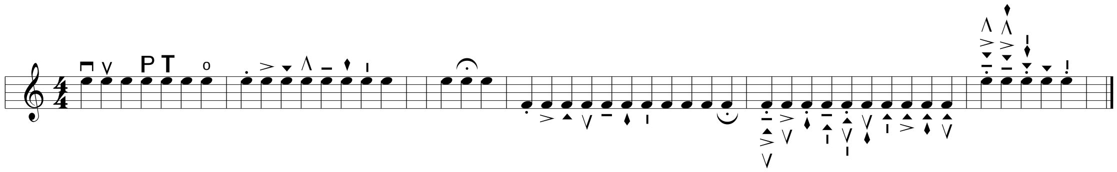
```
        BF 8            SX(15)

        EF
        BF 9            SX(15)

        EF
        BF 25           SX(15)

        EF
    BL FNLR
EM
BI 1
    SLR,DWN
        ST(12,1,25,0,0)
        END(12,1,28,0,0)
EI
BI 2
    SLR,DWN
        ST(22,1,25,0,0)
        END(23,1,25,0,0)
EI
BI 3
    SLR,DWN
        ST(23,1,25,0,0)
        END(24,1,25,0,0)
EI
BI 4
    SLR,DWN
        ST(24,1,25,0,0)
        END(25,1,22,0,0)
EI
BI 5
    SLR,UP
        ST(32,1,31,29,0)
        END(33,1,30,0,0)
EI
BI 6
    SLR,UP
        ST(33,1,34,28,0)
        END(34,1,9,0,0)
EI
```

```
BI 7
	SLR,UP
		ST(34,1,26,17,0)
		END(34,1,26,21,0)
EI
BI 8
	SLR,UP
		ST(35,1,29,1,0)
		END(35,1,29,21,0)
EI
BI 9
	SLR,UP
		ST(46,1,1,0,0)
		END(46,1,9,0,0)
EI
BI 10
	SLR,UP
		ST(48,1,1,0,0)
		END(48,1,9,0,0)
EI
EPR
```


P T

BP
FRM MOODS
LVL 1 REL 2
SCAL 10
DIMS 15
DIMF 15
TPMG 30.000000
LTMG 0.000000
BMG 0.000000
SRC 1.ex-accent.mds
EP

```
BPR
LVL 1 REL 2
""
BM 1,1
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4                 LAYER 1
                BF 7                N4                  S DWN
                        HN 7
                                        BS
                        ARC(DWN,FL)
                        BWDN,UP
                        ES
                EF
                BF 6                N4                  S DWN
                        HN 7
                                        BS
                        ARC(UP,FL)
                        BWUP,UP
                        ES
                EF
                BF 5                N4                  S DWN
                        HN 7
                                EF
                BF 4                N4                  S DWN
                        HN 7
                                        BS
                        ARC(DWN,FL)
                        PUN,UP
                        ES
                EF
                BF 3                N4                  S DWN
                        HN 7
                                        BS
                        ARC(DWN,FL)
                        TAL,UP
                        ES
                EF
                BF 2                N4                  S DWN
                        HN 7
```

```
                    EF
          BF 1               N4                  S DWN
                HN 7
                                 BS
                ARC(DWN,FL)
                STN(0,UP)
                ES
          EF
          LAYER 2
          BF 7               SX(15)

          EF
          BF 6               SX(15)

          EF
          BF 5               SX(15)

          EF
          BF 4               SX(15)

          EF
          BF 3               SX(15)

          EF
          BF 2               SX(15)

          EF
          BF 1               SX(15)

          EF
     BL SGL
EM
BM 2,5
     NP 0,0,0
     CLEF TRB NRM
     KS DOM
     TEM 4/4            LAYER 1
          BF 8               N4                  S DWN
                HN 7
                                 BE
                EX(STA,UP)
```

```
        EE
    EF
    BF 7              N4              S DWN
        HN 7
                      BE
        EX(AC,UP)
        EE
    EF
    BF 6              N4              S DWN
        HN 7
                      BE
        EX(MAR,UP)
        EE
    EF
    BF 5              N4              S DWN
        HN 7
                      BE
        EX(SFO,UP)
        EE
    EF
    BF 4              N4              S DWN
        HN 7
                      BE
        EX(TEN,UP)
        EE
    EF
    BF 3              N4              S DWN
        HN 7
                      BE
        EX(MD,UP)
        EE
    EF
    BF 2              N4              S DWN
        HN 7
                      BE
        EX(PALL,UP)
        EE
    EF
    BF 1              N4              S DWN
        HN 7
                  EF
```

```
          LAYER 2
          BF 8            SX(15)

          EF
          BF 7            SX(15)

          EF
          BF 6            SX(15)

          EF
          BF 5            SX(15)

          EF
          BF 4            SX(15)

          EF
          BF 3            SX(15)

          EF
          BF 2            SX(15)

          EF
          BF 1            SX(15)

          EF
     BL SGL
EM
BM 3,4
     NP 0,0,0
     CLEF TRB NRM
     KS DOM
     TEM 4/4           LAYER 1
          LAYER 2
     BL SGL
EM
BM 4,3
     NP 0,0,0
     CLEF TRB NRM
     KS DOM
     TEM 4/4           LAYER 1
          BF 7            N4              S DWN
```

```
            HN 7
                        MUT(MIN,UP)
        EF
        BF 6            N4            S DWN
            HN 7
                        FER UP
        EF
        BF 5            N4            S DWN
            HN 7
                    EF
        LAYER 2
        BF 7            SX(15)

        EF
        BF 6            SX(15)

        EF
        BF 5            SX(15)

        EF
    BL SGL
EM
BM 5,17
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 4/4         LAYER 1
        BF 11           N4            S UP
            HN 1
                        BE
            EX(STA,DWN)
            EE
        EF
        BF 10           N4            S UP
            HN 1
                        BE
            EX(AC,DWN)
            EE
        EF
        BF 9            N4            S UP
            HN 1
```

```
                    BE
        EX(MAR,DWN)
        EE
EF
BF 8            N4              S UP
        HN 1
                    BE
        EX(SFO,DWN)
        EE
EF
BF 7            N4              S UP
        HN 1
                    BE
        EX(TEN,DWN)
        EE
EF
BF 6            N4              S UP
        HN 1
                    BE
        EX(MD,DWN)
        EE
EF
BF 5            N4              S UP
        HN 1
                    BE
        EX(PALL,DWN)
        EE
EF
BF 4            N4              S UP
        HN 1
                    MUT(ON,DWN)
EF
BF 3            N4              S UP
        HN 1
                    MUT(OFF,DWN)
EF
BF 2            N4              S UP
        HN 1
                EF
BF 1            N4              S UP
        HN 1
```

```
                                FER DWN
            EF
            LAYER 2
            BF 11             SX(15)

            EF
            BF 10             SX(15)

            EF
            BF 9              SX(15)

            EF
            BF 8              SX(15)

            EF
            BF 7              SX(15)

            EF
            BF 6              SX(15)

            EF
            BF 5              SX(15)

            EF
            BF 4              SX(15)

            EF
            BF 3              SX(15)

            EF
            BF 2              SX(15)

            EF
            BF 1              SX(15)

            EF
        BL SGL
    EM
    BM 6,16
        NP 0,0,0
        CLEF TRB NRM
```

```
KS DOM
TEM 4/4            LAYER 1
     BF 10            N4              S UP
          HN 1
                        BE
          EX(STA,DWN)
          EX(TEN,DWN)
          EX(MAR,DWN)
          EX(AC,DWN)
          EX(SFO,DWN)
          EE
     EF
     BF 9            N4              S UP
          HN 1
                        BE
          EX(AC,DWN)
          EX(SFO,DWN)
          EE
     EF
     BF 8            N4              S UP
          HN 1
                        BE
          EX(STA,DWN)
          EX(MD,DWN)
          EE
     EF
     BF 7            N4              S UP
          HN 1
                        BE
          EX(TEN,DWN)
          EX(MAR,DWN)
          EX(PALL,DWN)
          EE
     EF
     BF 6            N4              S UP
          HN 1
                        BE
          EX(STA,DWN)
          EX(MAR,DWN)
          EX(SFO,DWN)
          EX(PALL,DWN)
```

```
    EE
EF
BF 5            N4            S UP
    HN 1
                BE
    EX(SFO,DWN)
    EX(MD,DWN)
    EE
EF
BF 4            N4            S UP
    HN 1
                BE
    EX(MAR,DWN)
    EX(PALL,DWN)
    EE
EF
BF 3            N4            S UP
    HN 1
                BE
    EX(MAR,DWN)
    EX(AC,DWN)
    EE
EF
BF 2            N4            S UP
    HN 1
                BE
    EX(MAR,DWN)
    EX(MD,DWN)
    EE
EF
BF 1            N4            S UP
    HN 1
                BE
    EX(MAR,DWN)
    EX(SFO,DWN)
    EE
EF
LAYER 2
BF 10           SX(15)

EF
```

```
            BF 9            SX(15)

            EF
            BF 8            SX(15)

            EF
            BF 7            SX(15)

            EF
            BF 6            SX(15)

            EF
            BF 5            SX(15)

            EF
            BF 4            SX(15)

            EF
            BF 3            SX(15)

            EF
            BF 2            SX(15)

            EF
            BF 1            SX(15)

            EF
        BL SGL
    EM
    BM 7,15
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4         LAYER 1
            BF 8            N4          S DWN
                HN 7
                              BE
                EX(STA,UP)
                EX(TEN,UP)
                EX(MAR,UP)
                EX(AC,UP)
```

```
        EX(SFO,UP)
        EE
EF
BF 7            N4              S DWN
        HN 7
                        BE
        EX(TEN,UP)
        EX(MAR,UP)
        EX(AC,UP)
        EX(SFO,UP)
        EX(MD,UP)
        EE
EF
BF 6            N4              S DWN
        HN 7
                        BE
        EX(STA,UP)
        EX(MAR,UP)
        EX(MD,UP)
        EX(PALL,UP)
        EE
EF
BF 5            N4              S DWN
        HN 7
                        BE
        EX(MAR,UP)
        EE
EF
BF 4            N4              S DWN
        HN 7
                        BE
        EX(STA,UP)
        EX(PALL,UP)
        EE
EF
LAYER 2
BF 8            SX(15)

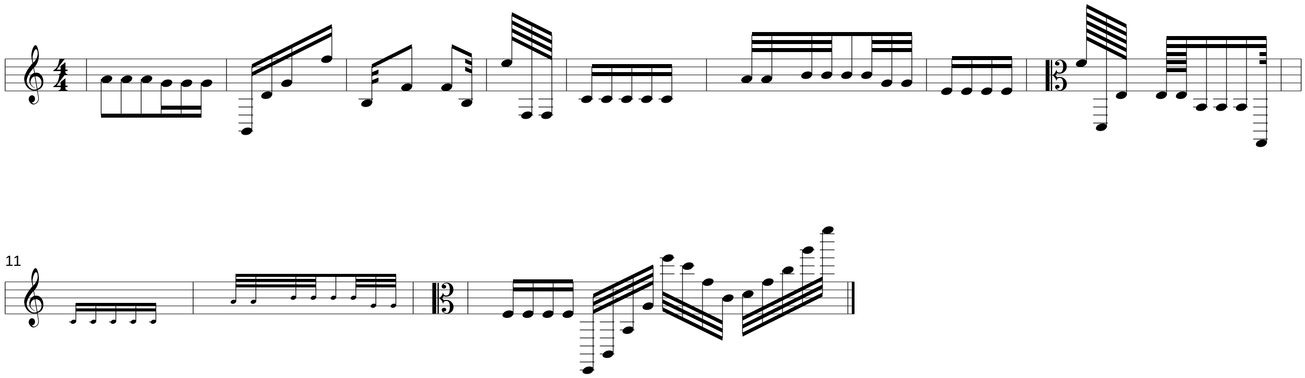
EF
BF 7            SX(15)
```

```
        EF
        BF 6            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 4            SX(15)

        EF
    BL SGL
EM
BM 8,6
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 4/4         LAYER 1
        LAYER 2
    BL FNL
EM
EPR
```


11

BP
FRM MOODS
LVL 1 REL 2
SCAL 10
DIMS 15
DIMF 15
TPMG 0.000000
LTMG 0.000000
BMG 0.000000
SRC 1.ex-beams.mds
EP

```
BPR
LVL 1 REL 2
""
BM 1,1
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4                 LAYER 1
                LAYER 2
        BL SGL
EM
BM 2,7
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4                 LAYER 1
                        BB 8
                        NB 1
                        N8                 S DWN
                        HN 3
                                        NB 3
                        N8                 S DWN
                        HN 3
                                        NB 2
                        N8                 S DWN
                        HN 3
                                        NB 6
                        N16                 S DWN
                        HN 2
                                        NB 5
                        N16                 S DWN
                        HN 2
                                        NB 4
                        N16                 S DWN
                        HN 2
                                        EB
                LAYER 2
                BF 1                SX(15)

                EF
                BF 3                SX(15)
```

```
          EF
          BF 2                SX(15)

          EF
          BF 6                SX(15)

          EF
          BF 5                SX(15)

          EF
          BF 4                SX(15)

          EF
     BL SGL
EM
BM 3,6
     NP 0,0,0
     CLEF TRB NRM
     KS DOM
     TEM 4/4             LAYER 1
               BB 7
               NB 6
               N16                 S UP
               HN -10
                              NB 1
               N16                 S UP
               HN -1
                              NB 5
               N16                 S UP
               HN 2
                              NB 2
               SX(15)

               NB 3
               N16                 S UP
               HN 8
                              EB
          LAYER 2
          BF 5                SX(15)
```

```
        EF
        BF 1            SX(15)

        EF
        BF 4            SX(15)

        EF
        BF 2            SX(15)

        EF
        BF 3            SX(15)

        EF
    BL SGL
EM
BM 4,5
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 4/4           LAYER 1
            BB 15
            NB 5
            N32             S UP
            HN -3
                        NB 4
            SX(15)

            NB 13
            N8              S UP
            HN 1
                        EB
        BF 2            SX(15)

        EF
            BB 16
            NB 14
            N8              S UP
            HN 1
                        NB 1
            N32             S UP
            HN -3
```

```
                          EB
            LAYER 2
            BF 5           SX(15)

            EF
            BF 4           SX(15)

            EF
            BF 12           SX(15)

            EF
            BF 2           SX(15)

            EF
            BF 13           SX(15)

            EF
            BF 1           SX(15)

            EF
        BL SGL
    EM
    BM 5,4
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4          LAYER 1
                BB 4
                NB 3
                N64            S UP
                HN 7
                          NB 2
                N64            S UP
                HN -6
                          NB 1
                N64            S UP
                HN -6
                          EB
            LAYER 2
            BF 3           SX(15)
```

```
            EF
            BF 2                SX(15)

            EF
            BF 1                SX(15)

            EF
        BL SGL
    EM
    BM 6,3
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4             LAYER 1
                BB 7
                NB 1
                N16                 S UP
                HN -2
                                NB 6
                N16                 S UP
                HN -2
                                NB 5
                N16                 S UP
                HN -2
                                NB 4
                N16                 S UP
                HN -2
                                NB 3
                N16                 S UP
                HN -2
                                EB
            BF 2                SX(15)

            EF
            LAYER 2
            BF 1                SX(15)

            EF
            BF 6                SX(15)

            EF
```

```
        BF 5            SX(15)

        EF
        BF 4            SX(15)

        EF
        BF 3            SX(15)

        EF
        BF 2            SX(15)

        EF
    BL SGL
EM
BM 7,2
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 4/4          LAYER 1
        BF 3            SX(15)

        EF
            BB 15
            NB 2
            N32              S UP
            HN 3
                          NB 1
            N32              S UP
            HN 3
                          NB 4
            SX(15)

            NB 6
            N32              S UP
            HN 4
                          NB 5
            N32              S UP
            HN 4
                          NB 7
            N8              S UP
            HN 4
```

```
                         NB 8
       N32                  S UP
       HN 4
                         NB 10
       N32                  S UP
       HN 2
                         NB 9
       N32                  S UP
       HN 2
                         EB
LAYER 2
BF 3                 SX(15)

EF
BF 2                 SX(15)

EF
BF 1                 SX(15)

EF
BF 4                 SX(15)

EF
BF 6                 SX(15)

EF
BF 5                 SX(15)

EF
BF 7                 SX(15)

EF
BF 8                 SX(15)

EF
BF 10                 SX(15)

EF
BF 9                 SX(15)

EF
```

```
        BL SGL
    EM
    BM 8,11
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4             LAYER 1
                BB 5
                NB 4
                N16                 S UP
                HN 0
                            NB 3
                N16                 S UP
                HN 0
                            NB 2
                N16                 S UP
                HN 0
                            NB 1
                N16                 S UP
                HN 0
                            EB
            LAYER 2
            BF 4                SX(15)

            EF
            BF 3                SX(15)

            EF
            BF 2                SX(15)

            EF
            BF 1                SX(15)

            EF
        BL SGL
    EM
    BM 9,10
        NP 0,0,0
        CLEF CC NRM
        KS DOM
        TEM 4/4             LAYER 1
```

```
        BB 14
        NB 2
        N128                S UP
        HN 7
                        NB 1
        N128                S UP
        HN -9
                        NB 7
        N128                S UP
        HN -1
                        EB
BF 6                SX(15)

EF
        BB 13
        NB 5
        N128                S UP
        HN -1
                        NB 4
        N128                S UP
        HN -1
                        NB 10
        N16                 S UP
        HN -4
                        NB 9
        N16                 S UP
        HN -4
                        NB 8
        N16                 S UP
        HN -4
                        NB 11
        N64                 S UP
        HN -13
                        EB
LAYER 2
BF 2                SX(15)

EF
BF 1                SX(15)

EF
```

```
            BF 6                SX(15)

            EF
            BF 5                SX(15)

            EF
            BF 4                SX(15)

            EF
            BF 3                SX(15)

            EF
            BF 9                SX(15)

            EF
            BF 8                SX(15)

            EF
            BF 7                SX(15)

            EF
            BF 10               SX(15)

            EF
        BL SGL
    EM
    BM 10,9
        NP 0,0,0
        CLEF CC NRM
        KS DOM
        TEM 4/4             LAYER 1
            LAYER 2
        BL SGL
    EM
    BM 11,14
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4             LAYER 1
                BB 9
                NB 1
```

```
            N16             S UP
            HN -2
            SN TR             NB 6
            N16             S UP
            HN -2
            SN TR             NB 5
            N16             S UP
            HN -2
            SN TR             NB 4
            N16             S UP
            HN -2
            SN TR             NB 3
            N16             S UP
            HN -2
            SN TR             EB
        BF 2            SX(15)

        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 6            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 4            SX(15)

        EF
        BF 3            SX(15)

        EF
        BF 2            SX(15)

        EF
    BL SGL
EM
BM 12,13
    NP 0,0,0
```

```
CLEF TRB NRM
KS DOM
TEM 4/4            LAYER 1
     BF 3               SX(15)

     EF
          BB 16
          NB 2
          N32                 S UP
          HN 3
          SN TR                 NB 1
          N32                 S UP
          HN 3
          SN TR                 NB 4
          SX(15)

          NB 6
          N32                 S UP
          HN 4
          SN TR                 NB 5
          N32                 S UP
          HN 4
          SN TR                 NB 7
          N8                 S UP
          HN 4
          SN TR                 NB 8
          N32                 S UP
          HN 4
          SN TR                 NB 10
          N32                 S UP
          HN 2
          SN TR                 NB 9
          N32                 S UP
          HN 2
          SN TR                 EB
     LAYER 2
     BF 3               SX(15)

     EF
     BF 2               SX(15)
```

```
            EF
            BF 1                  SX(15)

            EF
            BF 4                  SX(15)

            EF
            BF 6                  SX(15)

            EF
            BF 5                  SX(15)

            EF
            BF 7                  SX(15)

            EF
            BF 8                  SX(15)

            EF
            BF 10                 SX(15)

            EF
            BF 9                  SX(15)

            EF
        BL SGL
    EM
    BM 13,12
        NP 0,0,0
        CLEF CC NRM
        KS DOM
        TEM 4/4               LAYER 1
            LAYER 2
        BL SGL
    EM
    BM 14,8
        NP 0,0,0
        CLEF CC NRM
        KS DOM
        TEM 4/4               LAYER 1
            BF 5                  SX(15)
```

```
EF
    BB 28
    NB 4
    N16             S UP
    HN 0
                  NB 3
    N16             S UP
    HN 0
                  NB 2
    N16             S UP
    HN 0
                  NB 1
    N16             S UP
    HN 0
                  EB
    BB 31
    NB 7
    N32             S UP
    HN -14
                  NB 8
    N32             S UP
    HN -10
                  NB 9
    N32             S UP
    HN -4
                  NB 10
    N32             S UP
    HN 2
                  EB
    BB 32
    NB 11
    N32             S DWN
    HN 14
                  NB 12
    N32             S DWN
    HN 12
                  NB 13
    N32             S DWN
    HN 8
                  NB 14
```

```
        N32                    S DWN
        HN 4
                           EB
        BB 33
        NB 15
        N32                    S DWN
        HN 5
                           NB 16
        N32                    S DWN
        HN 8
                           NB 17
        N32                    S DWN
        HN 11
                           NB 18
        N32                    S DWN
        HN 16
                           NB 19
        N32                    S DWN
        HN 21
                           EB
    LAYER 2
    BF 5                 SX(15)

    EF
    BF 4                 SX(15)

    EF
    BF 3                 SX(15)

    EF
    BF 2                 SX(15)

    EF
    BF 1                 SX(15)

    EF
    BF 10                 SX(15)

    EF
    BF 11                 SX(15)
```

```
        EF
        BF 12           SX(15)

        EF
        BF 13           SX(15)

        EF
        BF 14           SX(15)

        EF
        BF 15           SX(15)

        EF
        BF 16           SX(15)

        EF
        BF 17           SX(15)

        EF
        BF 18           SX(15)

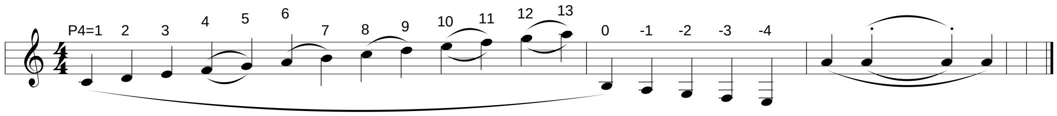
        EF
        BF 19           SX(15)

        EF
        BF 20           SX(15)

        EF
        BF 21           SX(15)

        EF
        BF 22           SX(15)

        EF
      BL FNL
    EM
    EPR
```


P4=1
2
3
4
5
6
7
8
9
10
11
12
13
0
-1
-2
-3
-4

BP
FRM MOODS
LVL 1 REL 2
SCAL 10
DIMS 15
DIMF 15
TPMG 30.000000
LTMG 0.000000
BMG 0.000000
SRC 1.ex-legat.mds
EP

```
BPR
LVL 1 REL 2
""
BM 1,1
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4              LAYER 1
                BF 1             N4              S UP
                        HN -2
                                  TAGOG("P4=1",UP)
                EF
                BF 2             SX(15)

                EF
                BF 3             N4              S UP
                        HN -1
                                  TAGOG("2",UP)
                EF
                BF 4             SX(15)

                EF
                BF 5             N4              S UP
                        HN 0
                                  TAGOG("3",UP)
                EF
                BF 6             SX(15)

                EF
                BF 8             N4              S UP
                        HN 1
                                  TAGOG("4",UP)
                EF
                BF 7             SX(15)

                EF
                BF 10             N4              S UP
                        HN 2
                                  TAGOG("5",UP)
                EF
                BF 9             SX(15)
```

```
EF
BF 12          N4          S UP
    HN 3
                 TAGOG("6",UP)
EF
BF 11          SX(15)

EF
BF 14          N4          S DWN
    HN 4
                 TAGOG("7",UP)
EF
BF 13          SX(15)

EF
BF 16          N4          S DWN
    HN 5
                 TAGOG("8",UP)
EF
BF 15          SX(15)

EF
BF 18          N4          S DWN
    HN 6
                 TAGOG("9",UP)
EF
BF 17          SX(15)

EF
BF 20          N4          S DWN
    HN 7
                 TAGOG("10",UP)
EF
BF 19          SX(15)

EF
BF 22          N4          S DWN
    HN 8
                 TAGOG("11",UP)
EF
```

```
BF 21             SX(15)

EF
BF 24             N4              S DWN
     HN 9
                    TAGOG("12",UP)
EF
BF 23             SX(15)

EF
BF 26             N4              S DWN
     HN 10
                    TAGOG("13",UP)
EF
LAYER 2
BF 1             SX(15)

EF
BF 2             SX(15)

EF
BF 3             SX(15)

EF
BF 4             SX(15)

EF
BF 5             SX(15)

EF
BF 6             SX(15)

EF
BF 8             SX(15)

EF
BF 7             SX(15)

EF
BF 10             SX(15)
```

EF
BF 9 SX(15)

EF
BF 12 SX(15)

EF
BF 11 SX(15)

EF
BF 14 SX(15)

EF
BF 13 SX(15)

EF
BF 16 SX(15)

EF
BF 15 SX(15)

EF
BF 18 SX(15)

EF
BF 17 SX(15)

EF
BF 20 SX(15)

EF
BF 19 SX(15)

EF
BF 22 SX(15)

EF
BF 21 SX(15)

EF
BF 24 SX(15)

```
            EF
            BF 23                SX(15)

            EF
            BF 26                SX(15)

            EF
        BL SGL
    EM
    BM 2,22
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4              LAYER 1
            BF 3              N4               S UP
                HN -3
                               TAGOG("0",UP)
            EF
            BF 2              SX(15)

            EF
            BF 7              N4               S UP
                HN -4
                               TAGOG("-1",UP)
            EF
            BF 6              SX(15)

            EF
            BF 4              N4               S UP
                HN -5
                               TAGOG("-2",UP)
            EF
            BF 5              SX(15)

            EF
            BF 9              N4               S UP
                HN -6
                               TAGOG("-3",UP)
            EF
            BF 8              SX(15)
```

```
        EF
        BF 11                N4                S UP
            HN -7
                              TAGOG("-4",UP)
        EF
        BF 10                SX(15)

        EF
        LAYER 2
        BF 3                 SX(15)

        EF
        BF 2                 SX(15)

        EF
        BF 7                 SX(15)

        EF
        BF 6                 SX(15)

        EF
        BF 4                 SX(15)

        EF
        BF 5                 SX(15)

        EF
        BF 9                 SX(15)

        EF
        BF 8                 SX(15)

        EF
        BF 11                SX(15)

        EF
        BF 10                SX(15)

        EF
    BL SGL
```

```
EM
BM 3,21
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4             LAYER 1
                BF 7            N4              S UP
                        HN 3
                            EF
                BF 6            SX(15)

                EF
                BF 5            N4              S UP
                        HN 3
                                    BE
                        EX(STA,UP)
                        EE
                EF
                BF 4            SX(15)

                EF
                BF 15           SX(15)

                EF
                BF 14           SX(15)

                EF
                BF 3            N4              S UP
                        HN 3
                                    BE
                        EX(STA,UP)
                        EE
                EF
                BF 2            SX(15)

                EF
                BF 1            N4              S UP
                        HN 3
                            EF
                LAYER 2
                BF 7            SX(15)
```

```
        EF
        BF 6            SX(15)

        EF
        BF 5            SX(15)

        EF
        BF 4            SX(15)

        EF
        BF 15            SX(15)

        EF
        BF 14            SX(15)

        EF
        BF 3            SX(15)

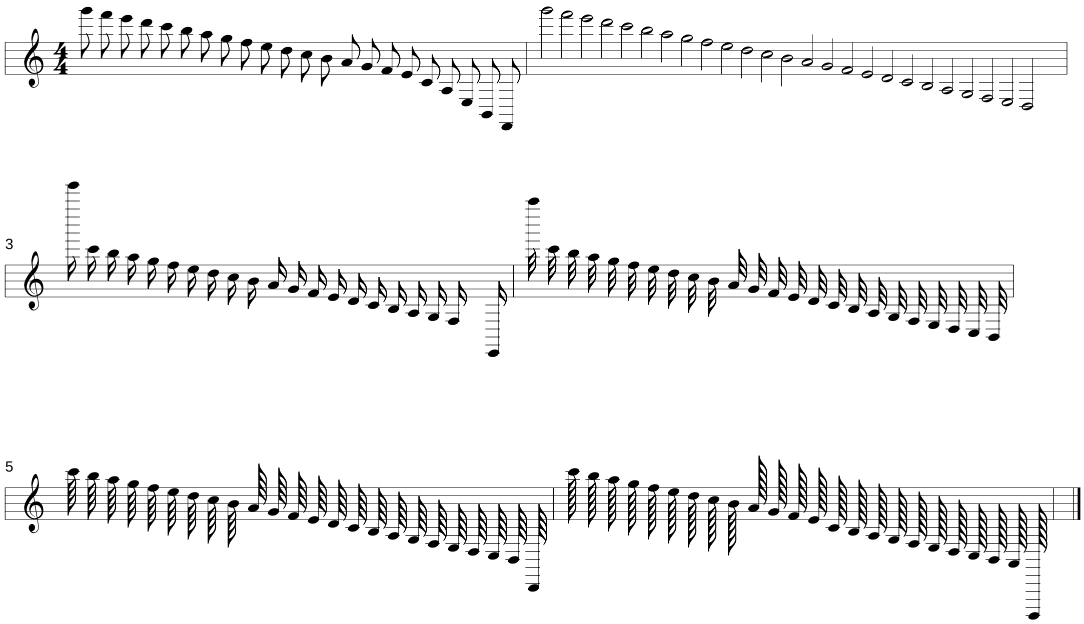
        EF
        BF 2            SX(15)

        EF
        BF 1            SX(15)

        EF
    BL SGL
EM
BM 4,3
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 4/4          LAYER 1
        LAYER 2
    BL SGL
EM
BM 5,2
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 4/4          LAYER 1
```

```
            LAYER 2
        BL FNL
    EM
    BI 1
        SLR,DWN
            ST(21,1,7,0,0)
            END(21,1,1,0,0)
    EI
    BI 2
        SLR,DWN
            ST(1,1,1,0,0)
            END(22,1,3,0,0)
    EI
    BI 3
        SLR,UP
            ST(1,1,12,0,0)
            END(1,1,14,0,0)
    EI
    BI 4
        SLR,UP
            ST(1,1,16,0,0)
            END(1,1,18,0,0)
    EI
    BI 5
        SLR,UP
            ST(1,1,20,0,0)
            END(1,1,22,0,0)
    EI
    BI 6
        SLR,UP
            ST(1,1,24,0,0)
            END(1,1,26,0,0)
    EI
    BI 7
        SLR,DWN
            ST(1,1,8,0,0)
            END(1,1,10,0,0)
    EI
    BI 9
        SLR,UP
            ST(1,1,8,0,0)
```

```
        END(1,1,10,0,0)
EI
BI 10
    SLR,DWN
        ST(1,1,24,0,0)
        END(1,1,26,0,0)
EI
BI 11
    SLR,DWN
        ST(1,1,20,0,0)
        END(1,1,22,0,0)
EI
BI 12
    SLR,DWN
        ST(21,1,5,0,0)
        END(21,1,3,0,0)
EI
BI 13
    SLR,UP
        ST(21,1,5,0,0)
        END(21,1,3,0,0)
EI
EPR
```


3
5

BP
FRM MOODS
LVL 1 REL 2
SCAL 10
DIMS 15
DIMF 15
TPMG 30.000000
LTMG 0.000000
BMG 0.000000
SRC 1.ex-note.mds
EP

```
BPR
LVL 1 REL 2
""
BM 1,1
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4             LAYER 1
                BF 79           N8              S DWN
                        HN 16
                                EF
                BF 78           N8              S DWN
                        HN 15
                                EF
                BF 77           N8              S DWN
                        HN 14
                                EF
                BF 76           N8              S DWN
                        HN 13
                                EF
                BF 75           N8              S DWN
                        HN 12
                                EF
                BF 74           N8              S DWN
                        HN 11
                                EF
                BF 72           N8              S DWN
                        HN 10
                                EF
                BF 71           N8              S DWN
                        HN 9
                                EF
                BF 70           N8              S DWN
                        HN 8
                                EF
                BF 69           N8              S DWN
                        HN 7
                                EF
                BF 68           N8              S DWN
                        HN 6
                                EF
```

```
BF 67           N8          S DWN
     HN 5
           EF
BF 66           N8          S DWN
     HN 4
           EF
BF 65           N8          S UP
     HN 3
           EF
BF 58           N8          S UP
     HN 2
           EF
BF 22           N8          S UP
     HN 1
           EF
BF 52           N8          S UP
     HN 0
           EF
BF 33           N8          S UP
     HN -2
           EF
BF 34           N8          S UP
     HN -4
           EF
BF 35           N8          S UP
     HN -7
           EF
BF 36           N8          S UP
     HN -10
           EF
BF 37           N8          S UP
     HN -13
           EF
LAYER 2
BF 45           SX(15)

EF
BF 44           SX(15)

EF
BF 43           SX(15)
```

EF
BF 1 SX(15)

EF
BF 24 SX(15)

EF
BF 23 SX(15)

EF
BF 22 SX(15)

EF
BF 21 SX(15)

EF
BF 20 SX(15)

EF
BF 38 SX(15)

EF
BF 37 SX(15)

EF
BF 41 SX(15)

EF
BF 42 SX(15)

EF
BF 36 SX(15)

EF
BF 40 SX(15)

EF
BF 18 SX(15)

EF

```
            BF 39           SX(15)

            EF
            BF 25           SX(15)

            EF
            BF 26           SX(15)

            EF
            BF 27           SX(15)

            EF
            BF 28           SX(15)

            EF
            BF 29           SX(15)

            EF
        BL SGL
    EM
    BM 2,7
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4         LAYER 1
            BF 12           N2          S DWN
                HN 16
                        EF
            BF 13           N2          S DWN
                HN 15
                        EF
            BF 14           N2          S DWN
                HN 14
                        EF
            BF 15           N2          S DWN
                HN 13
                        EF
            BF 17           N2          S DWN
                HN 12
                        EF
            BF 18           N2          S DWN
```

HN 11
EF
BF 19 N2 S DWN
HN 10
EF
BF 20 N2 S DWN
HN 9
EF
BF 22 N2 S DWN
HN 8
EF
BF 23 N2 S DWN
HN 7
EF
BF 25 N2 S DWN
HN 6
EF
BF 24 N2 S DWN
HN 5
EF
BF 27 N2 S DWN
HN 4
EF
BF 26 N2 S UP
HN 3
EF
BF 28 N2 S UP
HN 2
EF
BF 29 N2 S UP
HN 1
EF
BF 30 N2 S UP
HN 0
EF
BF 31 N2 S UP
HN -1
EF
BF 36 N2 S UP
HN -2
EF

```
BF 37           N2          S UP
    HN -3
            EF
BF 38           N2          S UP
    HN -4
            EF
BF 39           N2          S UP
    HN -5
            EF
BF 40           N2          S UP
    HN -6
            EF
BF 41           N2          S UP
    HN -7
            EF
BF 42           N2          S UP
    HN -8
            EF
BF 32           SX(15)

EF
LAYER 2
BF 12           SX(15)

EF
BF 13           SX(15)

EF
BF 14           SX(15)

EF
BF 15           SX(15)

EF
BF 17           SX(15)

EF
BF 18           SX(15)

EF
BF 19           SX(15)
```

EF
BF 20 SX(15)

EF
BF 22 SX(15)

EF
BF 23 SX(15)

EF
BF 25 SX(15)

EF
BF 24 SX(15)

EF
BF 27 SX(15)

EF
BF 26 SX(15)

EF
BF 28 SX(15)

EF
BF 29 SX(15)

EF
BF 30 SX(15)

EF
BF 6 SX(15)

EF
BF 31 SX(15)

EF
BF 32 SX(15)

EF

```
            BF 33               SX(15)

            EF
            BF 34               SX(15)

            EF
            BF 35               SX(15)

            EF
            BF 36               SX(15)

            EF
            BF 37               SX(15)

            EF
            BF 21               SX(15)

            EF
        BL SGL
    EM
    BM 3,6
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4             LAYER 1
            BF 40               N16             S DWN
                HN 28
                            EF
            BF 16               N16             S DWN
                HN 12
                            EF
            BF 17               N16             S DWN
                HN 11
                            EF
            BF 18               N16             S DWN
                HN 10
                            EF
            BF 19               N16             S DWN
                HN 9
                            EF
            BF 20               N16             S DWN
```

HN 8
EF
BF 21 N16 S DWN
HN 7
EF
BF 22 N16 S DWN
HN 6
EF
BF 23 N16 S DWN
HN 5
EF
BF 24 N16 S DWN
HN 4
EF
BF 25 N16 S UP
HN 3
EF
BF 26 N16 S UP
HN 2
EF
BF 28 N16 S UP
HN 1
EF
BF 30 N16 S UP
HN 0
EF
BF 29 N16 S UP
HN -1
EF
BF 31 N16 S UP
HN -2
EF
BF 32 N16 S UP
HN -3
EF
BF 37 N16 S UP
HN -4
EF
BF 38 N16 S UP
HN -5
EF

```
BF 39           N16          S UP
    HN -6
            EF
BF 7           SX(15)

EF
BF 41           N16          S UP
    HN -14
            EF
LAYER 2
BF 36           SX(15)

EF
BF 16           SX(15)

EF
BF 17           SX(15)

EF
BF 18           SX(15)

EF
BF 19           SX(15)

EF
BF 20           SX(15)

EF
BF 21           SX(15)

EF
BF 22           SX(15)

EF
BF 23           SX(15)

EF
BF 24           SX(15)

EF
BF 25           SX(15)
```

```
        EF
        BF 26           SX(15)

        EF
        BF 28           SX(15)

        EF
        BF 30           SX(15)

        EF
        BF 29           SX(15)

        EF
        BF 31           SX(15)

        EF
        BF 32           SX(15)

        EF
        BF 33           SX(15)

        EF
        BF 34           SX(15)

        EF
        BF 35           SX(15)

        EF
        BF 7            SX(15)

        EF
        BF 37           SX(15)

        EF
    BL SGL
EM
BM 4,5
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
```

TEM 4/4 LAYER 1
BF 31 N32 S DWN
HN 24
EF
BF 8 N32 S DWN
HN 12
EF
BF 9 N32 S DWN
HN 11
EF
BF 10 N32 S DWN
HN 10
EF
BF 11 N32 S DWN
HN 9
EF
BF 12 N32 S DWN
HN 8
EF
BF 13 N32 S DWN
HN 7
EF
BF 14 N32 S DWN
HN 6
EF
BF 15 N32 S DWN
HN 5
EF
BF 16 N32 S DWN
HN 4
EF
BF 17 N32 S UP
HN 3
EF
BF 18 N32 S UP
HN 2
EF
BF 19 N32 S UP
HN 1
EF
BF 20 N32 S UP

```
        HN 0
                EF
BF 21               N32                 S UP
        HN -1
                EF
BF 22               N32                 S UP
        HN -2
                EF
BF 23               N32                 S UP
        HN -3
                EF
BF 24               N32                 S UP
        HN -4
                EF
BF 25               N32                 S UP
        HN -5
                EF
BF 26               N32                 S UP
        HN -6
                EF
BF 27               N32                 S UP
        HN -7
                EF
BF 28               N32                 S UP
        HN -8
                EF
BF 29               N32                 S UP
        HN -9
                EF
BF 30               N32                 S UP
        HN -10
                EF
LAYER 2
BF 31               SX(15)

EF
BF 8               SX(15)

EF
BF 9               SX(15)
```

EF
BF 10 SX(15)

EF
BF 11 SX(15)

EF
BF 12 SX(15)

EF
BF 13 SX(15)

EF
BF 14 SX(15)

EF
BF 15 SX(15)

EF
BF 16 SX(15)

EF
BF 17 SX(15)

EF
BF 18 SX(15)

EF
BF 19 SX(15)

EF
BF 20 SX(15)

EF
BF 21 SX(15)

EF
BF 22 SX(15)

EF
BF 23 SX(15)

```
        EF
        BF 24           SX(15)

        EF
        BF 25           SX(15)

        EF
        BF 26           SX(15)

        EF
        BF 27           SX(15)

        EF
        BF 28           SX(15)

        EF
        BF 29           SX(15)

        EF
        BF 30           SX(15)

        EF
    BL SGL
EM
BM 5,4
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
    TEM 4/4         LAYER 1
        BF 10           N64             S DWN
            HN 12
                    EF
        BF 11           N64             S DWN
            HN 11
                    EF
        BF 12           N64             S DWN
            HN 10
                    EF
        BF 13           N64             S DWN
            HN 9
```

```
                EF
BF 14              N64               S DWN
     HN 8
                EF
BF 15              N64               S DWN
     HN 7
                EF
BF 16              N64               S DWN
     HN 6
                EF
BF 17              N64               S DWN
     HN 5
                EF
BF 18              N64               S DWN
     HN 4
                EF
BF 19              N64               S UP
     HN 3
                EF
BF 20              N64               S UP
     HN 2
                EF
BF 21              N64               S UP
     HN 1
                EF
BF 22              N64               S UP
     HN 0
                EF
BF 23              N64               S UP
     HN -1
                EF
BF 24              N64               S UP
     HN -2
                EF
BF 25              N64               S UP
     HN -3
                EF
BF 26              N64               S UP
     HN -4
                EF
BF 27              N64               S UP
```

HN -5
EF
BF 28 N64 S UP
HN -6
EF
BF 29 N64 S UP
HN -7
EF
BF 30 N64 S UP
HN -8
EF
BF 31 N64 S UP
HN -9
EF
BF 32 N64 S UP
HN -10
EF
BF 33 N64 S UP
HN -17
EF
LAYER 2
BF 10 SX(15)

EF
BF 11 SX(15)

EF
BF 12 SX(15)

EF
BF 13 SX(15)

EF
BF 14 SX(15)

EF
BF 15 SX(15)

EF
BF 16 SX(15)

EF
BF 17 SX(15)

EF
BF 18 SX(15)

EF
BF 19 SX(15)

EF
BF 20 SX(15)

EF
BF 21 SX(15)

EF
BF 22 SX(15)

EF
BF 23 SX(15)

EF
BF 24 SX(15)

EF
BF 25 SX(15)

EF
BF 26 SX(15)

EF
BF 27 SX(15)

EF
BF 28 SX(15)

EF
BF 29 SX(15)

EF
BF 30 SX(15)

```
            EF
            BF 31           SX(15)

            EF
            BF 32           SX(15)

            EF
            BF 33           SX(15)

            EF
        BL SGL
    EM
    BM 6,3
        NP 0,0,0
        CLEF TRB NRM
        KS DOM
        TEM 4/4         LAYER 1
            BF 12           N128            S DWN
                HN 12
                        EF
            BF 13           N128            S DWN
                HN 11
                        EF
            BF 14           N128            S DWN
                HN 10
                        EF
            BF 15           N128            S DWN
                HN 9
                        EF
            BF 16           N128            S DWN
                HN 8
                        EF
            BF 17           N128            S DWN
                HN 7
                        EF
            BF 18           N128            S DWN
                HN 6
                        EF
            BF 19           N128            S DWN
                HN 5
```

EF
BF 20 N128 S DWN
HN 4
EF
BF 21 N128 S UP
HN 3
EF
BF 22 N128 S UP
HN 2
EF
BF 23 N128 S UP
HN 1
EF
BF 24 N128 S UP
HN 0
EF
BF 25 N128 S UP
HN -2
EF
BF 26 N128 S UP
HN -3
EF
BF 27 N128 S UP
HN -4
EF
BF 28 N128 S UP
HN -5
EF
BF 29 N128 S UP
HN -6
EF
BF 30 N128 S UP
HN -7
EF
BF 31 N128 S UP
HN -8
EF
BF 32 N128 S UP
HN -9
EF
BF 33 N128 S UP

HN -10
EF
BF 34 N128 S UP
HN -11
EF
BF 35 N128 S UP
HN -24
EF
LAYER 2
BF 12 SX(15)

EF
BF 13 SX(15)

EF
BF 14 SX(15)

EF
BF 15 SX(15)

EF
BF 16 SX(15)

EF
BF 17 SX(15)

EF
BF 18 SX(15)

EF
BF 19 SX(15)

EF
BF 20 SX(15)

EF
BF 21 SX(15)

EF
BF 22 SX(15)

EF
BF 23 SX(15)

EF
BF 24 SX(15)

EF
BF 25 SX(15)

EF
BF 26 SX(15)

EF
BF 27 SX(15)

EF
BF 28 SX(15)

EF
BF 29 SX(15)

EF
BF 30 SX(15)

EF
BF 31 SX(15)

EF
BF 32 SX(15)

EF
BF 33 SX(15)

EF
BF 34 SX(15)

EF
BF 35 SX(15)

EF
BL SGL

```
EM
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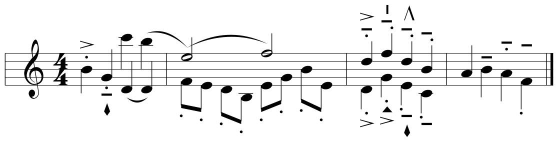
	CLEF TRB NRM
	KS DOM
	TEM 4/4		LAYER 1
		LAYER 2
	BL FNL
EM
EPR
```



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SCAL 10
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DIMF 15
TPMG 0.000000
LTMG 0.000000
BMG 0.000000
SRC 1.ex-sym.mds
EP

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BPR
LVL 1 REL 2
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	NP 0,0,0
	CLEF TRB NRM
	KS DOM
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		BF 1		N4		S DWN
			HN 4
					BE
			EX(STA,UP)
			EX(AC,UP)
			EE
		EF
		BF 2		N4		S UP
			HN 2
					BE
			EX(STA,DWN)
			EX(TEN,DWN)
			EX(MD,DWN)
			EE
		EF
		BF 3		N4		S UP
			HN -1
				EF
		BF 4		N4		S UP
			HN -1
				EF
		LAYER 2
		BF 1		SX(15)

		EF
		BF 2		SX(15)

		EF
		BF 5		N4		S DWN
			HN 12
				EF
		BF 6		N4		S DWN
			HN 11
```

```
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    BL SGL
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BM 2,6
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    KS DOM
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            HN 7
                        EF
        BF 51               SX(15)

        EF
        BF 52               SX(15)

        EF
        BF 53               SX(15)

        EF
        BF 64               N2              S UP
            HN 8
                        EF
        BF 54               SX(15)

        EF
        BF 56               SX(15)

        EF
        BF 57               SX(15)

        EF
        LAYER 2
            BB 58
            NB 46
            N8              S DWN
            HN 1
                            BE
            EX(STA,DWN)
            EE
            NB 57
```

```
N8                 S DWN
HN 0
                 BE
EX(STA,DWN)
EE
EB
BB 59
NB 39
N8                 S DWN
HN -1
                 BE
EX(STA,DWN)
EE
NB 40
N8                 S DWN
HN -3
                 BE
EX(STA,DWN)
EE
EB
BB 60
NB 41
N8                 S DWN
HN 0
                 BE
EX(STA,DWN)
EE
NB 42
N8                 S DWN
HN 2
                 BE
EX(STA,DWN)
EE
EB
BB 61
NB 43
N8                 S DWN
HN 4
                 BE
EX(STA,DWN)
EE
```

```
            NB 44
            N8          S DWN
            HN 0
                      BE
            EX(STA,DWN)
            EE
            EB
      BL SGL
   EM
   BM 3,5
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      CLEF TRB NRM
      KS DOM
      TEM 4/4        LAYER 1
         BF 5        N4          S UP
            HN 6
                      BE
            EX(STA,UP)
            EX(TEN,UP)
            EX(AC,UP)
            EE
         EF
         BF 6        N4          S UP
            HN 8
                      BE
            EX(STA,UP)
            EX(TEN,UP)
            EX(PALL,UP)
            EE
         EF
         BF 7        N4          S UP
            HN 6
                      BE
            EX(STA,UP)
            EX(TEN,UP)
            EX(SFO,UP)
            EE
         EF
         BF 8        N4          S UP
            HN 4
                      BE
```

```
            EX(STA,UP)
            EX(TEN,UP)
            EE
        EF
        LAYER 2
        BF 1            N4              S DWN
            HN -1
                        BE
            EX(STA,DWN)
            EX(AC,DWN)
            EE
        EF
        BF 2            N4              S DWN
            HN 2
                        BE
            EX(STA,DWN)
            EX(MAR,DWN)
            EX(AC,DWN)
            EE
        EF
        BF 3            N4              S DWN
            HN 0
                        BE
            EX(STA,DWN)
            EX(TEN,DWN)
            EX(MD,DWN)
            EE
        EF
        BF 4            N4              S DWN
            HN -2
                        BE
            EX(STA,DWN)
            EX(TEN,DWN)
            EE
        EF
    BL SGL
EM
BM 4,4
    NP 0,0,0
    CLEF TRB NRM
    KS DOM
```

```
    TEM 4/4         LAYER 1
        BF 1            N4          S UP
            HN 3
                    EF
        BF 2            N4          S DWN
            HN 4
                            BE
            EX(TEN,UP)
            EE
        EF
        BF 3            N4          S DWN
            HN 3
                            BE
            EX(STA,UP)
            EX(TEN,UP)
            EE
        EF
        BF 4            N4          S DWN
            HN 1
                            BE
            EX(STA,DWN)
            EX(TEN,UP)
            EE
        EF
        LAYER 2
        BF 1            SX(15)

        EF
        BF 2            SX(15)

        EF
        BF 3            SX(15)

        EF
        BF 4            SX(15)

        EF
    BL FNL
EM
BI 4
    SLR,UP
```

```
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EI
BI 7
    SLR,UP
        ST(6,1,63,0,0)
        END(6,1,64,0,0)
EI
BI 9
    SLR,DWN
        ST(1,1,3,0,0)
        END(1,1,4,0,0)
EI
EPR
```

Teatro alla Scala Press Release

Martedì 22 settembre 1998, alle ore 16:00 presso il ridotto dei Palchi del Teatro alla Scala sarà presentato il progetto MOODS - Music Object Oriented Distributed System

Il progetto ha portato alla realizzazione di un prototipo Funzionante dì Leggio elettronico, in grado di sostituire il tradizionale supporto cartaceo delle partiture e di gestire la modifica delle parti e la loro archiviazione.
Al progetto, che rientra nelle attività "ESPRIT HPCN - TTN TETRApc" finanziate dalla Comunità Europea, hanno partecipato, sotto il coordinamento dell'Ing. Paolo Nesi, alla progettazione e realizzazione delle apparecchiature e dei programmi necessari al suo funzionamento, il Dipartimento di Sistemi e Informatica dell'Università di Firenze, SHYLOCK Progetti e ELSEL. Inoltre, hanno preso parte i tipici potenziali utenti finali: il Teatro alla Scala, la Casa Editrice Ricordi e La Scuola di Musica di Fiesole.
Il nuovo sistema permetterà al direttore d'orchestra e agli orchestrali di leggere la partitura e le singole parti su appositi monitor interattivi, che sostituiscono quindi il tradizionale leggio, attraverso i quali sarà possibile apportare al brano musicale tutte quelle modificare necessarie nella fase di concertazione, come indicazioni dinamiche e agogiche, arcate e diteggiature, correzioni e modifiche alla musica, ma anche modifiche più profonde. Le modifiche possono quindi essere archiviate, per un loro successivo utilizzo.
Fra gli innumerevoli vantaggi, significativi sono quelli del notevole risparmio di tempo nella messa a delle parti e della loro gestione e archiviazione, nel rapporto con le case editrici che potrebbero fornire le musiche su supporto digitale, anziché cartaceo, nella facilità di trasferimento e circolazione delle stesse.
Durante l'esecuzione dei brani il sistema provvede in automatico alle voltate delle pagine.

Alla conferenza stampa interverranno Paolo Nesi per l'Università di Firenze, Gabriele Dotto per Casa Ricordi, Carlo Tabarelli, responsabile dell'Archivio Musicale del Teatro alla Scala e il Dott. Sandro Moro della SHYLOCK.
Nei corso della presentazione verrà effettuata una dimostrazione pratica del funzionamento del leggio elettronico con l'esecuzione dì alcuni brani di Mozart, Vivaldi e Verdi.

Informatic System Department University of Florence Press Release

Invitation for Demonstration of project MOODS: Music Object Oriented Distributed System, 22nd September, at Teatro alla Scala, Milan, Italy, at 16:00

Project MOODS has produced as a result the first implementation of an integrated system of "Electronic" lecterns/stands for the management of scores in large orchestras, music schools and for publishers. MOODS is a project partially supported by European Commission in the ESPRIT IV. It is based on HPCN (High Performance Computer Networking) technologies and object oriented paradigm. Partners of MOODS consortium are: Dipartimento di Sistemi e Informatica of Università di Firenze (as coordinator), Teatro alla Scala, BMG Ricordi, Shylock Progetti, Elsel, and the School of Music of Fiesole.

The demonstration of 22 September will be the absolutely first public presentation of MOODS. It will consists in the demonstration of the main functionalities of the MOODS system of computerised lecterns for co-operative editing/manipulation of music scores and for their visualisation. MOODS will be used to execute pieces of Mozart, Verdi, and Vivaldi.

The co-operative editing of music reduces the time needed to perform rehearsals, for concerts, operas, ballets, and is a way to avoid discontinuities, that in certain cases may need days to prepare the new versions of corrected parts. All interpretation and instrumental symbols (over the classical music notation symbols) can be added and visualised in real-time by musicians. This work can be saved for further reuse. In this way the specific execution can be re-proposed to musicians for execution or analysis. The work in schools of music can be facilitated, students may interact with the score in real-time by showing and receiving modifications of the Maestro as well as of other students. Music publishers could send to Theatres "electronic" versions of scores and parts to be used in real-time by orchestra lecterns or stored in the archive for their successive adoption. Publishers could, with MOODS, modify, in co-operative manner, scores and parts; thus, reducing the time needed for the production of revised version of scores. Main scores and parts can be joined and divided in real-time in order to build up in a few seconds the required structure for the orchestra.

After the adjusting phase (e.g., during rehearsals), MOODS is capable of presenting the main score and parts on lecterns for the execution of the orchestra. In this phase, MOODS displays the timely pages of music to the Conductor and to Musicians automatically, avoiding the problems related with the manual page turning. The Conductor is shown the main score, while the musicians have on their lecterns only their specific part.

For the above reasons, I hope that you accept the Invitation that I am presenting to you on behalf of MOODS Partners.

Paolo Nesi
(Coordinator of project MOODS)

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Comunicato stampa del Dipartimento Sistemi Informatica Università di Firenze

Invito alla Dimostrazione progetto MOODS: Music Object Oriented Distributed System,
Martedì 22 Settembre, Teatro alla Scala, Milano, ore 16:00

Il progetto MOODS ha portato alla prima realizzazione a livello mondiale di un sistema integrato di leggii ``Elettronici'' per la gestione delle partiture nelle grandi orchestre, teatri, scuole di musica ed in editoria musicale. MOODS e' un progetto finanziato parzialmente dalla Comunità Europea nell'ambito dell'ESPRIT IV e sfrutta le tecnologie HPCN (High Performance Computer Networking). Fanno parte del consorzio MOODS: il Dipartimento di Sistemi e Informatica dell'Università di Firenze (come coordinatore), il Teatro alla Scala, BMG Ricordi, SHYLOCK Progetti, ELSEL, e la Scuola di Musica di Fiesole.
La presentazione consisterà nella dimostrazione delle funzionalità del primo prototipo di MOODS che consiste in un sistema di leggii computerizzati che possono essere utilizzati per la manipolazione cooperativa della musica e la sua visualizzazione. Tale prototipo sarà utilizzato da un gruppo di musicisti per eseguire alcuni brani di musica classica da Mozart, Verdi, e Vivaldi.
La manipolazione cooperativa permette di ridurre drasticamente la durata delle pause delle prove, per concerti, opere e balletti, ed eliminerà la discontinuità delle stesse, eliminando le attese per le partiture e parti corrette che possono essere anche di giorni. Tutti i simboli di interpretazione e strumentali possono essere inseriti dagli orchestrali e salvati per un futuro utilizzo. In questo modo le singole interpretazioni potranno essere salvate e rianalizzate in futuro, nonché riproposte per l'esecuzione. Anche le classi di musica possono trarre vantaggio da un tale sistema, i singoli studenti possono interagire sulla partitura vedendo in tempo reale le modifiche del Maestro e degli altri studenti. Le case editrici possono finalmente inviare direttamente ai teatri versioni elettroniche delle parti e partiture che potranno essere visualizzate in tempo reale sui leggii degli orchestrali. Potranno inoltre, con il sistema stesso, correggere in modo cooperativo le parti riducendo i tempi di produzione. Partitura e parti possono venire divise ed unite in tempo reale per comporre in pochi secondi la struttura dell'orchestra desiderata.
Dopo la fase di modifica/aggiustamento della musica il sistema rende disponibile la musica per l'esecuzione all'orchestra. In questa fase, MOODS presenta le pagine di musica al direttore ed ai singoli orchestrali in modo automatico eliminando il problema delle voltate di pagina. Ovviamente, al direttore viene fornita una visione direttoriale della partitura mentre ai singoli orchestrali solo la loro parte.
La prego pertanto di accettare l'invito che Le porgo a nome di tutti i partner del consorzio.
Paolo Nesi
(Coordinatore progetto/consorzio MOODS)

MOODS

Music Object Oriented Distributed System

Un attività con il: TETRApc-TTN

Dimostrazione MOODS

22-Sept.-1998, Teatro alla Scala, Milano

Workpackage: WP7

Diffusione: Pubblica

Versione: 1.2

Date: 15/9/98

Partner responsabile: DSI

Partner coinvolti: DSI, SCALA ELSEL, SMF, RICORDI, SHYLOCK

Coordinatore del Progetto/Consorzio:

Paolo Nesi

Dipartimento di Sistemi e Informatica

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50139 Firenze, Italy

tel: +39-055-4796523

fax: +39-055-4796363

email: nesi@dsi.unifi.it, nesi@ingfi1.ing.unifi.it

www: http://aguirre.dsi.unifi.it/~hpcn/wwwmoods/wwwpage/html

Programma: 22 Settembre 1998

16:30 -Benvenuto
(Project Coordinator: P. Nesi, DSI and Maestro C. Tabarelli, Teatro alla Scala)

16:40 -Stato dell'Arte (Maestro G. Dotto, BMG RICORDI)

16:50 -Architettura MOODS e Ringraziamenti (P. Nesi, DSI)

17:05 -Musica in Esecuzione (Maestro C. Tabarelli, Teatro alla Scala)

17:15 -Preparazione ed Esecuzione della Serenata in G di Mozart

-Una piccola spiegazione di ciò che e' stato mostrato

17:25 -Preparazione ed Esecuzione del "La primavera" (Le 4 Stagioni di Vivaldi)

17:35 -Gestione dell'Archivio e Conversione di Formati (Dr. S. Moro, SHYLOCK)

17:45 -Preparazione ed Esecuzione de "La Traviata" primo atto, Verdi

-Una piccola spiegazione di ciò che e' stato mostrato

17:55 -Preparazione ed Esecuzione de "La Traviata" terzo atto, Verdi

18:05 -Conclusioni e Futuro (P. Nesi, DSI)

INDICE

I punti marcati con un asterisco, *, saranno solo sommariamente menzionati o completamente tralasciati durante la presentazione. Tali punti sono stati inclusi in questo documento per dare una visione più completa del progetto MOODS.

1. Benvenuto (P. Nesi, DSI, Maestro C. Tabarelli, Teatro alla Scala)

Siamo qui oggi al Teatro alla Scala per la presentazione dei risultati del progetto MOODS.

Questa e' in assoluto la prima presentazione pubblica della soluzione MOODS.

Il progetto MOODS e' stato parzialmente finanziato dalla European Commission nel dominio HPCN (High Performance Computer Networking) dell'ESPRIT IV. Il progetto e' solo uno dei tanti che utilizzano la tecnologia HPCN in Italia. La EC ha stabilito una rete di TTN (Technology Transfer Node, nodi di trasferimento tecnologico) per favorire ed incrementare la diffusione delle tecnologie HPCN. In questo senso, il progetto MOODS e' un'attività con il TETRApc TTN, supportato dal CPR (Consorzio Pisa Ricerche, Pisa), e CESVIT (High Tech Agency, Florence, Firenze).

In questa ottica, sono qui come Coordinatore del progetto/consorzio MOODS e come Responsabile Scientifico del TETRApc TTN per quanto riguarda le attività di CESVIT.

Partner del Progetto:

- DSI, Dipartimento di Sistemi e Informatica, Università di Firenze (software per i leggii e notazione musicale),
- Teatro alla Scala (confidenzialmente SCALA), Milano (utenti finali e validatori),
- BMG Ricordi (confidenzialmente RICORDI), Milano (utenti finali e validatori),
- Scuola di Musica di Fiesole (confidenzialmente SMF), Firenze (utenti finali e validatori),
- ELSEL, La Spezia (hardware per i leggii),
- SHYLOCK Progetti, Venezia (software per la conversione di partiture da e per altri formati "elettronici" e' gestione dell'archivio).

MOODS e' il progetto TETRApc ESPRIT IV HPCN n.25968

WWW site di MOODS: http://aguirre.ing.unifi.it/~hpcn/wwwmoods/wwwpag.html

Il progetto e' fortemente innovativo, a questo riguardo credo sia molto interessante conoscere l'opinione del Maestro C. Tabarelli del Teatro alla Scala che ci sta ospitando per questa presentazione.

Spiegazione delle motivazioni del Teatro all Scala relative alla loro partecipazione al progetto MOODS (Maestro C. Tabarelli).

Prima di spiegare cosa e' in grado di fare MOODS, e' meglio avere una delucidazione sulle attuali modalità operative che governano le relazioni fra i Teatri e le case editrici Musicali. A questo fine, e' meglio passare la parola al Maestro G. Dotto di CASA RICORDI.

1. *Stato dell'Arte (Maestro G. Dotto, BMG RICORDI)

I componenti del consorzio del progetto MOODS hanno lavorato su un problema ben conosciuto: salvare e gestire attraverso il computer l'enorme quantità di informazioni musicali usate dall'orchestra durante le prove e le esecuzioni di concerti, opere e balletti.

La quantità di informazioni usate dalle orchestre nelle esecuzioni e' enorme. Una partitura e' spesso composta da più di 100 pagine (per un'opera anche 600 o più) in formato largo, e per ogni musicista, o per ogni leggio, viene estratta la relativa parte (si consideri che le grandi orchestre hanno anche più di 100 musicisti). La presenza di un coro può comportare la presenza ulteriore di 100 coristi e l'esecuzione può durare da alcuni minuti a più di due ore.

Quando sono necessarie modifiche o speciali annotazioni scritte, la versione cartacea degli spartiti viene manipolata dal direttore o dall'archivista (prima delle prove) e dai musicisti (durante le prove). Le modifiche sono spesso significative e l'inserimento può essere un'operazione molto costosa in termini di tempo, particolarmente per balletti, o opere sinfoniche mai eseguite prima. Le modifiche più semplici consistono nell'aggiunta di simboli di interpretazione (simboli dinamici, espressioni, diteggiature, sordina, etc.). Modifiche pesanti possono anche consistere nell'eliminazione di alcune sezioni, spostare parti dello spartito, arrangiare la musica per strumenti diversi, etc.

Quando musicisti diversi utilizzano la stessa versione cartacea di uno spartito, le vecchie modifiche devono essere cancellate (quando possibile) e le nuove modifiche sono effettuate sullo stesso spartito. Se il tratto con cui sono stati inseriti i simboli e' troppo marcato, lo spartito o le singole parti devono essere sostituiti con un costo non indifferente. Entrambe le soluzioni sono particolarmente onerose dal punto del tempo necessario per l'effettuazione. D'altra parte, alcune volte le varie versioni di un certo insieme di spartiti e parti devono essere archiviati, poiché portano annotazioni di importanti interpreti o perché possono essere riutilizzate, nella stessa versione, anche dopo anni. Il costo di archiviazione, manutenzione, o sostituzione di parti può diventare insostenibile sia per i teatri che per gli editori.

Le modifiche possono spaziare da indicazioni minori, tipo quelle decise da ogni musicista ed inserite a matita sulla parte durante la prove a modifiche più sostanziali, tipo tagli o arrangiamenti, decisi dal direttore (o dal compositore, nel caso di nuovi lavori) per i quali l'archivista deve attaccare sopra o spillare pagine insieme, etc. Alcuni di questi cambiamenti più importanti dovrebbero essere decisi in anticipo, ma molte volte possono essere anche decisi durante le prove, provocando cosi' interruzioni che molto lunghe o un costo elevato per gli straordinari dell'archivista o dei copisti, fra una prova e l'altra. Tali decisioni prese sul posto sono specialmente frequenti per opere da palcoscenico tipo balletti ed opere (che sono anche i lavori teatrali per i quali e' necessaria una maggiore quantità di materiale musicale), e dove le decisioni per i cambiamenti musicali possono derivare, durante le prove, da necessita' diverse - dei cantanti, del direttore di palcoscenico, da problemi di acustica, etc. Il tempo speso aspettando le versioni modificate può raggiungere gran parte del tempo totale di una sessione di prove. Questo e' un costo significativo considerando il fatto che in molti casi i musicisti, i ballerini, i coristi, etc. sono pagati su base oraria ed in ogni caso il tempo totale stimato per la prova non puo' essere superato. E' chiaro che un sistema distribuito di leggii con la musica istantaneamente

modificabile possa portare ad un significativo risparmio di tempo e denaro.

Inoltre, in molti casi la logistica del noleggio del materiale musicale (per gli editori) o l'archiviazione di spartiti musicali (per gli archivi teatri dell'opera o delle orchestre) rende molto difficile, se non impossibile, collezionare copie di tutte le versioni di un dato lavoro dirette da personaggi diversi o per teatri diversi. Nella

migliore delle ipotesi, una copia dello spartito modificato può essere messa da parte, ma ciò non e' possibile per le singole parti. Quando una versione o produzione e' ripetuta alcune stagioni dopo, le modifiche devono essere rifatte nuovamente, generando cosi' costi ridondanti anche significativi. Una soluzione che renda possibile il salvataggio di versioni multiple, riducendo grandemente la mole di lavoro ripetitivo da svolgere, e' un importante risultato da raggiungere per molte orchestre ed editori. MOODS offre questo tipo di soluzione. Per gli editori, questa tecnologia offre il valore aggiunto di creare un enorme base di dati nel tempo, dalla quale derivare un numero potenzialmente infinito di versioni personalizzate, ed anche edizioni pubblicabili di lavori di repertorio. La metodologia della fornitura e distribuzione può anche, nel tempo, cambiare radicalmente, evitando in situazioni selezionate lo stato della carta stampata, andando verso la trasmissione digitale dell'informazione musicale, o la fornitura di CD Rom con i dati di diverse versioni. Questo stesso sistema potrebbe fornire la risposta anche ai problemi dei diritti di autore (si veda il progetto CITED della comunità europea).

La tecnologia per archiviare e prelevare tutte le varie versioni di lavori musicali saranno utili in special modo per le scuole di musica. Gli studenti potranno cosi' esaminare (ed eseguire) diverse interpretazioni dello stesso spartito. Inoltre, gli spartiti potrebbero essere richiamati istantaneamente sullo schermo in ogni istante, permettendo di programmare con risparmio di tempo prove complesse.

2. Architettura MOODS (P. Nesi, DSI)

MOODS e’ un sistema integrato di leggii per la musica basati su computer per la manipolazione cooperativa della musica e la sua visualizzazione. MOODS e' una soluzione innovativa per automatizzare e gestire l'enorme quantità di informazione utilizzata da (i) orchestre durante le prove e i concerti, opere, balletti, etc. (ii) studenti di musica durante le lezioni, (iii) editori di musica durante la realizzazione/revisione di partiture. Gli utenti finali sono i teatri, le orchestre itineranti, i gruppi di musicisti, le scuole di musica, le televisioni, e il mondo dell'editoria musicale.

1. Principali Caratteristiche e Benefici di MOODS

Le principali caratteristiche di MOODS sono:

- La riduzione del tempo necessario per modificare le partiture principali durante le prove.
- La gestione (caricamento, modifica e salvataggio) dei simboli/annotazioni strumentali sulla partiture direttoriale e sulle parti; salvando in questo modo dettagli che sono da sempre andati perduti.
- La gestione e riproduzione della velocità di esecuzione con la quale la musica e' stata eseguita dall'orchestra.
- L'automatizzazione dei meccanismi delle voltate di pagina durante l'esecuzione di brani e le prove.
- La visualizzazione in pochi minuti direttamente sui leggii degli orchestrali di partiture la cui ricerca in archivio potrebbe necessitare ore. Veloce

manipolazione di queste per arrivare alla versione definitiva da utilizzare sui leggii.

- La realizzazione veloce di cambiamenti sulla partitura e la ripartenza durante le prove da punti prefissati o da singole battute.
- La manipolazione in tempo-reale di partiture direttoriali e la produzione di tali modifiche ai musicisti direttamente alle parti in tempo-reale;

Il sistema MOODS che vedete oggi al lavoro e' il primo prototipo di un sistema molto complesso ed e' composto da 8 sistemi a microprocessore che collaborano fra di loro attraverso una rete al alte prestazioni.

In questa fase MOODS non pretende di essere un prodotto finito e robusto ma solo un prototipo avanzato per dimostrare le potenzialità della soluzione adottata e per aprire l'impiego di tale soluzione anche in applicazioni similari.

MOODS sarà ingegnerizzato dopo il completamento del progetto (a partire da novembre 1998) per arrivare alla produzione di una serie di prodotti.

L'aspetto dei leggii sarà notevolmente migliorato per trasformarli in strumenti che abbiano una aspetto più accattivante e amichevole per i musicisti.

1. Componenti del Sistema MOODS

Il progetto e prototipo MOODS e' stato realizzato utilizzando le tecnologie HPCN, il paradigma di modellazione ad oggetti (object-oriented paradigm), tecniche per specifica dei sistemi di tempo reale, sulla base dei risultati dei progetti LIOO e MSLIOO del DSI. La realizzazione del sistema MOODS ha interessato sia glia aspetti hardware che software.

Il sistema MOODS e' composto da:

- Una serie di leggii elettronici detti DLIOO (il cui acronimo significa LIOO distribuito, Distributed LIOO, Lectern Interactive Object-Oriented). I leggii possono essere configurati per stabilire i loro diritti riguardo alla manipolazione della musica. I musicisti sui singoli leggii possono modificare, aggiungere cancellare simboli della notazione musicale e simboli di interpretazione in base alle abilitazioni che hanno ricevuto. Le abilitazioni sono specifiche per ogni leggio. I PDLOO sono dei leggii totalmente non interattivi. Ogni modifica sostanziale effettuata su una parte viene inviata direttamente anche agli altri musicisti che leggono la stessa parte. Il lavoro di modifica e cooperativo nel senso che tutti i musicisti possono effettuare modifiche contemporaneamente in base alle abilitazioni che hanno.
- Uno o più leggii direttoriali detti MASE (il cui acronimo significa: MAin Score Editor). Questi possono essere utilizzati dal direttore, dal regista, dal suggeritore, etc. per modificare, visualizzare la partitura in formato direttoriale.
- Un MASAE (MAin Score Auxiliary Editor), cioè un leggio/editor per partiture musicali direttoriali che presenta la stessa funzionalità ed interfaccia utente di quello direttoriale. Questo non viene usualmente visualizzato su un leggio ma un computer potente. Per mezzo di questo leggio l'archivista opera la configurazione del sistema e ne controlla il funzionamento. In particolare, l'archivista può (i) fare modifiche sostanziali sulla partitura in tempo-reale durante le prove ed ogni modifica viene visualizzata direttamente agli orchestrali interessati (ii) indicare e correggere in tempo-reale la velocità di esecuzione della musica per aggiustare il meccanismo automatico delle voltate delle pagine. Specifiche esecuzioni possono essere memorizzate e riproposte in seguito.

Un configuratore detto ONCE (Orchestra/Network Configurator and Manager) che permette di definire le relazioni fra le macchine e le parti e aiuta l'archivista o l'attrezzista ad assegnare le parti agli specifici leggii. Sia la distribuzione della musica che la gestione delle sincronizzazioni viene effettuata tramite una rete ad alte prestazioni.

- Una base di dati (archivio informatico) per memorizzare ed effettuare ricerche di partiture e parti. L'archivio e' in grado contenere un numero più che sufficiente di partiture e parti, di configurazioni di orchestre per le varie versioni prodotte durante le prove e le rappresentazioni. Da questo se' possibile accedere direttamente alle basi di dati degli editori di musica via Internet.

La configurazione utilizzata in questa sede e' composta di 5 leggii per i musicisti (DLIOO). Questi sono di tre tipi che si differenziano per la risoluzione del sistema di visualizzazione LCD (a cristalli liquidi). Due di questi (quelli dei violini) possono essere utilizzati sia con una semplice penna che con una trackball (infatti, sono forniti di entrambe i dispositivi di interazione). Tali dispositivi sono utili per aggiungere simboli e sfruttare le funzionalità del sistema. Gli altri utilizzano trackball. I leggii sono dei sistemi a microprocessore, dei computer, specificatamente costruiti per questo scopo da ELSEL e sono basati su tecnologia INTEL Pentium 133 Mhz.

La stazione del direttore, MASE, e' una Personal Computer Hewlett e Packard ad alte prestazioni. Esso e' dotato di un monitor ad alta risoluzione (1600 x 1200 punti).

La stazione di controllo del sistema, cioè quella dell'archivista, detta MASAE, e' una workstation ad alte prestazioni della Hewlett and Packard, B32L, una macchina RISC.

Il supporto di rete per la comunicazione fra le macchine e' basato su tecnologia 100 BT di Hewlett and Packard.

Tutte le macchine utilizzano come sistema operativo un derivato di UNIX. La macchina utilizzata come base di dati (l'archivio) e' un Personal Computer ad alte prestazioni. Le altre macchine sui tavoli sono per la registrazione audio/video dell'evento.

1. *Relazioni fra i Leggii

I leggii ricevono dalla stazione dell’archivista (MASAE) tutte le informazioni per visualizzare automaticamente la pagina corrente della spartito per mezzo della rete. Sui DLIOO è visualizzata la parte musicale dello strumento cui il DLIOO è stato assegnato. Per ogni DLIOO, insiemi diversi di simboli di interpretazione sono presenti in funzione dello strumento assegnato al leggio. I cambiamenti effettuate sui DLIOO in modalità di modifica sono inviate in tempo reale al MASAE per la visualizzazione ed il salvataggio.

I DLIOO sono organizzati in accordo alla gerarchia dell’orchestra. I DLIOO di primo livello sono qualificati per effettuare modifiche sulla parte corrente (simboli principali e di interpretazione), mentre gli altri possono essere attivi o passivi. I leggii attivi hanno la stessa possibilità di quelli di livello superiore, mentre gli ultimi (PDLOO) possono solo visualizzare la partitura e le modifiche su di essa effettuate dai leggii di livello superiore.

Questa organizzazione gerarchica, permette allo strumento leader di un gruppo (i.e., il 1^{mo} violino) di trasmettere direttamente ai leggii da lui dipendenti (i.e. i violini) le modifiche effettuate sulla parte. Alcune volte può accadere che esistano due 1^{mo} violino: in questo caso uno dei due è ha le abilitazioni per compiere le modifiche e rifletterle sugli altri violini pur essendo gerarchicamente inferiore al leader, operando così in maniera realmente cooperativa. Si noti che in ogni caso le modifiche effettuate sono inviate al MASAE. Il lavoro cooperativo fra i leggii è possibile poiché è presente una rete molto affidabile e con alte velocità.

Ogni modifica, effettuata sullo spartito utilizzando i leggii del direttore o dell'archivista, è inviata in tempo reale ai leggii coinvolti nella modifica rispettando le associazioni fra le parti e i leggii fisicamente connessi attraverso la rete (ciò avviene per mezzo dell'ONCM).Si noti che le modifiche sulla partitura direttoriale possono includere sia simboli classici sia di interpretazione. Dalla postazione dell'archivista (MASAE) è anche possibile costruire ex-novo nuove partiture e modificare spartiti già usati senza farli apparire sui leggii degli orchestrali.

2. *Capacità di manipolazione della musica di MOODS

Dal 1970 esistono sul mercato molti programmi professionali per la manipolazione e la visualizzazione della musica tramite l'ausilio del computer: Score, Sibelius, Finale, Encore, Graphire Music Press, etc. Molti altri programmi non professionali sono disponibili sul mercato, ma essi sono principalmente basati sull'esecuzione della musica tramite l'interfaccia MIDI: Darms, Csound, QuickScore, CUbase, Cakewalk Express, Lime, MasterScore, MusicShop, Hightingate, Music Manuscript, Music Time, Notator, Overture, etc.

Si noti che, negli ultimi anni, gli editori sono più interessati all'uso di programmi professionali, la cui adozione dal 1991 ha comportato la produzione di molti spartiti musicali creati al computer. D'altra parte, a causa della continua evoluzione dei programmi per l'editoria musicale e al fatto che esiste un mercato solo per la versione cartacea degli spartiti, le versioni elettriche di essi sono presenti solo negli archivi degli editori.

Si noti anche che, nel campo musicale, sono presenti molti progetti della Comunità Europea, finalizzati in particolar modo all'archiviazione musicale: JUKEBOX, per la gestione di archivi musicali in formato audio; MODE, tecniche per inviare musica in formato audio e cartaceo tramite Internet; PARAGON, studio delle tecniche e di metodi per la gestione degli archivi musicali attraverso Internet; CITED, gestione dei diritti di autore finalizzata al noleggio elettronico tramite Internet; CANTATE, definizione di una architettura client-server per la distribuzione della musica in diversi formati; HARMONICA, un'azione combinata sui progetti nel campo dell'archiviazione musicale; E-MOLL, lo sviluppo reale del progetto CANTATE.

Il Progetto MOODS ha tenuto in considerazione i risultati prodotti da tali progetti con particolare attenzione a CANTATE, E-MOLL e HARMONICA. Tale riguardo verso i progetti esistenti è garantito dalla presenza di SHYLOCK fra i componenti del consorzio MOODS.

L'interfaccia utente e la raccolta di simboli musicali di MOODS sono state definite dopo un'accurata analisi effettuata intervistando editori musicali, direttori, archivisti, insegnanti di scuole di musica, musicisti ed eseguendo esperimenti pratici sull'utilizzabilità.

- Nessuno dei sistemi professionali commerciali per l'editoria musicale e' completamente soddisfacente per la scrittura della musica e per l'estrazione delle parti. La stessa informazione deve essere rappresentata in modo diverso nella partitura e nelle parti. Nella partitura i simboli strumentali vengono omessi e ogni battuta e' completamente sviluppata; nelle parti si dovrebbe fare uso della simbologia abbreviata il più possibile. Richiami devono essere posti dopo lunghe pause, informazioni aggiuntive relate alla presenza di varie voci devono essere inserite nei punti critici. Nelle modifiche, il tipo di informazione inserita dai musicisti (nelle loro parti) e' spesso diversa da quella utilizzata nella partitura direttoriale.

- Solo pochi sistemi professionali predispongono simboli di interpretazione per alcuni strumenti e nessuno gli offre per tutti. Perfino, sistemi e modelli ben conosciuti come Finale, NIFF, SMDL, Score, etc., sono completi da questo punti di vista.

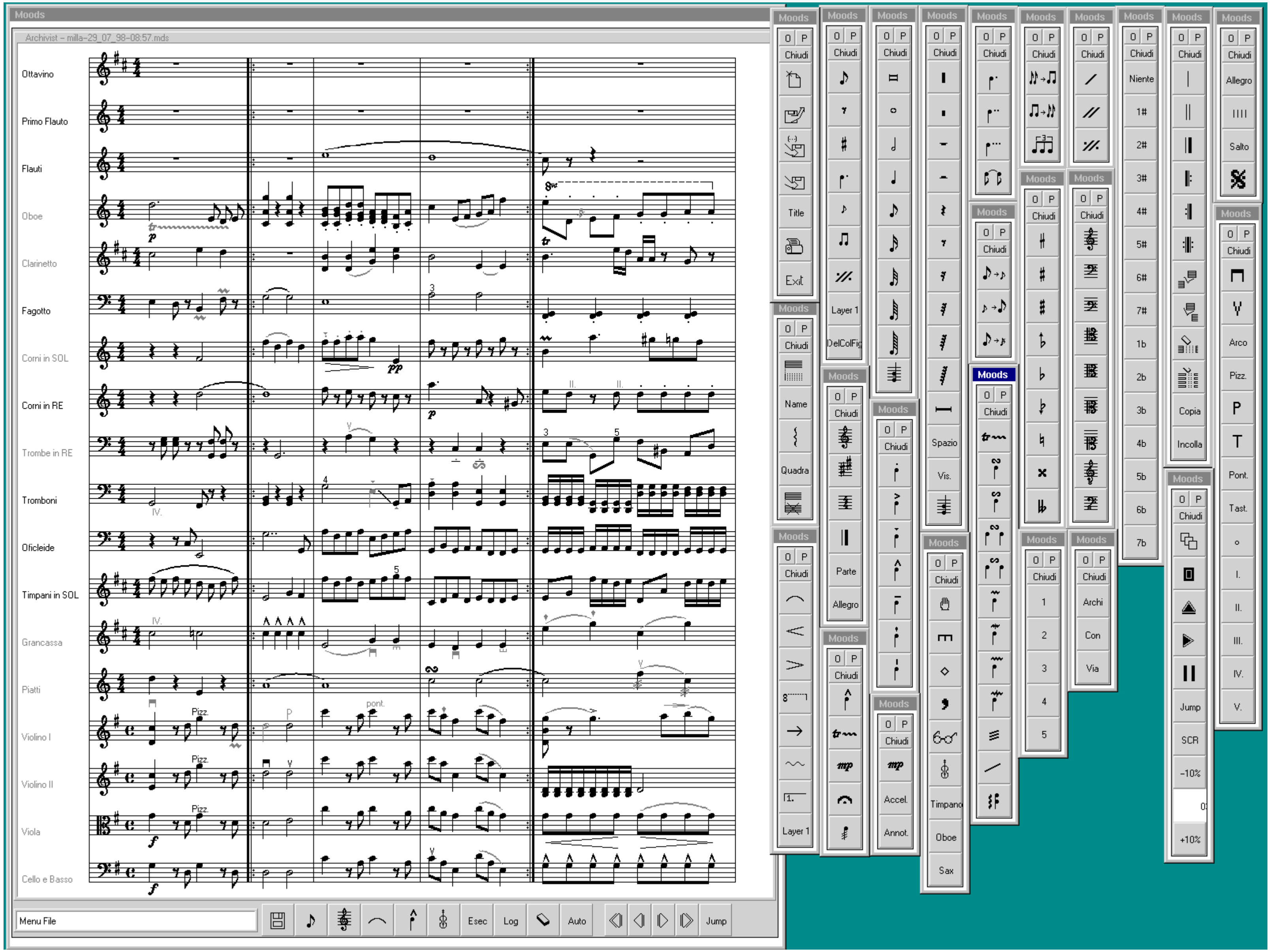
I sistemi per l'editoria musicale sono infine troppo complessi per essere utilizzati dal vivo da musicisti durante le prove e rappresentazioni. Questo e' dovuto al fatto che sono stati realizzati principalmente per soddisfare le necessita' dei copisti nell'editoria musicale e non quelle dei musicisti che necessitano di agire in breve tempo direttamente sulla partitura in modo semplice, con una penna o con una trackball.

- MOODS adotta un modello uniforme per gestire partiture complete e singoli spartiti con un'interfaccia utente molto semplice da utilizzare; infatti, per la sua gestione possono essere utilizzati i più diffusi sistemi di puntamento: mouse, trackball e penne. Tutti i menu possono essere posizionati orizzontalmente o verticalmente in qualsiasi punto dello schermo garantendo la selezione veloce dei simboli da posizionare sullo spartito.

- MOODS riesce a gestire sia i simboli fondamentali che quelli legati all'interpretazione dei vari strumenti; tale insieme di simboli può essere ampliato con uno sforzo contenuto.

- MOODS adotta un formato proprietario innovativo per il salvataggio ed il caricamento di spartiti da archivi musicali così come da CD. Tale formato è stato definito sulla base di quello usato nei progetti LIOO e MSLIOO del DSI.

- Gli spartiti musicali in formato SCORE e FINALE possono essere convertiti abbastanza velocemente nel formato MOODS.



La musica riportata nella partitura mostrata nella figura precedente non ha alcun senso musicale, è stata creata solamente per dimostrare le possibilità dell'interfaccia utente del MASAE.

1. **MOODS Durante l'Esecuzione**

Il meccanismo della voltata di pagina è gestito da MASAE durante l'esecuzione sulla base di regole discusse nel seguito. Si noti che i diversi strumenti, che hanno ovviamente parti diverse assegnate, hanno la voltata di pagina in istanti di tempo diversi; ciò è dovuto alla differenza nella quantità di simboli musicali presenti in ogni parte.

Durante l'esecuzione, sul leggio direttoriale (MASE) la pagina successiva a quella correntemente in esecuzione è visualizzata da sinistra verso destra, non appena le battute della pagina in esecuzione sono state eseguite; lo schermo è quindi diviso in due settori, quello più a destra che presenta la pagina in esecuzione e che gradualmente si riduce a favore del settore a sinistra, nel quale viene mostrata la pagina da eseguire successivamente; per quanto riguarda i leggi dei musicisti invece la sovrapposizione fra la pagina in esecuzione e quella successiva avviene dall'alto verso il basso non appena i pentagrammi vengono eseguiti. Utilizzando queste modalità il modo di leggere la musica da parte del direttore e dei musicisti non cambia.

1. Ringraziamenti (P. Nesi, DSI)

Come coordinatore ho il piacere ed il dovere di ringraziare:

- Il Teatro alla Scala per averci ospitato e per il suo supporto fattivo nella preparazione della dimostrazione.
- La European Commission per aver finanziato MOODS e per averlo supportato in questo anno di lavoro. In sala vi sono alcuni rappresentati della EC ed i revisori del progetto stesso.
- Il TETRApc TTN: CESVIT, CPR e ARTIC per il loro supporto: Ing. Maurizio Campanai, Dr. Cinzia Giachetti e i molti altri che ci hanno aiutato durante la definizione del consorzio e la sua realizzazione.
- Un ringraziamento speciale all'Ing. Silvestro Mitolo del CESVIT che sollecito' il nostro gruppo di ricerca al lavorare su queste tematiche.
- A ringraziamento particolare al Prof. Fabio Uccelli per il suo aiuto fattivo ed efficace durante la costituzione del consorzio.
- Hewlett and Packard Italia per aver aiutato il DSI su MOODS ed altri progetti, con Computer ad elevate prestazioni e con un supporto di rete ad alta velocità.
- RICORDI (Maestro Gabriele Dotto), SCALA (Maestro Carlo Tabarelli) e La Scuola di Musica di Fiesole, SMF (Maestro Nicola Mitolo) per la loro pazienza e capacita' durante il lungo lavoro di revisione della notazione musicale.
- I molti collaboratori ed amici che hanno lavorato al progetto MOODS al DSI trasformando i primi risultati in quello che oggi possiamo mostrarvi. Dobbiamo la nostra presenza qui a loro.

Personalmente voglio ringraziare il Prof. Giacomo Bucci del DSI per il suo supporto e incoraggiamento sin dalle prime fasi del lavoro al DSI. Un ringraziamento a tutti i membri del DSI (Dipartimento di Sistemi e Informatica) che hanno seguito con estremo interesse il progetto; ed infine, la Facoltà di Ingegneria per avere ospitato le prove del progetto MOODS in Luglio.

Un caloroso ringraziamento ai molti competenti musicisti che hanno collaudato MOODS e che sono qui oggi, alcuni hanno visto il sistema MOODS ieri per

la prima volta, ma sono qui oggi per dimostrarne le funzionalità e l'usabilità.

1. ## I Musicisti

Dal punto di vista musicale, l'organizzazione della dimostrazione come quella delle prove che si sono svolte a Firenze e' stata effettuata dalla Scuola di Musica di Fiesole, SMF (Maestro Nicola Mitolo).

L'esecuzione della musica sarà diretta dal Maestro Carlo Moreno Volpini.

I musicisti coinvolti nella dimostrazione sono:

- Claudio Fredducci (I Violino, Orchestra Regionale Toscana, Orchestra Maggio Musicale Fiorentino)
- Andrea Cortesi (I Violino, Città di Castello)
- Nicola Mitolo (II Violino, Scuola di Musica di Fiesole)
- Patrizia Ronconi (II Violino, Conservatorio Luigi Cherubini, Firenze)
- Carmelo Gianlombardo (Viola, Scuola di Musica di Fiesole)
- Giovanni Prosdocimi (Viola, Scuola di Musica di Fiesole)
- Veronica Lapiccirella(Violoncello, Orchestra Maggio Musicale Fiorentino)
- Benedetta Chiari (Violoncello, Conservatorio Luigi Cherubini, Firenze)
- Francesco Tomei (Contrabbasso, Conservatorio Luigi Cherubini, Firenze)

Il ruolo dell'archivista del tetro e' coperto da: Timna Panfietti Monaco e/o Antonio Albino (DSI).

Il ruolo del configuratore di MOODS e' coperto da: Pierfrancesco Bellini (DSI)

1. # La Musica Eseguita durante la Dimostrazione (Maestro C. Tabarelli, Teatro alla Scala)

Le musiche utilizzate durante le prove e per le esecuzioni durante la dimostrazione sono state scelte all'inizio del progetto quali punti di riferimento per la musica in teatro, ed in particolare:

- ``Eine kleine Nachtmusik'' (Serenata in G) di Mozart (primo movimento);
- Le 4 Stagioni di Vivaldi (La primavera, primo movimento);
- La Traviata di Verdi (il preludio del primo atto);
- La Traviata di Verdi (il preludio del terzo atto);

Altri pezzi che sono stati utilizzati:

- Linda di Chamonix di Donizetti (sinfonia) per un gruppo comprensivo di due violini, una viola, un violoncello ed un contrabbasso;
- Suite dei Boschi di A. Ferrari (IV movimento) per un gruppo comprensivo di un violino, un pianoforte, un flauto ed un chitarra.

1. Archive Management and Format Conversions (Dr. S. Moro, SHYLOCK)

Questa parte del sistema MOODS svolge due funzioni essenziali nell'uso reale:

- l'archiviazione delle partiture elettroniche nelle loro multiple versioni
- la conversione delle partiture da formati diversi da MOODS al linguaggio MOODS

L'archivio delle partiture in teatro

Quando il sistema MOODS dovrà gestire un grande numero di partiture elettroniche, ciascuna delle quali in più di una versione (dopo interventi di modifica durante le prove) e formato, MOODDB (MOODS database) offre le funzioni standard di catalogazione del programma ARCHImusica (di Shylock Progetti, un software specialmente dedicato a biblioteche e archivi musicali), arricchito per il progetto MOODS di un sistema di gestione delle differenti versioni di partiture impiegate dai leggi MOODS. Questo modulo serve da database locale del teatro o dell'orchestra. Un'interfaccia WWW (Intranet) anch'essa sviluppata per MOODS consente all'archivista di usare MOODDB o dal proprio ufficio su sistemi Wondows (vers. 3.1, 95, 98, NT 4.0) o dalla stessa stazione MASAE nella sala da concerto.

L' archivio delle partiture presso l'editore

Anche l'editore musicale ha l'esigenza di gestire il proprio catalogo di musica a stampa su computer, con un numero presumibilmente crescente di edizioni provviste anche della versione elettronica, ed eventualmente offrire tali partiture elettroniche direttamente via Internet.

Il Teatro richiede una partitura all’Editore

Il sistema MOODDB consente all'archivista di ricercare la partitura desiderata sia sull'Archivio locale del teatro che sul catalogo elettronico remoto dell'editore. Dato che BMG-Ricordi ha recentemente installato il proprio catalogo a noleggio su un sistema ARCHImusica provvisto di modulo ARCHIweb, può essere dimostrata una ricerca remota (dal teatro all'editore) via Internet, assieme al recupero immediato della partitura elettronica. Questa applicazione è stata ingegnerizzata su di un prototipo sviluppato in un altro progetto co-finanziato dalla UE, CANTATE (Computer Access to NoTation And TExt, 1996-1997)

Partiture elettroniche in diversi formati

Come per ogni testo su computer, il formato dei dati dipende dal programma usato per produrlo. Così è per la musica, laddove negli ultimi dieci anni diversi programmi di scrittura musicale sono stati impiegati per produrre la maggior parte delle pubblicazioni musicali.

MOODDB include un programma di conversione bi-direzionale da uno dei più diffusi formati (SCORE di Leland Smith) a MOODS e viceversa, permettendo al sistema MOODS di caricare e modificare anche partiture originariamente ricevute in quel formato. Esistono altri programmi sul mercato che convertono in SCORE uno degli altri più popolari formati (Finale di Coda Publishing), e così attualmente MOODS può alimentarsi da file prodotti da entrambi quei programmi.

1. *Consorzio e Progetto: Aspetti Storici

Negli anni 70’ sono comparsi i primi programmi per la gestione computerizzata della musica, come si può verificare consultando le pubblicazioni internazionali: [Abbott85], [Anderson91b], [Gordon85], [Gourlay86], [Loy85]. Tali approcci erano focalizzati alla manipolazione della musica, alla generazione, alla memorizzazione della musica in formati audio e simbolici, alla visualizzazione della musica per l’eventuale sostituzione della carta. Sin dai primi anni 80’ sono stati presentati studi sul riconoscimento di caratteri musicali al fine di convertire partiture da formato cartaceo a formati "elettronici". In [Morita91] si parla anche si inseguimento automatico della bacchetta del direttore al fine di dare la possibilità a un computer che genera musica di inseguire l’interpretazione del direttore. Pertanto l’idea del leggio elettronico e’ vecchia quanto il computer e la video scrittura. Lo dimostrano i vari tentativi, sia in Italia che all'estero, che vi sono stati in passato da parte di singoli e case costruttrici di strumenti. Queste hanno provato ad inserire piccoli display per la visualizzazione della musica direttamente sulla tastiera stessa.

Dietro alla visualizzazione della musica vi erano ovviamente enormi problemi tecnologici e formali, dovuti (i) alla bassa risoluzione dei dispositivi di visualizzazione dell’epoca; (ii) alla modellazione software della musica come linguaggio grafico con complesse regole di posizionamento dei simboli; e (iii) ai problemi architetturali software.

Pertanto, l’idea del leggio elettronico, come moltissime altre, e’ rimasta nell’immaginazione collettiva per molti anni, ma aveva bisogno di soluzioni tecnologiche innovative per essere realizzata. Lo dimostrano i vari tentativi di cui e’ testimone la letteratura scientifica internazionale, nazionale ed i vari costruttori di strumenti.

Recentemente, riguardo al punto (i), le nove tecnologie hanno permesso la realizzazione di LCD TFT ad alta risoluzione. Sulla modellazione della musica con tutte le sue regole sono stati scritti decine di trattati per migliaia di pagine. Pertanto non si e' certo arrivati ad una sua standardizzazione anche se l'informatica potrebbe essere una buona leva per raggiungere tale obiettivo; lo dimostrano gli oltre 200 programmi commerciali per l'immissione, la manipolazione, l'esecuzione di musica tramite computer che sin dagli anni '70 sono stati messi in commercio.

I problemi architetturali sono senza dubbio i più complessi da risolvere; tecnologie sperimentali dell'ingegneria del software e la telematica, nelle tecnologie HPCN (High Performance Computer Networking), hanno potuto risolvere tali problemi come dimostrato dalla realizzazione del progetto MOODS.

Tornando ai presupposti storici del progetto MOODS e' necessario spendere due parole su quali sono stati i presupposti che hanno dato la possibilità di realizzare il progetto MOODS.

Sulla base dei risultati ottenuti da DSI nell'attività di ricerca che aveva condotto ai prototipi LIOO nel Gennaio 1995 e MSLIOO nel 1996, alcuni dei futuri partner del progetto MOODS iniziarono i contatti per la costituzione di un consorzio.

Nei primi del 1996, venne istituito TETRApc TTN (Technology Transfer Node), un consorzio (finanziato dalla Comunità Europea) composto da CPR (Centro Pisa Ricerche), CESVIT e CSM. Il TETRApc TTN ha come scopo la promozione e la divulgazione delle tecnologie HPCN (High Performance Computer Networking) in ambito Nazionale ed in sinergia con altri TTN sparsi sul territorio Europeo. Fra i compiti del TTN vi e' quello di facilitare la sottomissione di richieste di finanziamento e quindi di indirizzare le aziende verso l'utilizzo di nuove tecnologie. Questo incarico ha dato lo spunto a CESVIT e DSI (e' responsabile scientifico per il CESVIT del TETRApc) per rilanciare il progetto LIOO/MSLIOO al fine di avere un finanziamento per realizzare quello che oggi e' il sistema MOODS. L'evoluzione in ambiente distribuito del sistema LIOO/MSLIOO dava la possibilità concreta di realizzare un prototipo per le orchestre, scuole di musica, etc. Il progetto doveva essere tipicamente un'operazione di utilizzo delle tecnologie HPCN in un sistema che poteva con tali tecnologie aprire nuove strade, anche per dimostrare che tali tecnologie potevano se applicate produrre sistemi con soluzioni tecnologiche innovative.

Nel 1996, il consorzio venne costituito: DSI (Dipartimento di Sistemi Informatica, Università degli Studi di Firenze), SCALA (Teatro alla Scala), RICORDI (BMG Ricordi, Casa Ricordi), ELSEL S.r.L., SHYLOCK Progetti, SMF (Scuola di Musica di Fiesole).

Le tre realtà degli utenti potenziali: orchestre, case editrici musicali e scuole di musica erano rappresentate ad alto livello come i partner tecnologici-industriali. A Marzo 1997 il progetto fu accettato per il finanziamento, il 16 Luglio 1997 poté partire in modo ufficiale. La sua conclusione e' prevista per la fine di Ottobre 1998. Fin dalla prima formulazione il coordinatore del progetto/consorzio MOODS e' stato il Dr. P. Nesi del DSI.

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2. Conclusioni e Futuro (P. Nesi, DSI)

Speriamo che la dimostrazione sia stata di Vostro gradimento.

E' ovviamente impossibile dare una completa dimostrazione di tutte le caratteristiche del sistema MOODS per mezzo di una sola dimostrazione in cosi' breve tempo. Il progetto e' iniziato come progetto interno del DSI nel 1994 ed e' diventato il progetto MOODS nel 1997 con l'aggiunta di moltissimi contributi oltre a quelli dei partner. In questi anni un considerevole numero di aziende e persone sono state coinvolte per arrivare a questo risultato, e' doveroso ringraziarli ancora una volta.

Dalle prime fasi di collaudo sul campo, MOODS e' stato considerato dai musicisti che lo hanno provato, uno strumento utile sia in orchestra che nelle scuole di musica. Le funzionalità di MOODS lasciano all'animo artistico del Compositore e/o del Direttore più spazio per sperimentare nuovi effetti ed arrangiamenti in pochi minuti. E’ nostra opinione che MOODS apre una nuova era per l'espressività artistica di direttori e maestri stabilendo un risposta diretta fra ciò che il direttore chiede e il risultato prodotto dall'orchestra o nella classe di musica. MOODS apre una nuova strada che potrà nei prossimi anni dare vita ad una vera e propria rivoluzione nel mondo dell'editoria musicale e dei teatri. Cambierà anche l'approccio che i musicisti potranno avere nei riguardi delle partiture musicali.

Il progetto MOODS sarà completato il 31 Ottobre 1998. Qualsiasi attività formale correlata a MOODS dovra' comunque essere coordinata dal Coordinatore del progetto.

Il completamento del progetto no significa che lo sforzo effettuato sarà abbandonato. I risultati saranno sfruttati a pieno:

- ELSEL intende procedere alla ingegnerizzazione del prototipo e alla commercializzazione di prodotti derivati da MOODS come di sistemi interi a partire dalla seconda meta' del 1999.
- SHYLOCK intende supportare tale sforzo provvedendo con una base di dati e i convertitori per le partiture musicali.
- RICORDI e' fortemente interessata a commercializzare i risultati del progetto MOODS.
- DSI continuerà il suo lavoro di ricerca sfruttando i risultati in nuove aree: gestione integrata degli effetti speciali con la musica in applicazioni televisive e teatri, conversione del di partiture da formato cartaceo a formato elettronico, generazione di musica da MOODS, etc.

- SMF potrà essere coinvolta nell'organizzazione di corsi speciali per e con l'utilizzo di MOODS.

Per cortesia compilate e consegnate il questionario che vi e' stato consegnato con la documentazione. Per noi, e' molto importante conoscere la Vostra opinione circa la dimostrazione che avete visto.

Come portavoce del progetto MOODS, sarà un piacere rispondere alle vostre domande.

Contattate il Coordinatore del Progetto per mezzo dei riferimenti riportati in copertina se:

- Siete interessati, come giornalisti o editori, ad avere piu' informazioni o a pubblicare articoli tecnici su MOODS.
- Siete interessati ad avere maggiori informazioni su MOODS o ad assistere a una dimostrazione più tecnica.
- Siete interessati all'evoluzione di MOODS come future e progetti innovativi.

MOODS

Music Object Oriented Distributed System

An activity within the: TETRApc-TTN

MOODS Demonstration

22-Sept.-1998, Teatro alla Scala, Milano

Workpackage: WP7

Availability: Public

Version: 1.2

Date: 15/9/98

Partner responsible: DSI

Partners involved: DSI, SCALA ELSEL, SMF, RICORDI, SHYLOCK

Project and Consortium Coordinator:

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www: http://aguirre.dsi.unifi.it/~hpcn/wwwmoods/wwwpage/html

Program: 22 Sept. 1998

16:30 -Welcome
(Project Coordinator: P. Nesi, DSI and Maestro C. Tabarelli, Teatro alla Scala)

16:40 -State of the Art (Maestro G. Dotto, BMG RICORDI)

16:50 -MOODS Architecture, aim, and acknowledgements (P. Nesi, DSI)

17:05 -Music that will be Executed (Maestro C. Tabarelli, Teatro alla Scala)

17:15 -The load and the execution of Serenade in G of Mozart

-A short explanation of what has been shown

17:25 -The load and the execution of La primavera (Le 4 Stagioni di Vivaldi)

17:35 -Archive Management and Format Conversions (Dr. S. Moro, SHYLOCK)

17:45 -The load and the execution of Traviata I, Verdi

-A short explanation of what has been performed

17:55 -The load and the execution of Traviata III, Verdi

18:05 -Conclusions and Future Work (P. Nesi, DSI)

Table of Contents

The points marked with * will be summarized or omitted during the demonstration. They have been included in this document to give a more complete view of MOODS project.

1. Welcome (P. Nesi, DSI, Maestro C. Tabarelli, Teatro alla Scala)

We are here today to present the results of MOODS project.

This is the absolutely first public presentation of MOODS project.

MOODS is a project partially founded by the European Commission in the HPCN (High Performance Computer Networking) domain of the ESPRIT. The project is only one of the several projects using the HPCN technology Italy. The EC has established a network of TTN (Technology Transfer Node) to increase the diffusion of HPCN technology. In this case, project MOODS is an activity with TETRApc TTN, supported by CPR (Consorzio Pisa Ricerche, Pisa, Italy), CESVIT (High Tech Agency, Florence, Italy).

In this view, I am the MOODS Project/Consortium Coordinator and the Scientific Responsible of TETRApc TTN for CESVIT part and activities.

Project partners:

- DSI, Dipartimento di Sistemi e Informatica, Università di Firenze, Italy (software for lecterns and music notation),
- Teatro alla Scala (confidentially SCALA), Milano, Italy (end-user and tester),
- BMG Ricordi (confidentially RICORDI), Milano, Italy (end-user and tester),
- Scuola di Musica di Fiesole (confidentially SMF), Firenze, Italy (end-user and tester),
- ELSEL, La Spezia, Italy (hardware of lecterns),
- SHYLOCK Progetti, Venezia, Italy (software for music score conversion and archive management).

MOODS is a TETRApc ESPRIT IV HPCN Project n.25968

WWW site of MOODS: http://aguirre.ing.unifi.it/~hpcn/wwwmoods/wwwpag.html

The project is really innovative, and it could be very interesting to know the opinion of Maestro C. Tabarelli of the Teatro alla Scala that his hosting us for this presentation.

Explanation of the motivation of Teatro all Scala in participating in MOODS project (Maestro C. Tabarelli).

Before to explain what MOODS is, it is better to explain the current operative way of theatres and music publishers. To this end, I would like to pass this work at Maestro G. Dotto of CASA RICORDI.

1. *State of the Art (Maestro G. Dotto, BMG RICORDI)

The partners in the MOODS project have worked on a well-known problem: storing and managing via computer the enormous amount of musical information used by orchestras during rehearsals and public performance of concerts, operas or ballets.

The amount of information to be managed by orchestras in performance is huge. A main score is often comprised of more than 100 pages (for an opera, as many as 600 or more pages) in large format, and each musician, or every lectern, a specific derived single "part" (involving, for larger orchestras, over 100 musicians). When a chorus is present it can number over 100 choristers. And the performance time can range from a few minutes to over two hours.

When modifications or special written instructions are required, paper versions of main scores and individual parts are usually manipulated by the conductor or the archivist (before rehearsals) and by musicians (during rehearsals). The modifications are often quite significant and inserting them can be very time consuming, particularly in the case of operas and ballets, or of new symphonic works. Simple modifications consist in adding interpretation symbols (dynamics, expression marks, string bowings, mute on/off, etc.) or modifying other figures (ties, slurs, measure, etc.). Heavy modifications can also consist in omitting sections, moving score parts, adding new portions of score, arranging the music for different instruments, etc.

When different musicians use the same paper version of a music score, old modifications must be deleted (if possible) and new modifications are made on the same scores. If the marks are too heavy, the scores or parts must be replaced, at significant cost. And both processes are particularly time-consuming. On the other hand, sometimes various versions of a set of score and parts must be kept in an archive, since they carry the interpretation marks of important interpreters or because they can be required, in the same version, even years later. The costs of storing, maintaining or replacing multiple unique sets of parts can become exorbitant both for theater archives and publishers.

Modifications can range from minor indications or changes decided by each musician and inserted by pencil on the parts during rehearsals, to major cuts or alterations decided by the conductor (or composer, in the case of new works) for which the archivist must insert paste-overs, clip pages together, write in long passages of in place of rest, et cetera. Some such major changes may be decided before hand, but many may be decided during the rehearsal period, necessitating time-consuming interruptions of the rehearsal time or else costly extra time of archivists and copyists between one rehearsal and the next. Such major, on-site decisions are especially frequent with stage works like operas and ballets (which are also the works which involve the largest amount of musical material), where decisions for musical changes can derive, during rehearsals, from various needs – of singers, of stage directors, problems of acoustical space, etc.

The time spent in waiting for the adapted version of a score and parts can reach large amounts of the total time allotted for a rehearsal. This is a significant cost considering that in many cases musicians, dancers, choristers, supernumeraries, etc. are on an hourly wage and, in all cases, the total time allotted to rehearsals is fixed. It is clear that a distributed system of lecterns with instantly modifiable music would result in impressive cost and time savings.

Further, in many cases the logistics of renting music material (for publishers) or storing sets of music scores and parts (for opera-theater or orchestra archives) make it difficult, if not impossible, to retain copies of all the various versions generated of a given work by different conductors or theater productions. At best, a copy of a modified score may be set aside, but not the full set of parts. When a specific version or production is repeated some seasons later, the modifications have to be re-generated, creating redundant costs that can be significant. A solution that would make storage of multiple versions possible, and greatly reduce the amount of repetitive work involved, is an important goal of many performing organizations and publishers. MOODS offers just such a solution.

For publishers, this technology offers the added solution of creating a huge data-base over time from which to derive and store a potentially infinite number of personalized versions, and even of various, publishable "editions" of repertory works. The methodology of supply and distribution could also, over time, change radically, avoiding in select cases the "printed paper" stage of supply altogether, and transmitting digital music information directly to theaters and performing organizations, or supplying CD Roms with the stored data of any number of versions. This same system would offer exact accounting for copyright purposes (see project CITED of EC).

The technology for storing and recalling all various versions of musical works will be especially useful for schools of music. Students can thus examine (and perform) different interpretations of the same score.

Moreover, scores can be called up instantly on screen at any time, allowing for the programming of time-saving, complex rehearsal schedules.

2. MOODS Architecture (P. Nesi, DSI)

MOODS consists in an integrated system of computer-based lecterns/stands for cooperative editing and visualization of music. MOODS is an innovative solution for automating and managing the large amount of information used by (i) orchestras during rehearsals and public performance of concerts, operas, ballets, etc. (ii) students of music during lessons in conservatories and schools of music, (iii) publishers during massive editing of music. The targeted end-users are theatres, itinerant orchestras, groups of musicians, schools of music, television network orchestras, and publishers of scores.

1. Main Features and Benefits of MOODS

The main features and benefits of MOODS are:

- reducing the time needed for modifying main scores and parts during rehearsals;

managing (loading, modifying and saving) the instrumental and personal symbols on main score and parts; Thus saving artistic details never save up to now;

- managing and reproducing the exact execution rate (tempo) in which each measure of the score has been executed;
- automating the turning of pages during rehearsals and final performances;
- visualizing in few minutes scores that usually have to be searched into the database and copied/ adjusted before to be shown on the lecterns of musicians;
- fast changing of music pieces or restarting from marked points, or arrangement;
- manipulating in real-time main score and parts as a whole music score, thus presenting the final version of the score in real time to musicians;

Please consider that the prototype that you will see at work is the first prototype of very complex system. It is comprised of 8 microprocessor-based systems that work all together by mean of a high-performance.

In this phase, MOODS does not pretend to be a complete and robust product but only an advanced prototype for demonstrating the potentiality of the solution and for opening its adoption in many several other application fields.

It will be engineered after the project completion to make from it a set of derived products.

The look of the lecterns will be strongly improved to transform them into cold tools for the musicians.

1. MOODS Components

MOODS project and prototype have been implemented by using technologies based on: HPCN, object-oriented paradigm, real-time technique, on the basis of the results of projects LIOO and MSLIOO of DSI. The implementation of MOODS prototype involves both hardware and software aspects.

A MOODS system is comprised of:

- a set of lecterns for musicians, called DLIOOs (Distributed LIOO, which means Lectern Interactive Object-Oriented). Lecterns can be configured in order to establishing the rights for modifying music, the possibility to add/delete specific symbols can be granted or forbidden. PDLOO are non interactive DLIOOs. Each substantial change performed on a lectern is sent in real-time to all the other musicians reading the same part. The work of score modification/adjustment is cooperative, in the sense that all musicians can perform changes at the same time on the same part on the basis of their habilitations.
- A or more lecterns for directors called MASE (MAin Score Editor). These can be used by the directors, conductors, director of chorus, to show, visualize and modify the main score according to their permissions.
- A MASAE, a MAin Score Auxiliary Editor which is strictly related to MASE and presents the same user interface. This is a music editor/lectern by means of which the archivist can (i) make even heavy modifications on score during rehearsals or score revision and (ii) beat time indicating the

measure under execution, thus correct the time of the automatic turning of pages of all lecterns during performances. Specific executions and scores can be stored and retrieved by using this station.

- ONCE: the Orchestra/Network Configurator and Manager. It is an application running on the same machine of MASAE for establishing the configuration relationships among lecterns and controlling the Network. The distribution of music and the synchronization among lecterns passe by means of a high performance network.
- A database for storing and retrieving main scores and parts. It is a workstation endowed with a suitable hardware for containing a huge archive of scores and orchestra configurations, etc. In teh same database also configurations and permission profiles are stored. From MASAE it is possible to access to all information contained into the database. From the database it is possible to establish a direct connection to the publisher in order to acquire the rights of a main score or the score itself, by using Internet.

The configuration used at the demonstration at the Teatro alla Scala is comprised of 5 lecterns for musicians (DLIOO). These are of three different types and are differentiated for resolution of the LCD monitor. Two of them (those used for violins) can be used with both a simple pen and a trackball for adding symbols, the other support only the trackballs. Two different types of trackball are available. The lecterns are special purpose machines designed by ELSEL and are based on Pentium 133 Mhz.

The MASE station is a Hewlett and Packard Personal Computer with high performance. It is endowed of an high resolution monitor of HP for a total of 1600 x 1200 pixels.

The MASAE station is the core of the system and is a Hewlett and Packard workstation B32L, a RISC machine.

The Theatre Network is based on a support at 100 BT of Hewlett and Packard.

All the above machines are based on UNIX-like operating system.

The machine devoted for the Database is a high performance Personal Computer.

The other machines on the desks are only for the audio/video recording of the event.

1. *Relationships among Lecterns

Lecterns receive from Archivist Station (MASAE) all information for automatically visualizing the current score page by the means of network. On DLIOO lecterns the visualization is performed according to the specific musical instrument to which each DLIOO is assigned. On each DLIOO, different sets of interpretation symbols are provided depending on the instrument assigned. The modifications performed on DLIOOs in editor mode are sent in real-time to MASE/MASAE editors for visualization and saving and to the other lecterns.

DLIOOs are organized according to the orchestra hierarchy. First level DLIOOs are qualified to perform changes on the current score (main and interpretation symbols), while the others can be active or passive. The active ones have the same capabilities of their parent, while the latter (the PDLOO) can only visualize scores/changes performed by the former.

st

This hierarchical organization allows the first instrument (e.g., the 1 violin) to directly transmit to the other sub-lecterns (e.g., violins) the changes decided on the score. Sometimes, the 1st violins can be two: in this case a DLIOO child is qualified to perform a co-operative work on the score and changes are reflected to the other violins. In any case, changes are sent to MASAE workstation. This co-operative work among distributed lecterns is possible since a high reliable and fast network is provided.

Each modification performed on the current score by using MASE/MASAE is sent in real-time to the corresponding lecterns according to the association of each pentagram to the corresponding physical lecterns connected through the network (using the ONCM). Modifications on the main score can involve both classical symbols of music and interpretation symbols. From the MASE/MASAE it is also possible to build new main scores and modifying old scores without loading the scores on DLIOOs (off-line modifications).

2. *Editing Capabilities of MOODS

Since the early 1970s, there exist on the market several professional programs for typesetting and editing music on computer: among the more recent higher-quality programs consistently used by publishers are Score, Sibelius, Finale, Encore, Graphire Music Press, etc. Many other non-professional programs for music are also available, but these are mainly based on executing music by means of a MIDI interface (Darms, Csound, QuickScore, CUbase, Cakewalk Express, Lime, MasterScore, MusicShop, Hightingate, Music Manuscript, Music Time, Notator, Overture, etc).

In recent years, almost all publishers have come to use the professional programs, instead of the traditional hand-processing technologies. Since 1991 the adoption of such programs has led to the computer-based production of a large quantity of scores. However, due to the constant evolution of music programs and to the fact that up to now there only exists a viable market for paper versions of scores, the electronic versions remain in publishers' archives (though they may sometimes appear in multimedia CDs).

There exist several European projects dealing with computerized storage and supply of music and music-related information, though these mainly regard library-related use: JUKEBOX (for managing music libraries of phonic format); MODE (techniques for delivering music in paper and phonic formats on Internet); PARAGON (the study of techniques and methods for managing archives of music on Internet); CITED (management of copyrights for selling information covered by copyrights on Internet); CANTATE (definition of a client-server architecture for distributing music in different forms); HARMONICA (a conglomerate of music-library projects); E-MOLL (a real scale development of CANTATE project).

MOODS project has taken into account the results produced by these projects and in particular by projects CANTATE, E-MOLL and HARMONICA. This has been is guaranteed by the presence of SHYLOCK among the partners of this project.

According to our analysis –interviewing publishers, conductors, archivists, teachers, and performing musicians, as well as by direct experiments – none of the professional editors in the market is completely satisfactory:

- none of the professional music writing or editing programs on the market is completely satisfactory for editing main scores and extracting parts while offering an accurate representation in both cases. The same information is differently represented in the main scores and the parts. In the main score, interpretation symbols are missing and every measure is laid out in full; in the parts, abbreviation symbology must be adopted as much as possible, "cues" need to be provided after long pauses, and various layers of instrument-specific performing information must be supplied at critical points. As for modifications, the kinds of information inserted by instrumentalists (in their single parts) are often different from those used by the conductor in the full score.

- only a few music programs provide interpretation symbols for instruments, and none of these editors offer interpretation symbols for all instruments. Even well-known computer languages (e.g., Finale, NIFF, SMDL, Score, etc.) for saving music are incomplete from this point of view.

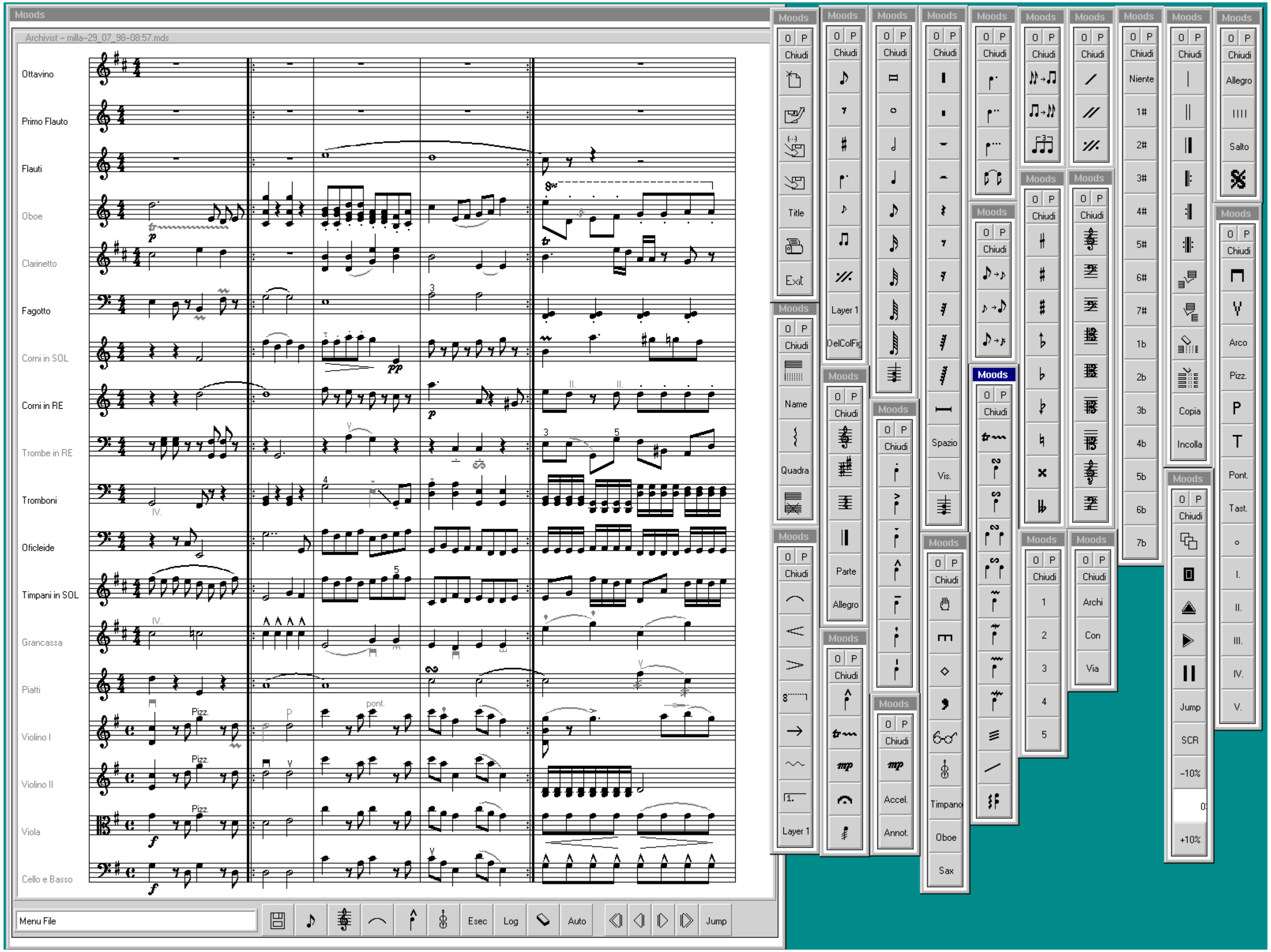
All of these programs are far too complicated to be of real, practical use to musicians in a live-time, actual rehearsal situation. They were designed as graphics tools to be employed by copyists and publishers rather than by musicians who need to quickly and efficiently insert modifications on scores in real time, using devices like a mouse, a trackball or a touch screen.

- MOODS adopts a uniform model for main score and parts and its user-interface is strongly user friendly; mouse, trackball and pens can be used. All menus can be oriented and arranged on the screen for the fast selection of symbols to be placed on the score.

- It manages both fundamental symbols and those that are typical of specific instruments. The set of symbols can be increased with a relative effort.

- Thus MOODS adopts an evolutionary and proprietary format for storing and retrieving scores form database as well as from CD. It has been defined on the basis of format used in LIOO and MSLIOO projects of DSI.

- Music scores in SCORE and FINALE formats can be quite quickly converted in MOODS format.



Music in the above main score has no sense, it is only a demonstrative view of MASAE user interface.

1. MOODS During the Execution

The mechanism of turning pages is driven by the MASAE lectern during execution. It should be noted that different instruments, and thus different lecterns have the page turning at different time instants; this is due to the different quantity of written music which has to be executed by each instrument.

During the execution, on the lectern of the director (MASE) the next page is constructed by starting from the left as soon as the beats on left are already executed. The screen shows two parts, one presenting the current page which is gradually reduced as soon as the measures and the pentagrams are executed. The DLIOOs presents the next page growing from top to bottom. In this way the modality adopted for reading scores by musicians is not changed.

1. Acknowledgements (P. Nesi, DSI)

As MOODS Project coordinator I would like to thanks:

- La SCALA theatre for hosting us and for the support in this demonstration.
- The European Commission of founding the MOODS project and supporting it during the last year of work. Here we have a representative of European Commission and the reviewers of MOODS project.
- TETRApc TTN: CESVIT, CPR and ARTIC for their support: Ing. Maurizio Campanai, Dr. Cinzia Giachetti and the many others that have helped during the consortium set-up.
- A particular thanks to Ing. Silvestro Mitolo of CESVIT to have solicited our research group in working on these aspects.
- A special thanks to Prof. Fabio Uccelli for his faithfully support during the construction of the consortium.
- Hewlett and Packard Italy for supporting of DSI with several high-performance computers as we have here and with the high speed network support for this projects and others.
- RICORDI (Maestro Gabriele Dotto), SCALA (Maestro Carlo Tabarelli) and SMF (Maestro Nicola Mitolo) for their support during the very long review of the complex music notation.
- The many coworkers and friends that have worked on MOODS project at DSI transforming the early results into what we are going to show. They have make possible our presence here today.

I would like to personally thank Prof. Giacomo Bucci of DSI for his support and encouragements since the early phases of work at DSI. A thanks also to the several members of DSI, Department of Systems and Informatics that have followed with extreme interest the project; and, the Faculty of Engineering for providing space to host the rehearsals of MOODS in July.

A warm thanks to the several musicians that have tested MOODS prototype. Some of them have used MOODS yesterday for the first time, today are here for demonstrating its functionalities and usability.

1. The Musicians Involved in the Demonstration

From the point of view of musicians, the organization of demonstration as well as the rehearsals performed in Florence has been performed by the Scuola di Musica di Fiesole, SMF (Maestro Nicola Mitolo).

The execution of music at the demonstration are directed by Maestro Carlo Moreno Volpini.

The musicians involved in the demonstrations are:

- Claudio Fredducci (I Violin, Orchestra Regionale Toscana, Orchestra Maggio Musicale Fiorentino)
- Andrea Cortesi (I Violino, Città di Castello)
- Nicola Mitolo (II Violin, Scuola di Musica di Fiesole)
- Patrizia Ronconi (II Violin, Conservatorio Luigi Cherubini, Firenze)
- Carmelo Gianlombardo (Viole, Scuola di Musica di Fiesole)
- Giovanni Prosdocimi (Viole, Scuola di Musica di Fiesole)
- Veronica Lapiccirella(Cell, Orchestra Maggio Musicale Fiorentino)
- Benedetta Chiari (Cell, Conservatorio Luigi Cherubini, Firenze)
- Francesco Tomei (Contrabass, Conservatorio Luigi Cherubini, Firenze)

The role of the Theatre Archivist is covered by: Timna Panfietti Monaco and/or Antonio Albino (DSI).

The role of MOODS configurator is covered by: Pierfrancesco Bellini (DSI)

1. Music Executed During Demonstration (Maestro C. Tabarelli, Teatro alla Scala)

The music used during rehearsals and execution were those selected at the begin of the project, and in particular:

- ``Eine kleine Nachtmusik'' (Serenate in G) of Mozart (1st movement);
- Le 4 Stagioni di Vivaldi (La primavera, 1st movement);
- La Traviata of Verdi (il preludio, the prelude of the first);

- La Traviata of Verdi (il preludio, the prelude of the third act).

Other available music pieces:

- Linda di Chamonix of Donizetti (symphony) for a group comprised of two violins, a viola, a violoncello and a contrabass (first movement);
- Suite dei Boschi of A. Ferrari (IV movement) for a group comprised of one violin, a piano, a flute and a guitar.

1. Archive Management and Format Conversions (Dr. S. Moro, SHYLOCK)

This part of the MOODS system provides two functions which are basic in a real-life use:

- archiving the electronic scores in their multiple versions
- converting scores in format other than MOODS to MOODS language

The score database in the theatre

As MOODS system will have to manage large amount of electronic scores, each possibility in more than one version (after modifying interventions during rehearsals) and formats, MOODDB provides the cataloging services of SHYLOCK's standard ARCHImusica - a software package especially devoted to musical libraries and archives -, customized within MOODS project with a versioning system integrated to the lecterns network. This could serve as the local database (at theatre). An Internet user interface (WWW) allows the archivist to use the system or from his/her office on Windows (3.1 to NT 4.0) or from the same MASAE workstation in the concert hall.

The score database at publishers

Also on the publisher's side there is the need of managing on computer the printed score catalogs, with an increasing number of entries enhanced with the score in electronic form, and possibly offering these scores directly via Internet.

The Theatre needs a score from the Publisher

MOODDB system allows the archivist of the theatre searching the score needed on the theatre local database or at the Publisher's one. As BMG-RICORDI has actually established its rental catalog on an ARCHImusica system with a SHYLOCK ARCHIweb module, a remote search via Internet on that catalog can be demonstrated, together with the retrieval of the needed electronic score. This application has been engineered after a prototype developed in another UE-cofunded project CANTATE (Computer Access to NoTation And TExt, 1996-1997).

Scores in different formats

As any text on computer, the format of data depends on the program which has been used to produce it. So is for music, where a number of musical writing programs have been used in the past 10 years to produce the most part of the published scores. MOODDB include a bi-directional conversion program from one of the most popular formats (SCORE by Leland Smith) to MOODS language and vice versa, allowing MOODS system to load and modify even scores available in that format. As other conversion programs exist on the market converting from another popular format (Finale by Coda Publishing) to SCORE, both formats are now suitable to feed MOODS system.

1. *Consortium and Project: Historical Issues

In the ‘70, the first programs for managing music on computer have been proposed [Abbott85], [Anderson91b], [Gordon85], [Gourlay86], [Loy85]. Those solutions were much more focussed on music editing, music generation, on storing music in audio formats for the eventual substitution of paper. Since the ‘80, researches on optical music recognition have been proposed in order to convert paper scores in "elettronic" format. In [Morita91], a system to follow the bat of director in order to provide at a computer generating music to follow the director’s interpretation has been also proposed. Therefore, the idea of "electronic lectern" is at least old such as the computer and first graphic editors. This is also demonstrated by the several attempts that have been performed in order built electronic lecterns, in Italy as well as in the rest of the world, from singles and from companies producing instruments. These have tried to insert small display for the visualization of music directly on their keyboard.

For the visualization of music there obviously were enormous technological and formal problem, due (i) to the low resolution of monitors; (ii) to the software modeling of music as visual language with complex rules for placing symbols; and (iii) to the architectural problem of a software itself.

Thus, the idea of electronic lectern, as many others, has been confined in the collective imagination for several years. It needed innovative technological solutions to be realized. This is demonstrated by the several attempts of which the national and international literature and the instruments builders are witness.

Recently, as regards point (i), the new technology has allowed the implementation of LCD TFT at high resolution. On music modeling and notation, several treatises have been written for several thousands of pages, without to reach standardization. The computer science and could be the right tools reach the objective, as demonstrated by the presence of more than 200 programs for music editing, executing, acquiring, that since the ’70 have been commercialized.

The architectural problems are the most complex to be solved; research technologies of software engineering and telematics with HPCN technology (High Performance Computer Networking), have allowed to set up a solution as demonstrated by the implementation of MOODS.

As regards historical issues of MOODS project, it is necessary to spend a few of words on reasons that have created the fundamentals for implementation of MOODS project.

On the basis of the results obtained by DSI in the research activity, that had produced LIOO prototype in January 1995 and MSLIOO in the 1996, some of the future partners of MOODS proejct started with the definition of a consortium.

In the first part of 1996, the TETRApc TTN (Techonlogy Transfer Node) was built: a consortium (founded by European Commission) comprised of CPR (Centro Pisa Ricerche), CESVIT e CSM. TETRApc TTN has as target the promotion and the diffusion of HPCN technology (High Performance Computer Networking) at the national level and joined with the others TTNs in Europe. Among the homeworks of TTN, there is the soliciting of project proposals with the adoption of HPCN technology. This role has stimulated CESVIT and DSI (scientific responsible for CESVIT inthe TETRApc) to give a chance to projects LIOO/MSLIOO of DSI to become what is today MOODS. The evolution of projects LIOO/MSLIOO into a distributed system environment gave the real possibility to implement a system of lecterns for theatres, orchestras, schools of music, etc. The project had to be the typical operation in which the injection of new HPCN technology in a traditional system could produce new solution and market. This for demonstrating the usefulness of HPCN technology and to increase their diffusion for producing innovative systems.

In the 1996, the consortium was constituted: DSI (Dipartimento di Sistemi Informatica, Universita' degli Studi di Firenze), SCALA (Teatro alla Scala), RICORDI (BMG Ricordi, Casa Ricordi), ELSEL S.r.L., SHYLOCK Progetti, SMF (Scuola di Musica di Fiesole).

The three views of the potential end-users for MOODS system orchestra, music publishers and music scools were represented at high level, as well as the technological-industrial partners. In March 1997 the project was founded, the 16th of July 1997 started. The conclusion is planned for the 31st of October 1998. Since from its early formulation the coordinator has been Dr. P. Nesi of DSI.

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2. Conclusions and Future Work (P. Nesi, DSI)

We hope that the demonstration has been of interest for you.

It is obviously impossible to describe and to give a full demonstration of all MOODS features in so short time. This project started in 1994 internally at DSI and is become MOODS project in 1997 by adding several contributors. It has seen, in these years a considerable number of companies and people involved in. Thanks again to all of them.

From the early testing of MOODS, it has been considered strongly useful and interesting to be used in orchestras and music schools. MOODS functionalities leave free the artistic aim of Composer and of Conductor that can directly experiment new effects/arrangements with the orchestra in few seconds. It is our opinion that, MOODS opens a new era for expressiveness of the artistic aim of Conductors and Musicians establishing a direct feedback from requests to the result produced by the orchestra. MOODS opens the path to what in the next years could be a real revolution in the world of music publishing and in the approach of musicians toward the music to be executed.

MOODS project will be completed within the October 31st. Any formal activity related to MOODS project has to be always directed to its coordinator.

The completion of the project does not means that the effort spent for building this experiment/prototype will be destroyed. The results will be exploited.

- ELSEL intends to proceed by engineering this prototype and commercializing a derived product of MOODS in the second half of 1999.
- SHYLOCK intends to support this effort by providing database support and converters for music score.
- RICORDI is strongly interested in any commercialization of the results of MOODS projects.
- DSI will continue its work by solving related research problems and by using the results of this project for exploiting new areas: managing special effects in integrated manner with music in television, conversion of paper scores into MOODS format automatically, generation of music from MOODS, etc.
- SMF could be involved in organizing special courses by using MOODS and on the use of MOODS.

Please don't forget to compile and leave the questionnaire that you have in the documentation, for us, it is very important to know your opinion about the demonstration that you have attended.

As the spokesman of MOODS project, it is a pleasure to answer to any your questions.

Please contact the Project Coordinator by means of the references on the cover page of this document, if:

- you are interested, as journalist or publisher, in having more information or publishing a technical articles on MOODS.
- you are interested in having more information about MOODS or assisting to a more technical demonstration.
- you are interested in the evolution of MOODS as future and innovative related projects.

Cooperative Visual Manipulation of Music Notation

P. Bellini, P. Nesi, M. B. Spinu

Authorization Rights

In MOODS, different preferences may lead musicians to work on the same music by using different views or formatting rules. This means that the information is differently visualized in the several terminal of the cooperative environment.

Provided that there are distinct roles in a group, separate permissions for manipulating the information are assigned to different users. The changes have to be collected according to the configuration of the cooperative system and they are grouped according to the relationships among manipulated symbols in order to make possible the undo mechanism as described in Section 5 of the paper.

A relevant aspect of the cooperative work is to deal with the management of authorization rights to manage music notation symbols. To give full power to all musicians so that they can manipulate notes, rests, measures, beams, slurs, etc., is a unsuitable approach because it is likely to produce chaotic results. According to their configuration and profile, all musicians may modify their set of symbols while heavier changes can be performed or supervised by the archivist on the MASAE station. The Group leaders should be authorized to modify a larger number of music notation symbols than their related lecterns in the same group. In effect, typical scenarios are much more complex since during operas and ballets heavy changes can occur. In such events, the group leader could be delegated to modify music in depth, for example by adding notes which change the music structure in a different way from the light changes performed through adding/deleting, fingering, bowing, mutes, accents, etc.).

To manage these conditions, a specific User Permission profile is defined and assigned to each lectern. It is used for limiting the manipulation of notation symbols and the execution of selected operations such as the deletion of notation symbols. The notation symbols of the music editor have been classified in categories to simplify both the configuration and the comprehension of the mechanism by the musicians. The adopted classification has been carried out on the basis of the results of several questionnaires during the early stage of requirement analysis of MOODS projects. For example, the category of symbols (in the fifth position of the list on the right part of the window depicted in the following Figure) is named clef/key signature/time and includes the insertion and deletion of clefs, key signatures, time signatures; the category of accents includes: tenuto, staccato, martellato, snap, etc.; the category of symbols named strings: bowing, tallone, punta, pizzicato, etc.

The assigned permissions to each lectern to manipulate music can be dynamically changed.
This means that permissions are part of the initial system configuration and that they can be changed during the manipulation of each piece of information and during the collaborative editing of data. Whether a dynamic definition of permissions is possible, then the assignment of roles in the community of people involved is also dynamic. In fact, the

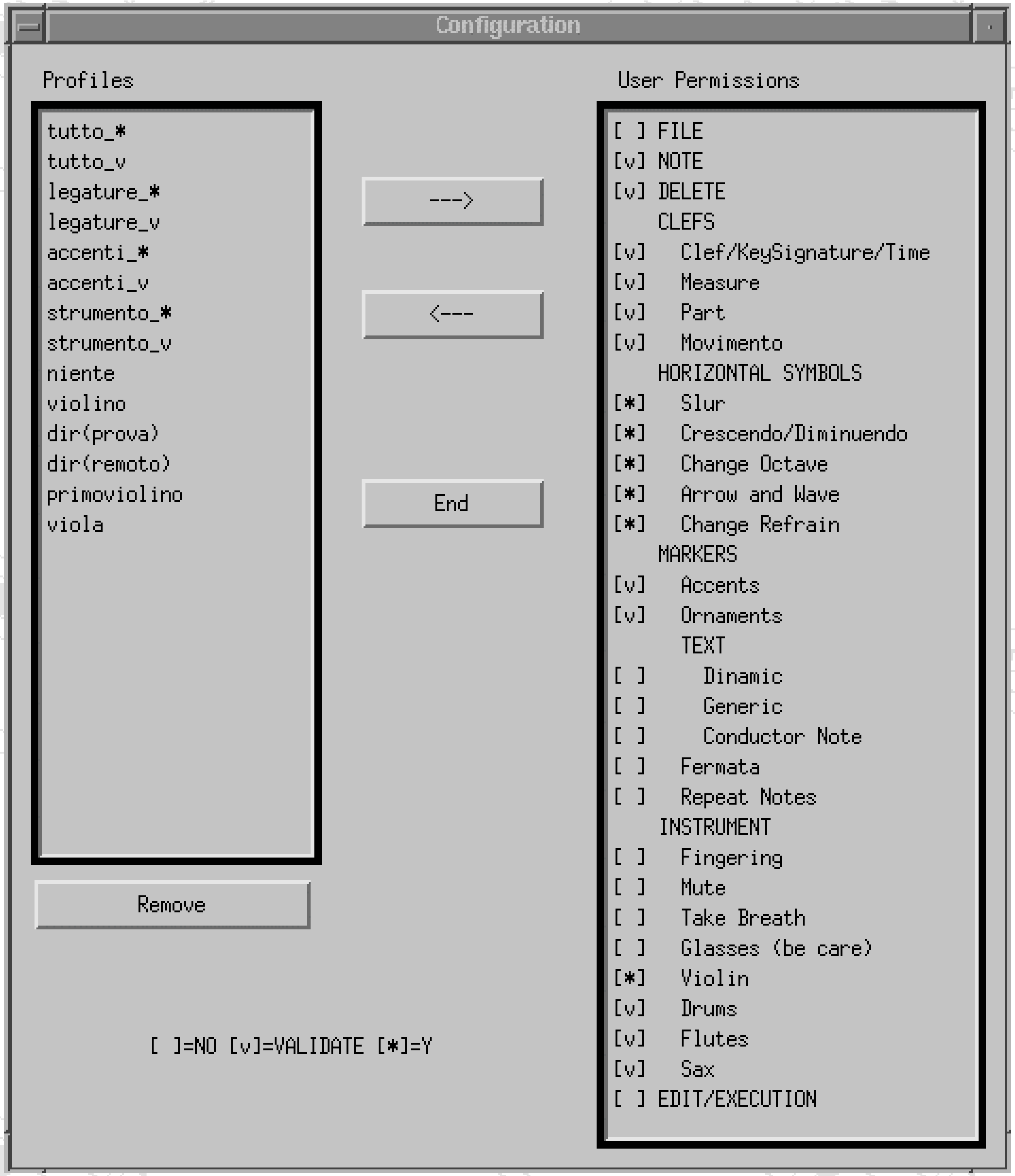
MASAE operator plays also the role of permission manager.

When changes involve the structural part of the music (notes, rests, key signature, etc.) two distinct approaches could be followed. The first avoids their adoption by unauthorized lecterns. The second allows their adoption, but the archivist on the MASAE station has to supervise the changes. This supervisor may validate (accept) or invalidate (discharge) changes.
As already mentioned, each lectern can be authorized or not to manipulate symbols of each category. In particular, in MOODS, each lectern presents a profile describing the lectern behavior for each symbol category.
This can be

i. enabled without the need of the archivist's validation;
ii. totally disabled;
iii. enabled with the need of the archivist's validation.

The symbols that are added and that have to be validated appear on the MASAE main score in different colors according to the lecterns that added the notation symbol. Symbols that do not need to be validated by the archivist are directly written in black on the MASAE music editor.

In the following figure, the ONCM window for defining the profile of MASEs and DLIOOs lecterns is presented. On the left of the configuration window, the list of already available profiles is reported, while on the right, the User Permission table is reported. The available profiles can be used either as they are or to produce customized profiles. The buttons with arrows allow the definition of new profiles and the loading of already defined ones. By means of the User Permissions table the archivist can specify the notation symbol categories that can be manipulated (inserted/deleted) by each lectern. The notation symbols and MOODS editor menu are grouped and listed. Each group can be disabled (when an empty [ ] is present), enabled with no need of validation (with [*]), and enabled with validation when the item is marked with [v]. For example, in the profile reported in the following figure, the fingering is disabled, while symbols of violin are allowed without permission and the drum symbols, when inserted, have to be validated by the archivist. The END button provokes the setting of the permissions selected. The above User Permissions can be imposed during the configuration, and can be updated in real-time during EDITING. This possibility allows enabling the adding or deleting of specific symbols on a temporary basis to perform actions limited in time. The archivist has to control the access to the parts granting to musicians specific access capabilities such as the ability to add or delete some types of symbols or to add/delete new measures, etc. For example, a musician may see an incorrect note on the score, and the archivist may delegate that musician to make this type of change.
The updated profiles can be maintained for the next section of work and belong to the general configuration.


Configuration
Profiles
tutto_*
tutto_v
legature_*
legature_v
accenti_*
accenti_v
strumento_*
strumento_v
niente
violino
dir(prova)
dir(remoto)
primoviolino
viola
Remove
--->
<---
End
[ ]=NO [v]=VALIDATE [*]=Y
User Permissions
[ ] FILE
[v] NOTE
[v] DELETE
CLEFS
[v] Clef/KeySignature/Time
[v] Measure
[v] Part
[v] Movimento
HORIZONTAL SYMBOLS
[*] Slur
[*] Crescendo/Diminuendo
[*] Change Octave
[*] Arrow and Wave
[*] Change Refrain
MARKERS
[v] Accents
[v] Ornaments
TEXT
[ ] Dinamic
[ ] Generic
[ ] Conductor Note
[ ] Fermata
[ ] Repeat Notes
INSTRUMENT
[ ] Fingering
[ ] Mute
[ ] Take Breath
[ ] Glasses (be care)
[*] Violin
[v] Drums
[v] Flutes
[v] Sax
[ ] EDIT/EXECUTION

Cooperative Visual Manipulation of Music Notation

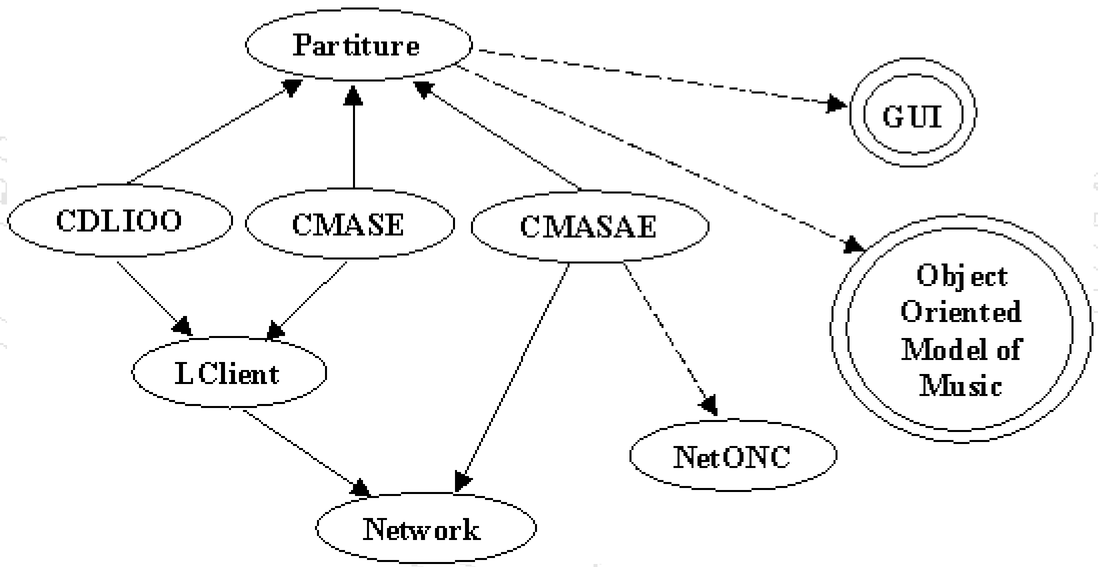
P. Bellini, P. Nesi, M. B. Spinu

Overview of the Object-Oriented Architecture

The MOODS has been modeled and implemented by using the object-oriented paradigm. The following Figure depicts the relationships among classes appointed with the task of modeling the main components of the cooperative system. The notation used shows specialization relationships by using continuos lines, while dashed lines stand for relationships of use. Class Partiture has resort to two class clusters:

i. the object-oriented model of music
   and
ii. the object-oriented model of GUI (graphic user interface)

for the visualization of the music according to the windowing systems used.



Main classes of the MOODS cooperative editor, cluster of classes are represented with double circles.

Class Partiture has distinct specializations according to different visualization modalities. The visualization of music has to conform to different modalities such as CMASAE (Class MASAE for visualizing main score on the archivist lectern), CDLIOO (Class DLIOO for visualizing single parts on the musicians lecterns), and CMASE (Class MASE for visualizing main score on the conductors lecterns). Different sets of classes are used for building different processes of the MOODS cooperative editor -- for example, DLIOO is built by using class CDLIOO, LClient, Network, Partiture, cluster GUI and the Cluster of classes containing the Object-Oriented Model of Music. The solution chosen allows any expanding of the system so as to work with other kinds of lecterns by specializing classes from Class Partiture. Class Network is the interface between the MOODS system and the PVM support, Geist et al. (1994), and therefore it is the low-level interface for using the PVM in the DLIOO, MASE and MASAE applications. At present the MOODS systems is operative under UNIX platform, including Linux, HPUX and Sun Operating system. Class LClient adds to class Network the specific functionalities for the Remote Command Manager. Class NetONC (Net Orchestras Network Configurator) contains and manages the configuration of the Orchestra/Network of lecterns and their configuration including relationships, assigned part, and the allowed permissions for editing music notation symbols.

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CORRIERE DELLA SERA
23 settembre 1998

Spartiti addio, arriva il leggio elettronico

MILANO – Finita l'era delle pesanti partiture anche di 600 pagine, delle modifiche a matita,: gli orchestrali e i direttori avranno leggi elettronici in grado di sostituire la tradizionale partitura in carta, di porre modifiche durante le prove di concerti, opere e balletti, di provvedere automaticamente alla girata automatica delle pagine e di archiviare le varie versioni di lavori musicali. È il progetto "Moods", finanziato dall'UE, al quale hanno partecipato, tra gli altri, l'Università di Firenze, la scuola di musica di Fiesole e il Teatro alla Scala (dove ieri è stato presentato con una dimostrazione dal vivi). Direttori e orchestrali potranno leggere la partitura e le singole parti su monitor interattivi sostitutivi ai tradizionali leggii. Con una penna o un mouse potranno apportare al brano modifiche, tagli, arrangiamenti. Editori e archivisti con il nuovo sistema potranno fornire le musiche su supporto digitale.

La Nazione, Il Resto del Carlino, Il Giorno

Mercoledì 23 settembre 1998

ALLA SCALA PRESENTATO UN LEGGIO RIVOLUZIONARIO:

SUL DISPLAY CON LE NOTE ANCHE LE INDICAZIONI DEL DIRETTORE D'ORCHESTRA

La musica corre sul monitor, ecco lo spartito elettronico

MILANO – Anno duemila e qualcosa. Un teatro, un auditorium qualsiasi. Direttore e orchestra in maniche di camicia. Si prova una sinfonia qualunque. "Signori, i corni non sono a tempo… più graduale il rallentando. Riprendiamo dalla battitura venticinque. regolate i vostri monitor". Il futuro è vicino, anzi è già qui, non più saliva sul dito e voltar di pagine, né fruscio di partiture e spartiti. Anche il romantico leggio con la lira di ottone può finire nei negozi di chincaglierie. Fra poco.
È nato il leggio elettronico davanti, i professori d'orchestra non avranno più i gualciti fogli pieni di annotazioni, fitti dei segni di chi li ha studiati e sofferti prima, ma piccoli monitor. Il computer è entrato nel golfo mistico. Il videoprocessore s'è infilato tra violini, oboe e fagotti.
Che cos'è un leggio elettronico? È appunto un display come quelli che adornano le scrivanie dei nostri uffici e delle nostre case, su cui le note scorrono – non è esattamente così, ma semplifichiamo- in sincrono con l'esecuzione della musica, battuta per battuta, frase per frase, senza però perdere la visione completa della pagina.
Per gli orchestrali, che leggono solo la loro "parte", la comodità è intuibile. Ma più interessante e importante è il leggio elettronico del direttore, cui gli altri sono collegati: non soltanto una partitura limpida da leggere, ma lo schermo che visualizza un vero e proprio programma dal quale riversare sui monitor periferici (in orchestra) ogni seno d'espressione, ogni "arcata", ogni indicazione di tempo che contribuisce a fare di un'esecuzione un'interpretazione a sé, firmata. Invece che con carta e matite colorate, il maestro deciderà elettronicamente tutta la parte nascosta dell'iceberg che si chiama concertazione, la fisserà sul Compact Disc e con questo lavorerà insieme ai professori d'orchestra.
Il leggio elettronico è insomma un ulteriore colpo mortale al foglio di carta. Gli archivi di teatri e orchestre potranno attingere tutto il materiale necessario a un'esecuzione dall'archivio elettronico della casa editrice. La rivoluzione è evidente. Ma ci sono altre conseguenze. Il direttore, dopo aver studiato la partitura a casa, potrebbe anche distribuire il Cd con le sue annotazioni per mandare avanti il lavoro in sua assenza. I professori potranno gestirsi le prove con più ampia autonomia, forse anche senza bacchetta.
Karajan, si sa, usava spesso far scaldare l'orchestra da un fido maestro sostituto. Poi raccoglieva la fila dell'interpretazione e, in pubblico, la magia delle sue mani e dei suoi occhi chiusi, senza musica davanti, metteva tutto a posto.
Oggi Riccardo Muti ha mostrato il suo interesse per la novità.
Un brevetto così radicale, (non l'unico, ma il più avanzato al mondo) è frutto del genio italico, anche se ha un nome internazionale: Moods è nato all'Università di Firenze, Dipartimento di Sistemi e Informatica , coordinato da Paolo Nesi e sostenuto dall'Unione Europea. Ma un apporto decisivo è venuto dal Prof. Fabio Uccelli, docente all'Università di Pisa, fisico e musicista.

Il Moods è stato presentato ieri alla Scala, che è parte del progetto assieme a casa Ricordi, alla veneziana Shylock (software) e alla spezzina Elsel, pronta a produrre l'hardware (video e computer) dalla metà del '99. Alla Scala giovani musicisti della scuola di Fiesole hanno suonato Mozart, Vivaldi e Verdi leggendoli su Moods. La porta sul futuro è almeno socchiusa.

(Carlo Maria Cella)

ANSASERVICE
22 settembre 1998

MUSICA: ARRIVA "MOODS", NUOVO LEGGIO ELETTRONICO

(ANSA) - MILANO, 22 SET - Basta con le pesanti partiture di 600 pagine e oltre, basta con le modifiche fatte a matita durante le prove: da oggi direttori e orchestrali hanno a disposizione un nuovo leggio elettronico in grado di sostituire il supporto cartaceo e di gestire tagli, annotazioni e successiva archiviazione.
Il progetto "MOODS - presentato oggi alla Scala di Milano - e' stato in parte finanziato dalla UE ed ha come partner, tra gli altri, L'Università di Firenze, la Scala, la BMG Ricordi e la Scuola di Musica di Fiesole. Il nuovo sistema permette al direttori d'orchestra e ai musicisti di leggere la partitura e le singole parti su monitor interattivi che sostituiscono il tradizionale leggio. Sullo schermo, con una speciale penna o con un mouse, gli orchestrali potranno apportare al brano modifiche come indicazioni dinamiche, arcate e diteggiature, ma anche cambiamenti più, sostanziali quali tagli e arrangiamenti. In fase di esecuzione il monitor visualizza la partitura con un meccanismo automatico di voltata di pagina. Ma anche gli editori e gli archivisti potranno trarre vantaggi dal nuovo sistema, fornendo le musiche su supporto digitale. Quattro brani sono stati eseguiti oggi col nuovo sistema da un gruppo di musicisti. "Non amo il computer - ha detto Claudio Fredducci, primo violino del Maggio Musicale - ma non ho avuto alcuna difficoltà a passare dalla carta al monitor".

Avvenire

24 settembre 1998

NOVITA' E' in arrivo «MOODS»: trasmette via Internet la musica agli strumentisti

Un Video al Posto dello Spartito

La tecnologia arriva sui leggii delle orchestre. Grazie al progetto MOODS, elaborato presso il Dipartimento di Sistemi e Informatica di Firenze, un circuito di computer permetterà di eliminare la mole di materiale cartaceo richiesto da ogni esecuzione (per un'opera anche migliaia di pagine fra partitura del direttore e parti staccate di ogni strumentista). Basta con le voltate di pagina, con i fogli che volano durante i concerti all'aperto, con le correzioni trasmesse lentamente fra gli strumenti. Basta con la carta che pesa, si deteriora e richiede tempo e denaro per il trasporto; e anche con la matita, dato che durante le prove ogni musicista, dalla propria postazione, potrà riportare annotazioni e correzioni direttamente a video, in maniera indipendente dai colleghi: spetterà poi all'Archivista, una specie di supervisore generale del programma, stabilire se rendere permanenti queste modifiche. Un prototipo di MOODS è già operativo ed è stato presentato martedì al Teatro alla Scala, partner dell'operazione insieme con la BMG Ricordi, la Scuola di Musica di Fiesole e, per la parte informatica, ELSEL e SHYLOCK Progetti. Il procedimento è semplice e potrebbe trovare vantaggiosa applicazione anche presso le scuole: la musica viene richiesta via Internet all'archivio della casa editrice (che dovrà logicamente attrezzarsi in questo senso) e trasmessa in rete agli strumentisti; ciascuno ha, al posto del normale leggio, un terminale video con i pentagrammi che scorrono in sincronia con l'esecuzione. Il direttore, a sua volta, vede scorrere l'intera partitura, e come lui possono osservarla il regista o il maestro del coro dalle loro postazioni. Non manca la possibilità di stampare su carta la musica, per esigenze di studio o altro. lì progetto, parzialmente finanziato dalla Comunità Europea, dovrebbe essere completato entro la fine di ottobre e commercializzato nella seconda metà del'99. Almeno due gli interrogativi aperti. Primo, il costo di un'installazione del genere, non ancora precisato. Secondo, la necessità dì adeguare la mentalità e la preparazione degli esecutori, che avranno necessità di un po' di praticaccia per intervenire sulle partiture del 1eggio-monitor, scegliendo fra vari menu i simboli da applicare e facendo fronte a tutte le grandi e piccole esigenze dell'editing informatico.

La Repubblica

22 settembre 1998

Nasce i leggio elettronico e le note passano sul monitor

E' stato chiamato "leggio elettronico" ed l'ultima applicazione, in campo musicale della tecnologia digitale. Il progetto "MOODS - presentato ieri alla Scala di Milano - e' stato studiato per sostituire la carta sia della partitura usata dal direttore d'orchestra, isa degli spartiti dei vari strumentisti. E' stato realizzato da un gruppo di ricerca cui hanno partecipato il Dipartimento di Sistemi e Informatica dell'Università di Firenze, Shylock progetti ed ELSEL. Si presenta come uno schermo piatto sul quale la pagina musicale scorre lentamente tigo dopo rigo, e sulla quale e' possibile apportare, in tempo reale, ogni modifica, annotazione, correzione ritenuta necessaria in fase di concertazione. Ma se e' difficile immaginare nel pbreve periodo l'utilizzo del MOODS durrante l'esecuzione musicale (la velocita' di scorrimento e' controllata fuori dal podio e si puo' immaginare che cio' possa rappresentare quantomeno un handicap psicologico per un direttore), i vantaggi sono notevoli per l'archiviazione e la gestione delle edizioni musicali.

La Repubblica delle Donne
20 Ottobre 1998

Spartiti Addio

Fine dei vecchi, cari spartiti. Nei teatri sinfonici di tutto il mondo arriva il leggio elettronico Brevettato dall'università di Fìrenze, Dipartimento di Sistemi e Informatica, coordinato dal Professor Paolo Nesi (e sostenuto dalla UE) consentirà ai musicisti di non seguire più la partitura sui consueti fogli pieni di annotazioni, bensì su piccoli monitor. Un display su cui le note scorrono in sincrono con l'esecuzione della musica, senza perdere la completa visione della pagina.

il leggio "elettronico"

Settembre 1998, Teatro alla Scala; i busti severi di grandi musicisti nel Ridotto dei Palchi scrutano con diffidenza strani oggetti, una serie di leggii dall'aspetto marcatamente "non tradizionale" e svariate altre apparecchiature. La platea attende, i musicisti arrivano alla spicciolata, estraggono i loro strumenti dai velluti delle custodie, si preparano. Il direttore arriva, il solo capace di instaurare quell'atmosfera creativa che porta l'orchestra a produrre suoni ed armonie che possono suscitare sentimenti profondi. La sua posizione austera, una rapida accordata agli strumenti, uno sguardo, il silenzio, un gesto, la musica ha inizio. Passano i secondi, i minuti, la musica continua, ne' un fruscio di pagina ne' un attimo di distrazione per *voltar pagina*, gli orchestrali sono concentrati sulla musica dei loro leggii. Il direttore, conduce l'orchestra con movimenti misurati, rapidi e talvolta decisi, senza distrazioni, senza gesti frettolosi per voltar pagina. I nove orchestrali distribuiti su cinque parti di archi hanno suonato in piena concentrazione alcuni brani di Vivaldi, Verdi e Mozart davanti a un pubblico scettico e a dir poco incredulo.

Questo è quanto è accaduto al Teatro alla Scala. L'unica distinzione, la presenza di uno strumento di alta tecnologia come ausilio al lavoro dell'orchestra e dell'archivista. Lo strumento si chiama MOODS, Music Object Oriented Distributed System, primo prototipo al mondo di sistema integrato di leggii "elettronici" per orchestre. Più che una rappresentazione è stata una conferenza stampa con dimostrazione. L'esecuzione dei brani è stata seguita da una breve dimostrazione tecnica delle funzionalità d'interazione dei musicisti con i leggii (sul fondo della foto lo schermo utilizzato durante la dimostrazione tecnica). La conferenza stampa è stata tenuta dal coordinatore del progetto, Prof. P. Nesi del Dipartimento di Sistemi e Informatica, Università di Firenze, dal Maestro Carlo Tabarelli (primo archivista del Teatro alla Scala), dal Maestro Gabriele Dotto (responsabile della produzione di Casa Ricordi) e dal Dr. Sandro Moro della Shylock Progetti.

Durante la conferenza stampa, le molte domande provenienti dalla sala hanno messo in luce il forte interesse suscitato dal progetto. A tale conferenza hanno partecipato le più importanti testate giornalistiche che hanno messo l'accento sulle prerogative del sistema "presentato un leggio rivoluzionario … Non più saliva sul dito e volta pagine, ne' fruscio di partiture e spartiti … Il computer e' entrato nel golfo mistico." (La Nazione, Il Resto del Carlino, Il Giorno, di Carlo Maria Cella). Su La Repubblica "Nasce il leggio elettronico e le note passano sul monitor", "...vantaggi notevoli per l'archiviazione e la gestione delle edizioni musicali."; e l'Avvenire decanta "Basta con le voltate di pagina, con i fogli che volano durante i concerti all'aperto, con le correzioni trasmesse lentamente fra gli strumentisti. Basta con la carta che pesa, si deteriora e richiede tempo e denaro per il trasporto…", (Patrizia Luppi).

Il progetto fonda le sue origini nel 1994, quando il Prof. Ing. Giacomo Bucci e il Prof. Ing. Paolo Nesi del Dipartimento di Sistemi e Informatica, DSI, presero in considerazione tali problematiche come caso di studio per gli studenti di Ingegneria del Software della Facoltà di Ingegneria. I primi programmi per la gestione computerizzata della musica risalgono ai primi anni '70. Da quegli anni, l'idea del leggio elettronico ha viaggiato nell'immaginazione collettiva di molti avendo bisogno di soluzioni scientifico/tecnologiche innovative per essere realizzata. Dietro alla rappresentazione di partiture vi sono enormi problemi dovuti alla modellazione della musica come linguaggio grafico con complesse regole di posizionamento dei simboli, oltre a problemi architetturali del software stesso per gestire un *sistema di leggii interattivi*. Tali spunti lasciarono spazio ad una sfida, quindi inizio' la ricerca su tali problematiche. I primi risultati non tardarono ad arrivare e su tali presupposti si e' sviluppato il progetto/consorzio MOODS. Fra i partner tre prestigiose realtà del mondo della musica e della cultura: il Teatro alla Scala; la BMG Ricordi/Casa Ricordi; la Scuola di Musica di Fiesole. Del mondo dell'industria, la Elsel di La Spezia e la Shylock di Venezia si sono interessate rispettivamente degli aspetti hardware e della gestione dell'archivio. Come promotore, il DSI ha partecipato come coordinatore e fornitore di soluzioni scientifico-tecnologiche software in grado di gestire l'intero sistema di leggii. Potenziali fruitori sono le grandi orchestre/teatri, le scuole di musica e gli addetti dell'editoria musicale. Il progetto MOODS e' stato parzialmente finanziato dalla European Commission dell'ESPRIT IV HPCN (High Performance Computer Networking). Alla dimostrazione al Teatro alla Scala hanno assistito i commissari della comunità europea che hanno considerato MOODS come uno dei progetti più riusciti di tutto il programma HPCN.

Per favorire ed incrementare la diffusione delle tecnologie HPCN la European Commission ha stabilito una rete di TTN (Technology Transfer Node, nodi di trasferimento tecnologico). In questo senso, il progetto MOODS è un'attività con il TETRApc TTN, supportato dal CPR (Consorzio Pisa Ricerche, Pisa), e CESVIT (High Tech Agency, Florence, Firenze). Sin dal 1996, il Prof. Paolo Nesi del DSI è Responsabile Scientifico del TETRApc TTN per quanto riguarda le attività di CESVIT. MOODS e' uno dei quattro progetti in ambito HPCN gestiti dal DSI come TETRApc.

Le Problematiche e MOODS

La quantità d'informazione utilizzata dalle orchestre è enorme. Una partitura tipicamente comprende di più di 100 pagine (nelle opere anche oltre 600). Dalle partiture sono prodotte le parti per i 60 ed oltre musicisti dell'orchestra, senza considerare l'eventuale presenza del coro. L'esecuzione può durare da alcuni minuti a più di due ore.

Semplici modifiche sugli spartiti sono tipicamente decise da ogni musicista ed effettuate a matita sulla parte durante le prove: aggiunta di simboli d'interpretazione (simboli dinamici, espressioni, diteggiature, sordina, direzioni dell'arco, etc.). Modifiche sostanziali, come nell'eliminazione di alcune sezioni, spostare parti dello spartito, arrangiare la musica per strumenti diversi, trasporre la musica, sono decise dal direttore (dal compositore, nel caso di nuovi lavori). Per queste l'archivista ed i suoi collaboratori utilizzano colla e forbici per arrivare a produrre la nova versione dopo ore/giorni di lavoro (prima delle prove e/o fra queste), etc. Alcuni dei cambiamenti più importanti dovrebbero essere decisi in anticipo, ma spesso sono definiti solo durante le prove, provocando lunghe e tediose interruzioni, per gli orchestrali e un gran lavoro per l'archivista e i suoi collaboratori. Tali decisioni, prese sul posto, sono molto frequenti durante la preparazione di balletti ed opere (che sono anche i lavori teatrali per i quali è necessaria una maggiore quantità di materiale musicale), dove le decisioni per i cambiamenti possono derivare, durante le prove, da necessita' dei cantanti o del direttore di palcoscenico, da problemi d'acustica, dalla regia, etc. Il tempo speso aspettando la nuova versione della musica è una parte significativa del tempo totale delle prove e spesso le rende frammentarie e stressanti poiché la concentrazione e l'atmosfera sono difficili da ricreare a comando.

Tipicamente musicisti diversi utilizzano la stessa versione cartacea di uno spartito, le vecchie modifiche devono essere cancellate (quando possibile) per lasciare spazio alle nuove. Questo processo porta parti e partiture a un rapido deterioramento. D'altra parte, alcune volte le varie versioni di un certo insieme di spartiti e parti devono essere archiviati, poiché riportano annotazioni d’importanti interpreti o perché potrebbero essere riutilizzate anche dopo anni. L'archiviazione, la manutenzione, o la sostituzione di parti può diventare inavvicinabile sia per i teatri sia per gli editori. In molti casi la logistica del noleggio del materiale musicale (per gli editori) o l'archiviazione di spartiti musicali (per gli archivi teatri dell'opera o delle orchestre) rende molto difficile, se non impossibile, collezionare copie di tutte le versioni. Nella migliore delle ipotesi, una copia della partitura direttoriale modificata può essere messa da parte, ma ciò è impossibile per le singole parti. Quando una versione o produzione è ripetuta alcune stagioni dopo, le modifiche devono essere rifatte nuovamente.

La soluzione MOODS

MOODS è un sistema integrato di leggii basati su sistemi a microprocessore (in sostanza dei computer) per la manipolazione della musica e la sua visualizzazione durante l'esecuzione, studiato per risolvere i problemi precedentemente descritti. MOODS e' in grado di gestire in modo funzionale ed efficace l'enorme quantità di informazione utilizzata da (i) orchestre durante le prove e i concerti, opere, balletti, etc. (ii) studenti di musica durante le lezioni, (iii) editori di musica durante la realizzazione/revisione di partiture. Possono trarre vantaggio da questa soluzione anche piccoli gruppi di musicisti, e i network televisivi. MOODS permette:

- La riduzione del tempo necessario per modificare le partiture principali durante le prove.
- La gestione (caricamento, modifica e salvataggio) dei simboli/annotazioni strumentali sulla partitura direttoriale e sulle parti; salvando in questo modo dettagli che sono da sempre andati perduti.
- La riproduzione e la manipolazione della velocità d’esecuzione con la quale la musica è stata eseguita dall'orchestra.
- L'automatizzazione dei meccanismi delle voltate di pagina durante l'esecuzione di brani e le prove.
- La visualizzazione in pochi minuti direttamente sui leggii degli orchestrali di partiture la cui ricerca in archivio potrebbe necessitare ore. Veloce manipolazione di queste per arrivare alla versione definitiva da utilizzare sui leggii.
- La realizzazione veloce di cambiamenti sulla partitura e il riavvio durante le prove da punti prefissati o da singole battute.
- La manipolazione in tempo reale di partiture direttoriali e la produzione di tali modifiche ai musicisti direttamente alle parti in tempo reale;

Un sistema MOODS è composto da una serie di leggii elettronici che comunicano fra di loro attraverso una rete ad alte prestazioni. Agendo sui leggii i musicisti possono modificare, aggiungere cancellare simboli della notazione musicale e simboli d’interpretazione. Ogni modifica effettuata su una parte è inviata direttamente anche agli altri musicisti che leggono la stessa parte. Le complesse relazioni fra i simboli della notazione musicale e l’architettura stessa del sistema sono il risultato di anni di lavoro di ricerca. Il lavoro di modifica è cooperativo nel senso che: tutti i musicisti possono effettuare modifiche contemporaneamente anche sulla stessa parte operando da leggii diversi.

MOODS è in grado di gestire uno o più leggii direttoriali, che possono essere utilizzati dal direttore, dal regista, dal suggeritore, etc. per modificare, visualizzare la partitura in formato direttoriale. Il cuore del sistema è il computer tipicamente gestito dall'archivista. Un vero e proprio strumento di composizione per partiture musicali direttoriali. Con tale ausilio, l'archivista può (i) effettuare modifiche sostanziali sulla partitura in tempo reale durante le prove ed ogni modifica e' visualizzata direttamente agli orchestrali interessati (ii) indicare e correggere in tempo reale la velocità di esecuzione della musica per aggiustare il meccanismo automatico delle voltate delle pagine.

Durante l'esecuzione, sul leggio direttoriale, la pagina successiva è sostituita a quella correntemente in esecuzione partendo da sinistra e andando verso destra. Non appena le battute della pagina in esecuzione sono state eseguite compaiono quelle della nuova in loro sostituzione; lo schermo è quindi diviso in due settori, quello più a destra che presenta la pagina in esecuzione e che gradualmente si riduce a favore del settore a sinistra, nel quale è mostrata la pagina da eseguire successivamente; per quanto riguarda i leggii dei musicisti invece la scomparsa della pagina in esecuzione a favore di quella successiva avviene dall'alto verso il basso. Utilizzando queste modalità il modo di leggere la musica da parte del direttore e dei musicisti non cambia.

E' chiaro come un sistema distribuito di leggii con la musica istantaneamente modificabile possa portare ad un significativo risparmio di tempo e denaro ed al salvataggio di un bene culturalmente prezioso come la specifica musica definita da un certo specifico direttore con una certa orchestra, etc. Questo ha una notevole importanza dal punto di vista culturale e per le scuole di musica che potrebbero veder rianimare musica ben nota nelle varie interpretazioni dei singoli musicisti e dei direttori. Gli studenti potranno esaminare ed eseguire diverse interpretazioni dello stesso spartito. Gli spartiti potrebbero essere richiamati istantaneamente sullo schermo in ogni istante, permettendo di saltare dallo studio di una parte ad un'altra in tempi brevissimi. Nuove strade si aprono anche per i musicologi.

Dai primi riscontri sul campo, MOODS è stato considerato dai musicisti che lo hanno provato, uno strumento utile sia in orchestra che nelle scuole di musica. Le funzionalità di MOODS lasciano all'animo artistico del Compositore e/o del Direttore più spazio per sperimentare nuovi effetti ed arrangiamenti in pochi minuti. MOODS permette una risposta diretta fra ciò che il direttore chiede e il risultato prodotto dall'orchestra. MOODS forse potrà nei prossimi anni dare vita ad una vera e propria rivoluzione nel mondo dell'editoria musicale e dei teatri.

Altre informazioni possono essere acquisite visitando il sito WWW:

http://aguirre.dsi.unifi.it/~hpcn/wwwmoods/wwwpag/html

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Progetto MOODS: la musica

incontra l'informatica

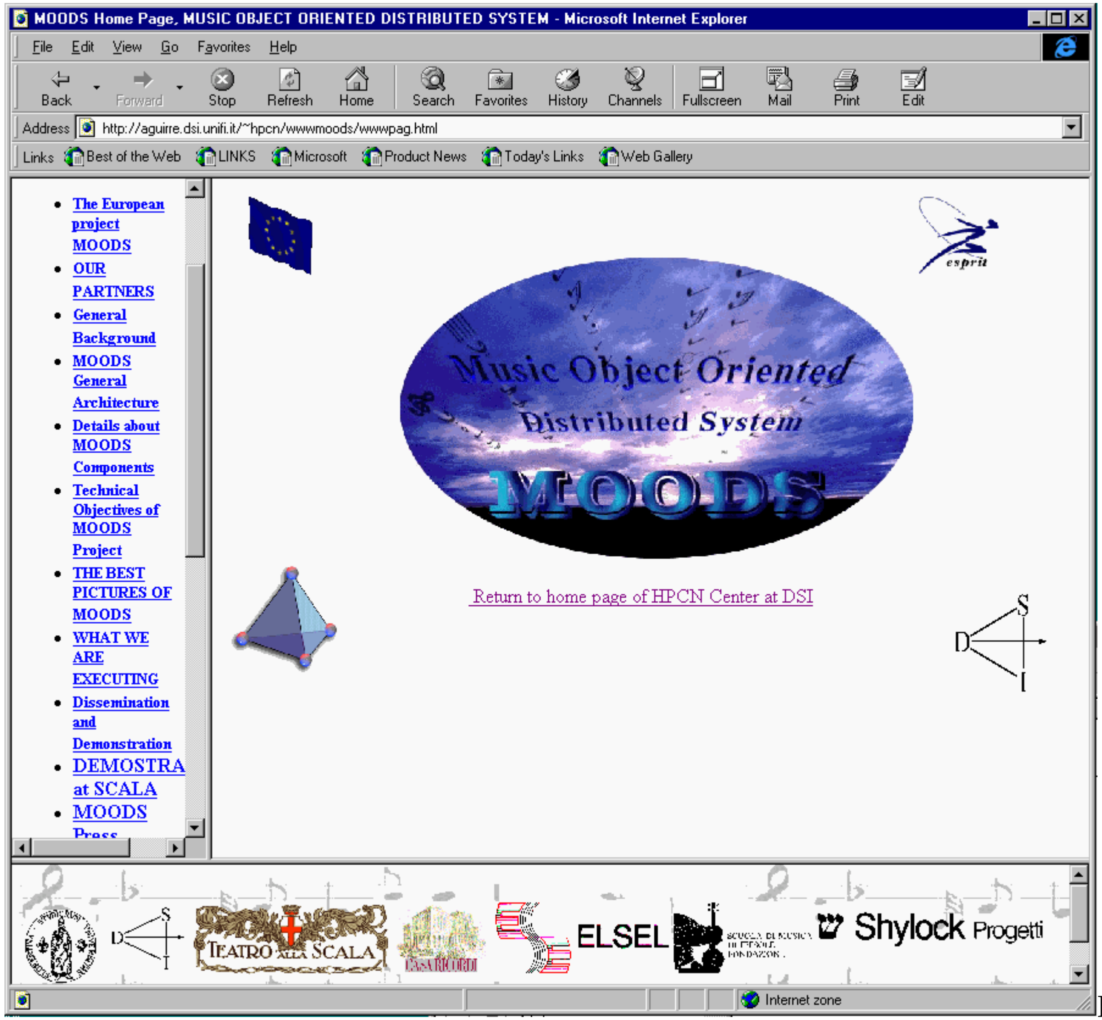
Il profumo dei mobili incerati, i busti severi di grandi musicisti ci scrutano quando entriamo in uno dei templi della musica classica mondiale: il Teatro alla Scala di Milano. Noi poveri informatici non possiamo capire, siamo troppo abituati a guardare i nostri macchinari dall'obsolescenza rapida ed inevitabile. Si vive nel timore di non riuscire ad entrare in sintonia con gli abitanti di questo mondo, tradizioni conservate gelosamente, sensazioni e profumi che i nostri sensi poco avvezzi con grande difficoltà riescono a cogliere. I musicisti arrivano alla spicciolata, estraggono i loro strumenti dai caldi abbracci dei velluti delle loro custodie, si preparano alla prova. Il direttore arriva per la prova: uno spettacolo a sé stante, bisognerebbe farvi assistere quelli che credono che il direttore non serva a niente, musicisti che danno il meglio delle loro capacità solo in sua presenza , è lui l'artefice di quell'atmosfera artistico-creativa senza la quale le Partiture sarebbero buone solo per un impolverato archivio.

di Nicola Baldini, Pierfrancesco Bellini, Fabrizio Fioravanti, Paolo Nesi

Come saprete ogni opera musicale consiste di una notevole quantità di materiale cartaceo che normalmente viene noleggiato o acquistato dai teatri presso gli editori che di solito ne detengono anche i diritti d'autore.

Una partitura è spesso composta da più di 100 pagine (per un'opera anche 600 o più). Dalle partiture sono prodotte le parti per i 60 ed oltre musicisti dell'orchestra, senza considerare l'eventuale presenza del coro. L'esecuzione può durare da alcuni minuti a più di due ore.

Di solito il rapporto dei musicisti con la partitura è piuttosto intenso. Il direttore e l'archivista, prima delle prove, apportano modifiche ed annotazioni che spesso possono essere anche significative specialmente nel caso di balletti ed opere mai eseguite prima. I musicisti intervengono sulle parti singole durante le prove aggiungendo simboli di interpretazione o indicazioni del direttore (simboli dinamici, espressioni, diteggiature, sordina, ecc.). Modifiche pesanti possono consistere nell'eliminazione di alcune sezioni, spostamento di parti dello spartito, arrangiamento della musica per strumenti diversi, ecc. Tutto il materiale cartaceo dell'opera è soggetto ad essere pesantemente annotato e poi successivamente riportato allo stato originale con l'antico metodo della gomma. Il metodo presenta degli ovvi svantaggi che vanno dal deterioramento alla perdita delle preziose annotazioni che sono state fatte per una certa rappresentazione di una particolare opera e che invece sarebbe gradito poter conservare come archivio. Il direttore potrebbe volerle riutilizzare in una successiva rappresentazione, il musicologo potrebbe volerle studiare, lo studente di musica potrebbe desiderare di carpire i segreti di un grande maestro.



Ma l’informatica cosa c’entra con tutto questo? Niente, proprio niente, e questo è davvero stupefacente.

Progetto MOODS

MOODS nasce con l’obiettivo principale di affrontare il problema della gestione delle partiture musicali nei teatri in tutte le loro fasi: dalla scrittura da parte degli editori, all’archiviazione, all’effettiva utilizzazione in orchestra. Tale obiettivo può essere sintetizzato nei seguenti punti:

- Riduzione del tempo necessario per modificare le partiture principali durante le prove.
- Gestione (caricamento, manipolazione, salvataggio) dei simboli/annotazioni strumentali sulla partitura direttoriale e sulle parti; salvando in questo modo dettagli che sono da sempre andati perduti.
- Riproduzione e manipolazione della velocità d’esecuzione con la quale la musica è stata eseguita dall'orchestra.

- Automazione dei meccanismi delle voltate di pagina durante l'esecuzione di brani e le prove.
- Visualizzazione in pochi minuti direttamente sui leggii degli orchestrali di partiture la cui ricerca in archivio potrebbe necessitare ore. Veloce manipolazione di queste per arrivare alla versione definitiva da utilizzare sui leggii.
- Realizzazione veloce di cambiamenti sulla partitura e il riavvio durante le prove da punti prefissati o da singole battute.
- Manipolazione in tempo reale di partiture direttoriali e la visualizzazione di tali modifiche ai musicisti direttamente sulle singole parti.

Il progetto e' nato all'interno del Dipartimento di Sistemi e Informatica dell'Università di Firenze nel 1994 a partire dal lavoro di un gruppo di studenti nell'ambito del corso di Ingegneria del Software, successivamente e' stato sviluppato un progetto finanziato dalla European Commission nel dominio HPCN (High Performance Computer Networking) dell'ESPRIT IV. Fra i partecipanti al consorzio le tre tipologie di utenti potenziali sono egregiamente rappresentate: il DSI, Università di Firenze (modellazione della musica e software di gestione dei leggii, coordinatore del progetto); il Teatro alla Scala; la BMG Ricordi/Casa Ricordi; la Scuola di Musica di Fiesole; la ditta ELSEL di La Spezia (hardware per i leggii); e la SHYLOCK Progetti di Venezia (software per la conversione di partiture da e per altri formati "elettronici" e gestione dell'archivio). Il progetto si e' concluso il 31 Ottobre 1998. La Hewlett Packard Italia supporta il DSI in alcune attività relate all'informatica musicale.

Caratteristiche del sistema

Il sistema MOODS è composto da una serie di leggii elettronici messi in comunicazione fra loro attraverso una rete ad alte prestazioni. I musicisti possono interagire con i leggi in modo molto simile a quello tradizionale: possono modificare, aggiungere, cancellare simboli della notazione musicale e simboli d'interpretazione utilizzando una penna ottica direttamente su di uno schermo LCD, o tramite trackball. Ogni modifica effettuata su una parte è inviata direttamente anche agli altri musicisti che leggono la stessa parte e all'archivista e al direttore che invece hanno una visione completa della partitura su di un leggio con schermo di dimensioni adeguate. In questo modo può essere organizzato un lavoro di "editing" cooperativo che risulta essere estremamente produttivo per documenti di tale complessità.

I componenti principali del sistema appartengono alle seguenti categorie:

- **MASAE (Main Score Auxiliary Editor)**
  Si tratta del gestore del sistema ed è una workstation UNIX riservata alla persona dell'archivista. Da essa è possibile gestire tutte le funzionalità di base del sistema sia in fase di editing che di esecuzione ed è inoltre abilitata a tutte operazioni di configurazione. Nell'attuale prototipo del sistema l'hardware utilizzato è una stazione Hewlett Packard PA-RISC.
- **DLIOO (Distributed Lectern Interactive Object Oriented)**
  Sono i leggii dedicati alla visualizzazione delle parti. Strutturalmente è costituito da un monitor LCD in tecnologia TFT e dotato di touchscreen e/o trackball per consentire l'inserimento di modifiche alla parte musicale. Nell'attuale versione del prototipo l'hardware utilizzato è di tipo custom basato su processore Intel Pentium 133Mhz. Con l'attuale tecnologia e' possibile la gestione fino a 200 leggii. Versioni puramente passive dei DLIOO sono denominate PDLOO.
- **MASE (MAin Score Editor)**
  Si tratta del leggio riservato a direttori d'orchestra. Da un punto di vista funzionale è identico al DLIOO con la differenza che è dedicato alla visualizzazione di un'intera partitura e quindi richiede che il monitor debba avere una risoluzione minima di 1600x1200 punti. Nell'attuale versione del

prototipo l’hardware utilizzato è un Personal Computer Hewlett Packard Vectra con processore Intel Pentium 166Mhz.

- **Database**
  L’archiviazione delle partiture e la gestione delle varie versioni di esse è realizzata con il supporto di una versione estesa di ArchiMUSICA della SHYLOCK progetti di Venezia.

Il profumo dei bit

Se i bit abbiano un profumo non lo sappiamo, almeno noi informatici, i musicisti chissà, forse un giorno...

La prima cosa che viene in mente di chiedersi è come il mondo della musica classica sia potuto rimanere ai margini dell'incredibile informatizzazione che ha interessato tutti i settori dell'attività umana; questo però è successo veramente e il progetto MOODS ci ha dato la possibilità di avvicinare questo mondo meraviglioso con un'emozione degna delle grandi imprese pionieristiche di ottocentesca memoria.

Le esigenze degli utenti hanno avuto un ruolo di primo piano nelle scelte progettuali e nella realizzazione del prototipo del sistema MOODS. Nel caso di un’utenza come quella a cui si rivolge MOODS il compito di raccogliere le informazioni non è stato marginale e abbiamo cercato di approfittare al meglio dell'occasione unica che ci veniva presentata: sfruttare la consulenza dei partner del consorzio MOODS: Casa Ricordi, editore leader mondiale per la musica classica , Teatro alla Scala di Milano e Scuola di Musica di Fiesole. Il nostro sistema ha potuto quindi beneficiare di un'analisi dei requisiti di livello altissimo in particolare per quanto riguarda il numero di simboli musicali manipolabili, le tecniche di editing, di archiviazione e di interfacciamento con l'utente.

Siamo rimasti abbastanza stupiti nel constatare che tra molti copisti e editori non è ancora stato ben metabolizzata la vera essenza del formato elettronico di un documento. Spesso il formato elettronico è considerato solo un mezzo comodo per archiviare e stampare più volte qualcosa che normalmente se ne starebbe su lastra di piombo o pellicola per fotocomposizione. In un mondo dove altri tipi di documenti stanno già beneficiando di tutti i valori aggiunti offerti dal formato elettronico il settore musicale sta solo adesso muovendo i primi passi, in questo senso MOODS ha definito un formato di documento che oltre a consentire la riproduzione riesce a tenere traccia delle modifiche che vengono apportate, supporta vari stili di formattazione della musica attraverso la definizione di regole, è compatibile con l'archiviazione in un database.

Anche ammesso di aver a disposizione un catalogo di opere musicali in formato elettronico il presupposto per poterle tenere aggiornate in tale formato è riuscire a fornire ai musicisti uno strumento con cui possano interagire con esse modificando il meno possibile il loro modo di lavorare. Il primo dubbio che ha un musicista di qualunque livello a cui venga prospettata la possibilità di leggere la musica su di uno schermo per computer è ovviamente quella della resa grafica. Bisogna tenere presente che spesso il musicista è prevenuto nei confronti del computer, nella migliore delle ipotesi non solo non lo usa abitualmente ma lo associa agli schermi a fosfori verdi di molti anni fa. Va detto che negli ultimi anni la tecnologia degli LCD ci è venuta incontro ad una velocità che non potevamo nemmeno immaginare, alla fine del progetto siamo stati in grado di proporre una resa grafica della pagina dello spartito di qualità equivalente a quella su carta con gli ulteriori vantaggi della retroilluminazione e la possibilità di ingrandire i caratteri secondo le esigenze dell’utente.

Un altro aspetto che abbiamo dovuto curare con particolare attenzione è stato quello dell'interfaccia utente, le considerazioni su di essa devono prescindere da valutazioni estetiche o ergonomiche nel senso informatico del termine, ancora una volta l'utente deve essere al centro dell'analisi. Nel corso del primo collaudo a porte chiuse effettuato nei locali messi a disposizione dalla Facoltà di Ingegneria dell'Università di Firenze, i musicisti della Scuola di Musica di Fiesole ci hanno fatto notare che accedere ad alcuni simboli attraverso la gerarchia dei menù che avevamo pensato era "come azionare la freccia dell'automobile con la leva collocata nel cassetto portaoggetti"; a noi pareva di aver fatto bene...

Situazione analoga per quanto riguarda il dispositivo di input: abbiamo provato sia la trackball che il touchscreen con penna, a noi pareva più comoda la prima ma anche questa volta i musicisti ci hanno detto che trovavano fantastico il secondo sistema...

I commenti che sono seguiti alla dimostrazione presso il Teatro alla Scala di Milano, lo scorso 22 Settembre, sono stati estremamente positivi anche da parte di coloro che si erano dichiarati scettici fin dal primo momento.

Indicativo il commento del Maestro Freducci, primo violino della Scuola di Musica di Fiesole: "All'inizio ho pensato a MOODS come ad un sistema utile per i concerti all'aperto per sostituire le mollette usate per tenere ferme le pagine dello spartito quando tira vento, ho trovato invece un oggetto veramente utile e facile da utilizzare anche per uno come me completamente al di fuori di tutto ciò che è computer".

Moltissimi anche gli apprezzamenti alle modifiche apportate rispetto alla versione provata solo due mesi prima della dimostrazione che hanno messo in luce, se ancora ce ne fosse bisogno, che la stretta collaborazione fra progettisti ed utenti va solo a beneficio del risultato finale.

Ma cosa ne sarà della sensazione di avere tra le mani una partitura intensamente vissuta da tanti direttori? Come sarà possibile conservarne il profumo? Su questo hanno ragione, non sono sensazioni da ricercare nelle sequenze di bit, non ne siamo capaci nemmeno noi informatici.

Unix & Co.

Uno degli scopi del progetto è anche quello della formalizzazione del linguaggio musicale; l'approccio che fin dal primo momento è sembrato meglio adattarsi al problema, anche tenuto conto delle problematiche legate all'ingegneria del software, è quello Object Oriented. Tale approccio si differenzia in maniera abbastanza sostanziale da quello di altri programmi per la scrittura di musica che operano sulla pagina unicamente da un punto di vista grafico. La nostra idea consiste nel legare, da un punto di vista semantico, le figure musicali con gli attributi ad esse correlabili e successivamente definire delle regole per l'impaginazione e la giustificazione automatica dei simboli musicali.

Il progetto (internamente al DSI) ha mosso i primi passi nel 1994 quando la tecnologia Java era ben lungi da essere utilizzabile davvero e anche il fatto che tuttora sia carente nelle prestazioni ci conferma la correttezza della scelta che facemmo del C++ come linguaggio principale di sviluppo. Anche Lex e Yacc sono stati ampiamente utilizzati nel progetto: la formalizzazione del linguaggio musicale è stata fatta con sintassi EBNF ed essi sono stati utilizzati per la generazione del relativo codice.

La necessità di poter accedere a queste risorse nel contesto di un unico ambiente operativo ha condotto alla scelta del sistema operativo Unix come piattaforma principale di sviluppo anche tenuto conto delle richieste di affidabilità e robustezza che in un sistema complesso come MOODS devono essere tenute in grande considerazione. Il mondo Unix offre anche la facilitazione di un ambiente grafico (X Windows) le cui primitive sono considerate standard su tutte le versioni di questo sistema operativo, offrendo quindi un panorama di portabilità molto ampio. In ogni caso tutta l'interfaccia fa unicamente affidamento sulla disponibilità di funzioni elementari come il tracciamento di linee, rettangoli e creazione di finestre e su una gestione degli eventi basati su di un sistema di callback; caratteristiche di base praticamente disponibili in tutti i sistemi operativi moderni.

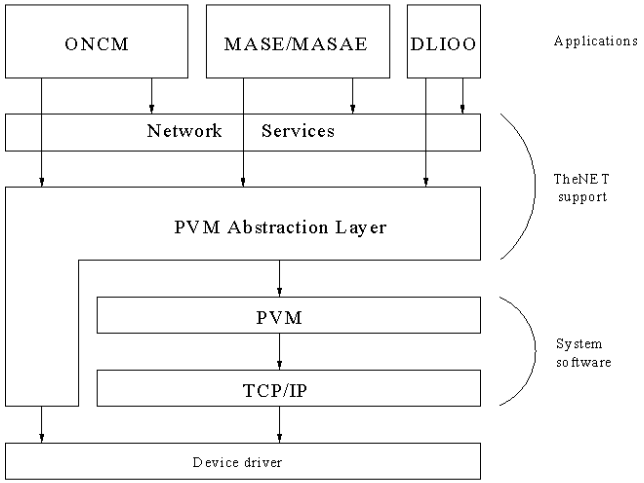
Un'altra motivazione che ci ha spinto alla scelta di Linux fra le varie piattaforme Unix disponibili è stato dettata dalla necessità di realizzare leggii custom per soddisfare i requisiti di rumorosità imposti dalle specifiche di progetto. Sarebbe inaccettabile avere un centinaio di ventole e hard disk in funzione contemporaneamente e per questo ogni leggio è stato dotato di EEPROM contenente una versione ridotta del kernel. Linux, essendo disponibile sotto forma di sorgente, consente la riduzione del sistema operativo solo alle parti strettamente necessarie.

La necessità di rendere il sistema portabile ha fortemente influito anche su un'altra delle scelte cardine nella progettazione: l'architettura del sistema dal punto di vista della rete. Nella figura vediamo rappresentata l'architettura di rete del sistema MOODS: fra le classi che rapprentano le applicazioni fondamentali del MOODS (ONCM, MASE/MASAE, DLIOO) ed il protocollo TCP/IP sono stati inseriti diversi layer che permettono di filtrare le informazioni e rendere così l'applicazione indipendente dal protocollo di rete effettivamente in uso. Vediamo più nel dettaglio i singoli componenti.

PVM (Parallel Virtual Machine) è una libreria di funzioni che permette di trattare una rete non omogenea di macchine come una unica unità di elaborazione parallela, incapsulando il protocollo software ed i meccanismi hardware di comunicazione dei vari nodi della rete. L'utilizzo della PVM, disponibile su tutte le piattaforme Unix, oltre che sulle piattaforme Windows permette di ottenere un alto livello di portabilità del software che la utilizza, rendendolo anche indipendente dal protocollo di basso livello utilizzato per la connessione fisica di rete. Il solo livello della PVM non garantisce un buon livello di isolamento del sistema dalla rete fisica, e non essendo strutturato ad oggetti impedisce di fatto una buona integrazione delle funzioni messe a disposizione dalla PVM con il sistema; da qui la necessità di creare un ulteriore livello: il PVM abstraction layer, che astrae il nucleo principale del sistema dalla PVM stessa.

Questo ulteriore livello fornisce al sistema un'interfaccia verso la rete ad oggetti consistente con la gerarchia di classi pensata per i servizi di rete del sistema MOODS.

Vista la enorme quantità di dati da trattare per la trasmissione di intere partiture musicali, si è resa necessaria l'introduzione di alcune classi che si occupassero esclusivamente della gestione dei servizi di rete di cui il sistema necessita: trasmissione di messaggi per l'invio di battute musicali, trasmissione di messaggi per l'esecuzione e la voltata automatica di pagina sincronizzata fra i vari leggii , trasmissione di messaggi per la notifica ed il recupero di situazioni anomale o di errori. L'insieme di classi preposte all'interfacciamento fra il livello dell'applicazione e quello del software di sistema è stato chiamato TheNet (Theater Network).



La presenza di alcuni livelli di astrazione fra il protocollo di rete, un'oculata progettazione, ed un uso dei costrutti standard del C++ non preclude la portabilità verso piattaforme diverse da quelle Unix, prima fra tutte la piattaforma Windows, che potrebbe essere adottata per dotare il sistema di una interfaccia più usuale per un eventuale utilizzo di MOODS nell'editoria elettronica, ferma restando la convinzione che la piattaforma Unix offre una stabilità migliore al sistema durante l'esecuzione, dovuta anche al maggiore sforzo profuso nell'ottimizzazione della PVM in ambiente Unix.

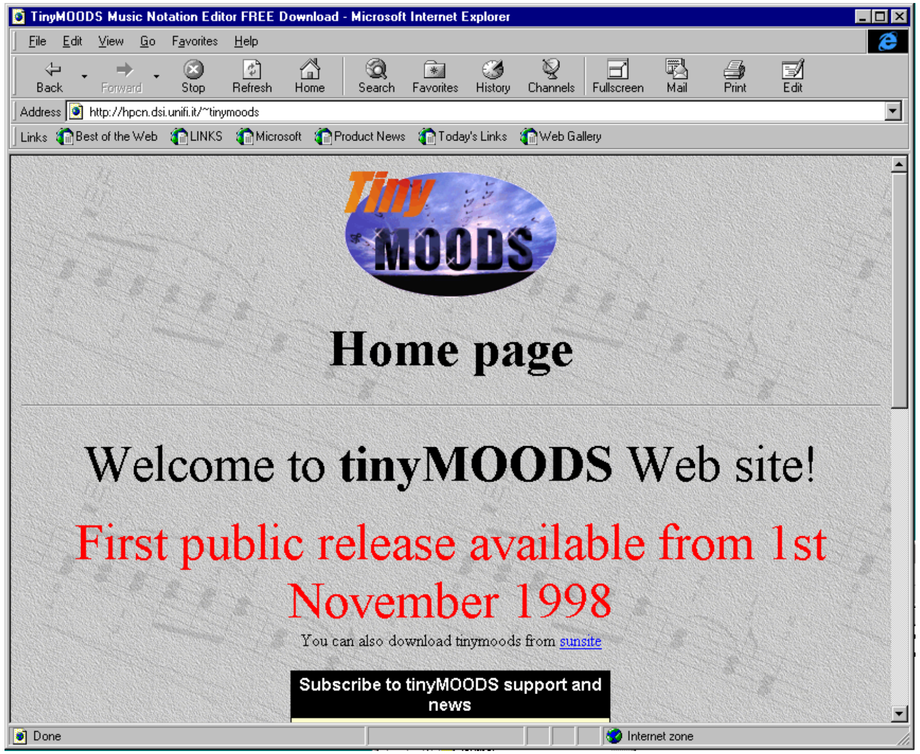
Il cuore del sistema è la stazione MASAE. Si tratta di un vero e proprio editor di partiture musicali direttoriali col quale è possibile effettuare modifiche sostanziali in tempo reale sulla partitura anche durante le prove in modo che ogni musicista abbia sul proprio leggio sempre la parte aggiornata. Da MASAE vengono anche controllate tutte le funzionalità relative all'esecuzione. La reale velocità di voltata delle pagine viene calibrata sulla base dell'indicazione di tempo fornita a priori, l'esecuzione però non segue quasi mai fedelmente tale indicazione di tempo e quindi l'archivista ha il compito di effettuare piccoli aggiustamenti mentre il pezzo viene eseguito qualora ve ne sia necessità. MASAE è l'unico componente del sistema MOODS che è in grado di lavorare da solo e venire quindi sfruttato esclusivamente come editor di partiture.

Ad ogni DLIOO viene assegnata una specifica parte insieme ad una serie di permessi che definiscono le loro possibilità di manipolazione della musica. Durante tale fase tutti i musicisti possono interagire liberamente sulla propria parte ed effettuare le necessarie modifiche. Qualunque modifica eseguita su una singola parte contribuisce all'aggiornamento della partitura globale che risiede su MASAE. Tutti i leggii sono organizzati in accordo alla gerarchia dell'orchestra. Quelli di primo livello sono qualificati per effettuare modifiche sulla parte corrente (simboli principali e di interpretazione) e sono tipicamente abilitati a manipolare un maggior numero di simboli, per gli altri il numero di simboli utilizzabile è di solito più limitato. In questa organizzazione gerarchica, il leggio leader di un gruppo trasmette direttamente ai leggii da lui dipendenti le modifiche effettuate sulla parte.

MOODS si basa su un modello ad oggetti della musica che permette di essere esteso in molteplici direzioni. Per esempio l'aggiunta di simboli per la musica moderna come la gestione di strumenti di vario tipo anche non convenzionali. Inoltre, il modello ad oggetti di MOODS è particolarmente adatto ad essere utilizzato per integrare nella partitura musicale con notazioni relative alla regia teatrale: effetti di palcoscenico, azionamenti, effetti di spazializzazione, ecc.

Interfaccia utente

L’interfaccia utente e la raccolta di simboli musicali di MOODS sono state definite dopo un'accurata analisi effettuata intervistando esperti dell'editoria musicale, direttori, archivisti, insegnanti di scuole di musica, musicisti ed eseguendo esperimenti pratici sull’utilizzabilità. Da tali interviste, e dall'analisi degli attuali strumenti professionali per l'editoria musicale e' stato notato che nessuno di questi è completamente soddisfacente per la scrittura della musica e per l'estrazione delle parti in automatico. La stessa informazione deve essere rappresentata in modo diverso nella partitura e nelle parti. Nella partitura i simboli strumentali vengono omessi e ogni battuta è completamente sviluppata; nelle parti si dovrebbe invece fare uso della simbologia abbreviata il più possibile. Richiami devono essere posti dopo lunghe pause, informazioni aggiuntive in relazione alla presenza di varie voci devono essere inserite nei punti critici. Nelle modifiche, il tipo di informazione inserita dai musicisti (nelle loro parti) è spesso diversa da quella utilizzata nella partitura direttoriale.



I sistemi attuali per l'editoria musicale computerizzata sono infine troppo complessi per essere utilizzati dal vivo da musicisti durante le prove e rappresentazioni. Questo è dovuto al fatto che sono stati realizzati principalmente per soddisfare le necessità dei copisti nell'editoria musicale e non quelle dei musicisti che necessitano di interagire in breve tempo direttamente sulla partitura in modo semplice. A tale proposito MOODS adotta un modello uniforme per gestire partiture complete e singoli spartiti con un'interfaccia utente molto semplice da utilizzare. Tutti i menù possono essere posizionati orizzontalmente o verticalmente in modo statico in qualsiasi punto dello schermo garantendo la selezione veloce dei simboli da posizionare sullo spartito. I simboli che vengono gestiti sono sia quelli fondamentali che quelli legati all'interpretazione dei vari strumenti e in ogni caso tale insieme può essere ampliato con uno sforzo contenuto.

Software di base

Una delle principali linee guida dello sviluppo di MOODS è stata quella della portabilità, il sistema è stato realizzato totalmente in C++ utilizzando il compilatore GNU disponibile su praticamente tutte le piattaforme software. Per il supporto alle comunicazioni tra leggi è stata scelta la strada dell'astrazione da qualunque protocollo a basso livello per non precludere l'utilizzo di standard di rete diversi da Ethernet e quindi si è utilizzato il supporto di PVM (Parallel Virtual Machine), un insieme di librerie e strumenti che permettono la realizzazione di applicazioni distribuite in maniera altamente efficiente e portabile. PVM è disponibile su innumerevoli piattaforme software e ottimizzata anche per reti di tipo ATM. Il sistema operativo di riferimento è obbligatoriamente Linux per le stazioni DLIOO dove parte del sistema operativo risiede su flash EPROM mentre per le altre stazioni è prevista fin da subito compatibilità anche con Solaris SPARC e HP-UX.

Dimostrazione al Teatro alla Scala

Un prototipo di sistema MOODS, composto da 5 leggii per musicisti, un leggio direttoriale e una stazione per l'archivista, è stato presentato pubblicamente per la prima volta al Teatro alla Scala, lo scorso 22 Settembre con una conferenza stampa, dimostrazione e presentazione tecnica (si veda foto allegata, sullo sfondo lo schermo per la presentazione tecnica). La conferenza stampa è stata tenuta dal coordinatore del progetto Prof. Ing. Paolo Nesi, dal Maestro Carlo Tabarelli (primo archivista del Teatro alla Scala), dal Maestro Gabriele Dotto (responsabile della produzione di Casa Ricordi) e dal Dr. Sandro Moro della Shylock Progetti. La dimostrazione ha incluso l'esecuzione di alcuni brani di Mozart, Verdi e Vivaldi, seguiti da una breve dimostrazione tecnica delle funzionalità d'interazione dei musicisti con i leggii.

Dimostrazione al Teatro alla Scala, settembre 1998

Dai primi riscontri sul campo, MOODS è stato considerato dai musicisti che lo hanno provato, uno strumento utile sia in orchestra che nelle scuole di musica. Le funzionalità di MOODS lasciano all'animo artistico del Compositore e/o del Direttore più spazio per sperimentare nuovi effetti ed arrangiamenti in pochi minuti. MOODS lascia spazio all'espressività artistica di direttori e maestri stabilendo una risposta diretta fra ciò che il direttore chiede e il risultato prodotto dall'orchestra o nella classe di musica. MOODS potrà nei prossimi anni dare vita ad una vera e propria rivoluzione nel mondo dell'editoria musicale e dei teatri. Potrà cambiare anche l'approccio che i musicisti potranno avere nei riguardi delle partiture musicali.

In occasione della manifestazione Mediartech 1999 che avrà luogo a Firenze in Marzo, il Dipartimento Sistemi e Informatica sarà presente col sistema MOODS con una serie di dimostrazioni per il pubblico ed altri progetti. Per conoscere dettagli e le date consultate direttamente il sito http://www.mediartech.com o il sito ufficiale MOODS.

tinyMOODS

A partire dalla prima settimana di Novembre 1998 il Dipartimento di Sistemi ed Informatica dell'Università di Firenze, interamente responsabile della parte software del progetto MOODS, ha deciso di rendere disponibile sul proprio sito Web una versione ridotta del sistema, denominata tinyMOODS, in grado di lavorare su personal computer. Tale versione implementa tutte le funzionalità di MOODS per quanto riguarda l'editing musicale mentre risulta limitato il supporto delle funzionalità di rete per il lavoro cooperativo e l'esecuzione.

Per informazioni si consulti il sito Web http://hpcn.dsi.unifi.it/~tinymoods.

Nicola Baldini, Pierfrancesco Bellini, Fabrizio Fioravanti e Paolo Nesi lavorano presso il Dipartimento Sistemi e Informatica, Facoltà di Ingegneria dell'Università di Firenze.

Chi e Dove

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Amadeus

MEDIA

a cura di
PATRIZIA LUPPI

Il mensile della grande musica, De Agostini - Rizzoli periodici

Anno X, 11 (108) Novembre 1998

Dall'archivio al Leggio: la musica in rete

Anche le partiture viaggiano su Intenet: ormai arrivano fin sui leggii dei musicisti grazie al nuovo progetto Moods (Music Object Oriented Distributed System), elaborato presso il Dipartimento di Sistemi e Informatica dell'Università (di Firenze e parzialmente finanziato dalla Comunità Europea. Si tratta di "*un sistema integrato di leggii basati su computer per la manipolazione cooperativa della musica e la sua visualizzazione*": utilizzando Moods, si richiede la musica via Internet all'archivio della casa editrice - che com'è ovvio dev'essere attrezzata in questo senso - e la si trasmette in rete agli esecutori che hanno davanti, al posto del tradizionale leggio, un terminale video.

Il sistema Moods in prova all'Università di Firenze

Ciascuno può seguire la propria parte che scorre in sincronia con l'esecuzione; il direttore vede invece scorrere l'intera partitura e come lui possono osservarla il maestro del coro o il regista dalle rispettive postazioni. Durante le prove, qualsiasi aggiunta o correzione può essere apposta direttamente dai leggii dai singoli musicisti; spetterà poi alla figura dell'Archivista, una sorta di coordinatore e supervisore del sistema, stabilire se le modifiche resteranno operative o meno. Prevista anche la possibilità di stampare su carta la musica, per esigenze di studio o altro. Con il sistema Moods - che sarà messo in commercio nella seconda metà del 1999 - orchestre, teatri, case editrici e scuole di musica potrebbero usufruire di grossi vantaggi: l'abbandono almeno parziale del supporto cartaceo potrebbe portare soprattutto a grandi economie di tempo e denaro (basti pensare, per esempio, a cosa significa inviare da una città all'altra un'opera che fra partitura e parti staccate arriva a contare migliaia di pagine) e a una più corretta gestione dei diritti d'autore.

Una dimostrazione delle possibilità di Moods è avvenuta in settembre al Teatro alla Scala, partner dell'operazione dell'Università di Firenze con la Bmg Ricordi, con la Scuola di Musica di Fiesole e, per l'informatica, con Elsel e con Shylock Progetti. Dimostrazione interessante e convincente, che ha lasciato però alcuni interrogativi aperti: prima di tutto il costo dell'installazione, ancora impossibile da calcolare. Viene da chiedersi poi con quanta facilità e disponibilità gli esecutori (presumibilmente in gran parte non abituati a usare un computer) impareranno a districarsi con l'editing informatico, ogni volta che dovranno aggiungere un'arcata o cambiare una legatura.

FOCUS - Innovazioni, dicembre 1998

Da Firenze, lo spartito elettronico

Addio spartiti musicali. E' arrivato il leggio elettronico, un monitor sul quale scorrono automaticamente le note del brano da suonare. Il MOODS (Music Object Oriented Distributed System), nasce all'universita' di Firenze.
Prova d'orchestra. Dice Paolo Nesi, coordinatore del progetto: "Il sistema puo' registrare tutte le operazioni, finora manuali, compiute sulle partiture musicali durante le prove". I leggii degli orchestrali, cosi, ricevono subito le modifiche decise dal direttore. Informazioni: http://aguirre.dsi.unifi.it/~hpcn/wwwmoods/wwwpag.html.

MOODS: Music Object Oriented Distributed System

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Abstract

La Scala, Milan: The severe busts of famous composers in the "Ridotto dei Palchi" look distrustfully at some strange objects: a set of "non-traditional" lecterns and several other pieces of equipment. The pit waits, the musicians arrive a few at a time, take their instruments out of their cases, and get ready. The conductor arrives, the only person capable of reproducing the creative atmosphere that may lead the orchestra to produce sounds and harmonies that can provoke deep emotions. A stiff posture, a quick tuning of instruments, a glance, silence, a gesture, the music starts. Seconds pass, minutes pass, the music continues without a page rustle, without a moment of distraction needed for turning pages; the musicians concentrate on the music on their lecterns. The conductor directs the orchestra with tidy movements, fast and sometimes strong, without distractions, without hasty page-turning gestures. Nine musicians on five string parts/lecterns play with total concentration some pieces by Vivaldi, Verdi and Mozart for a skeptical and, at the very least, incredulous audience.

The above events took place on 22 September 1998 with the support of a technological tool to ease the work of the orchestra and the archivist (see Fig.1). The tool, called MOODS (Music Object Oriented Distributed System), is the very first prototype of an integrated system of computerized lecterns: the subject of this paper. A technical demonstration and discussion followed the execution of the pieces. The demonstration provoked strong interest from many newspapers and musicians who have written favorable critiques of MOODS.

1 Introduction

The amount of information managed by orchestras is huge. A main score is often comprised of more than 100 pages (for an opera, 600 pages or more). From a main score, 40 or more lecterns for 70 musicians are typically needed for the 15–30 different instrumental parts (without considering the presence of a chorus). The performance time can range from a few minutes to over two hours.

Simple changes are typically decided by each musician and written in pencil or pen on the music parts during rehearsals – for instance, by adding interpretation symbols: dynamics, expression marks, string bowings, mute on/off, etc. More complex changes, such as the deletion or addition of music sections, their movements along the score, music arrangements, transposition, etc. are decided by the conductor (by the composer in the case of new music). These modifications are very time consuming, and are frequently performed in the case of operas, ballets, or new symphonic works. For these changes the archivist team uses cut and paste, clipping pages together, writing long passages in place of rests, etc. to reach the final version as soon as possible. This process can take a few hours, days or sometimes weeks, delaying and fragmenting rehearsals. Relevant changes should be decided in advance, but frequently they are identified only during rehearsals, provoking long and tedious pauses. Such major on-site decisions are especially frequent with stage works like operas and ballets (which are also the works involving the largest amount of music material), where decisions on musical changes can derive, during rehearsals, from various needs – of singers, of stage directors, problems of acoustical space, etc. The time spent waiting for the adapted version of a score and parts can add up to large amounts of the total time allotted for a rehearsal. This is a significant cost considering that in many cases musicians, dancers, choristers, supernumeraries, etc. are on an hourly wage.

When different musicians use the same paper version of a music score, old modifications must be deleted (if possible) and new modifications made on the same score. If the marks are too heavy, the scores or parts must be replaced, at significant cost (much classical music is covered by copyright and since the performances are public it is easy for music publishers to exercise control effectively). Deleting old changes and replacing scores are both particularly time consuming. On the other hand, it is sometimes necessary to keep various versions of a set of scores and parts in the archive, because they carry the interpretation marks of important interpreters or because they can be required, in the same version, years later. The costs of storing, maintaining or replacing multiple unique sets of parts can become exorbitant both for theater archives and for publishers.

Fig.1 -- MOODS at work: La Scala, Milan (in the background is the screen used during the technical presentation).

This leads theaters to work with music scores rented from publishers. Further, in many cases the logistics of renting music material or storing sets of music scores and parts (for opera-theater or orchestra archives) make it difficult, if not impossible, to retain copies of all the various versions generated for a given work by different conductors or theater productions. At best, a copy of a modified score may be set aside, but not the full set of parts. When a specific version or production is repeated some seasons later, the modifications have to be regenerated, creating redundant costs that can be significant. A solution that would make the storage of multiple versions possible, and greatly reduce the amount of repetitive work involved, is an important goal for many performing organizations and publishers.

For publishers, this technology offers the added solution of creating a huge database, over time, from which to derive and store a potentially infinite number of personalized versions, and even of various publishable editions of repertory works. The methodology of supply and distribution could also, over time, change radically, avoiding the printed paper stage in select cases. The transmission of digital music information directly to theaters by means of CDs containing the music in any number of versions can be a practicable solution.

2 From the State of the Art to MOODS

The first programs for managing music by computer were proposed in the early 1970s. Such tools mainly focused on generating and archiving music in audio and symbolic formats rather than on visualizing music scores on video as a substitute for paper. Presently, computer music applications range from audio tools to instruments for music publishers. Several music-based software applications use music models that have multiple interpretations and different manipulation mechanisms. In fact, publishers of music scores, composers, musicians, conductors, and computer music analysts look at music notation from different points of view because they use it for different purposes.

The elementary operations on a music score are: editing, saving, loading, visualizing, executing, coding grabbed sounds, printing, analyzing, etc. In order to provide these capabilities, specific music models and languages have been defined; these can be mainly classified into three large categories: sound-oriented, notation-oriented, and analysis-oriented models. *Sound-oriented models* address music modeling by considering the sounds produced, disregarding the visual representation issues of music notation. Multiple modalities to represent the same sound and several interpretation symbols of music notation are neglected. Classical examples of sound-oriented models are MIDI, Csound, Music Macro Language, etc. Among these MIDI (Music Instrument Digital Interface), is the most diffuse. For MIDI, a limited number of music notation symbols are needed (e.g., notes, rests, accidentals, clefs, ties and points – approximately 50 symbols), since it is impossible to reproduce with a MIDI interface (connected to a MIDI instrument or synthesizer) the effects specified by most music notation symbols (direction of the bow, fingering, specific accents, etc.). *Notation-oriented models* focus on representing scores on the screen and on printing them on paper by using a set of notation symbols; examples are Finale, Score, DARMS, Common Music Notation, LIME, Nightingale, etc. Some of these use a MIDI interface and a MIDI instrument (for example a keyboard) as a short key to input music and for simulating the music playing. *Analysis-oriented models* are used for describing music for its further analysis at the level of harmony, style, and melody, for example EsAC, Humdrum, MusicData, etc. These tend to code music with numbers in order to make metric analysis easier while neglecting several detailed interpretation symbols.

2.1 The Goals and MOODS project

Since the 1970s, the idea of an "electronic lectern/stand" for music has been a dream of many people. In 1994, our research group started to study the problems involved in producing a network of computer-based music lecterns oriented to musicians. These were studied with a view to editing/showing music scores by means of a suitable interface, with the goal of removing paper scores from musicians' stands (lecterns) during rehearsals and final performances, and thus solving/reducing the problems discussed in the introduction. Computerized music lecterns can be used by musicians to avoid transporting many kilograms of paper music scores, to save their work, to manage version control, to reduce the cost of rehearsals, to improve the quality of service offered by music publishers, etc.

MOODS consists of an integrated system of computer-based lecterns/stands for the cooperative editing and visualization of music (see Figs 1 and 2). MOODS is an innovative solution for automating and managing the large amount of information used by (i) orchestras during rehearsals and public performances of concerts, operas, ballets, etc., (ii) students of music during lessons in conservatories and schools of music, and (iii) publishers carrying out massive amounts of music editing. The target end-users are theaters, itinerant orchestras, groups of musicians, music schools, television network orchestras, and music publishers.

The main features and benefits of MOODS are its ability to:

- reduce the time needed for modifying main scores and parts during rehearsals;
- manage (load, modify and save) instrumental and personal symbols on main scores and parts and thus save artistic details never saved before;

- manage and reproduce the exact execution rate (tempo) at which each measure of the score has been executed;
- automate the turning of pages during rehearsals and final performances;
- visualize in a few minutes scores that usually have to be searched for in the theater archive and copied/ adjusted before being shown on musicians' lecterns;
- change pieces quickly or restart from marked points, or arrangement;
- manipulate the main score and parts as a whole music score in real time, thus presenting the final version of the score to musicians in real time.

Fig. 2 -- A first violin playing with an "electronic lectern".

2.2 MOODS vs. the State of the Art

At first glance, this kind of application seems to be not much different from notation-oriented music editors (such as Finale, Score, Sibelius, etc.) in terms of the arrangement of music symbols. But it is surely quite different from sound-oriented tools, which neglect most of the specific interpretation symbols, and also from analysis-oriented models, which do not address the visualization problems of notation. Applications for music publishing need to produce very high-quality music scores in terms of the number of symbols and their correct placement on the staff. Music scores have to be presented to professional users (musicians) with specific relationships and proportions between the symbols. The precise positioning is implemented in most of the music editors presently available by allowing music symbols to be placed freely in all positions on the staff, disregarding their relationships. This lack of support of formal relationships between music symbols is mainly due to the complexity of music notation, which includes so many exceptions; their formalization is a complex task. Therefore, most notation-oriented music editors allow the placement of several notation symbols in incorrect positions, resulting in the production of strange, incorrect music scores. These music editors give no support to their users in producing correct scores. The more complete notation-oriented music editors are typically very complex for musicians to use. Incorrect music scores cannot be played by musicians, cannot be correctly interpreted by style analysis algorithms, and cannot be correctly used to generate sound, and thus they are professionally unusable. Commercial music editors for publishing are mainly oriented towards placing music symbols on the staff rather than collecting relationships between symbols and organizing the visual information on that basis. Instead, they are mainly oriented towards printing music, since this is their most important application. They provide a complete set of symbols and instruments that a user skilled in both music notation and graphic computer user interfaces can use to produce a professional music page.

Thus, professional music editors are powerful, but difficult for users who are not experts in music notation to employ. Typically, musicians are capable of reading music, but are not familiar with the exact rules for arranging symbols (e.g., when symbol A is associated with symbol B, symbol C has to be moved up one-half unit, etc.). On the other hand, musicians have no problem in correctly reading a properly annotated score, but can be perplexed when non-perfect visual constructs appear. Most members of an orchestra are artists, not music engravers nor notation technicians. Conductors and composers are frequently more sensitive to problems of music notation and visual expressiveness. Archivists in music theaters, music engravers, and teachers of music notation are the experts to rely on for problems of music notation.

The above-mentioned problems also exist when using the so-called interchange languages for storing/coding and interchanging music, such as NIFF (Notation Interchange File Format) and SMDL (Standard Music Description Language). Even these languages do not model all the relationships described above, and they also allow the placement of symbols at any point on the staff. They suffer from the same problems as the others.

Music editors must provide support for verification of the visual syntax. Moreover, a music editor has to help the user to produce correct music scores easily (correct in terms of the relative positioning of notation symbols). These very important features can be easily obtained if the syntax and the relationships between the notational entities are formally defined. In the case of music, the definition of the visual grammar is a highly complex task that is not yet formalized. As the number of music symbols grows, the number of relationships between them and the related rules for visualizing them grow more than proportionally, since the presence of certain symbols influences the relationships between other symbols. The rules for adopting symbols are much more important than their availability as graphic elements to be inserted on a score. Therefore, knowledge of the syntax and semantics of music is mandatory for organizing music symbols on the staff. From this point of view, very few music editors (Finale, MusicEase, Lime, Score) address the problems of (i) automatic placement of symbols and (ii) music justification. Some of them are capable of correctly arranging a limited number of symbols.

Music justification involves the placement of symbols both horizontally and vertically on the staff, and can be performed on the basis of several different algorithms. These rules, together with those for the justification of music, have not yet been formalized. Several books have been written to solve this problem, but inconsistencies and incompleteness still exist. In certain respects, the automatic justification of music should be regarded as an open problem. Moreover, all music notation symbols should be placed automatically during insertion; for instance, in music notation, several notation symbols must be placed around the notehead. These symbols, in many editors, must be placed by hand, whereas automatic placing with respect to the reference note could greatly simplify music editing. For example, by associating a given symbol with a note, the symbol has to be automatically placed in the right position with respect to the note, and the position of the other symbols involved has to be adjusted. To this end, we defined three types of rules for: (i) positioning symbols during insertion, (ii) adjusting symbols with respect to the presence of neighboring symbols, and (iii) justifying the measure and the line on the basis of the symbols present.

3 MOODS Solution

MOODS (see Fig.3) is comprised of (i) a set of lecterns for musicians, called DLIOOs (Distributed LIOO, Lectern Interactive Object-Oriented) for editing and visualizing score parts; (ii) a set of lecterns for directors called MASE (MAin Score Editor), used by directors, conductors, and directors of the chorus to show, visualize and modify the main score; (iii) a workstation called MASAE (MAin Score Auxiliary Editor), by means of which the archivist can make even heavy modifications directly on the main score during rehearsals or score revision and can configure the orchestra by using ONCM (Orchestra Network Configurator and Manager); (iv) a database workstation for managing the music archive.
In the following, by “lecterns” we mean both DLIOOs and MASE lecterns. The cooperative distributed system is based on a high performance network support, for example 100 BT Ethernet. The MASAE is capable of distributing music on all orchestra lecterns and interacts with the database managing the theatre/school/orchestra archive; it also allows a connection between the theater's archive and the publishers to be established, via the Internet.

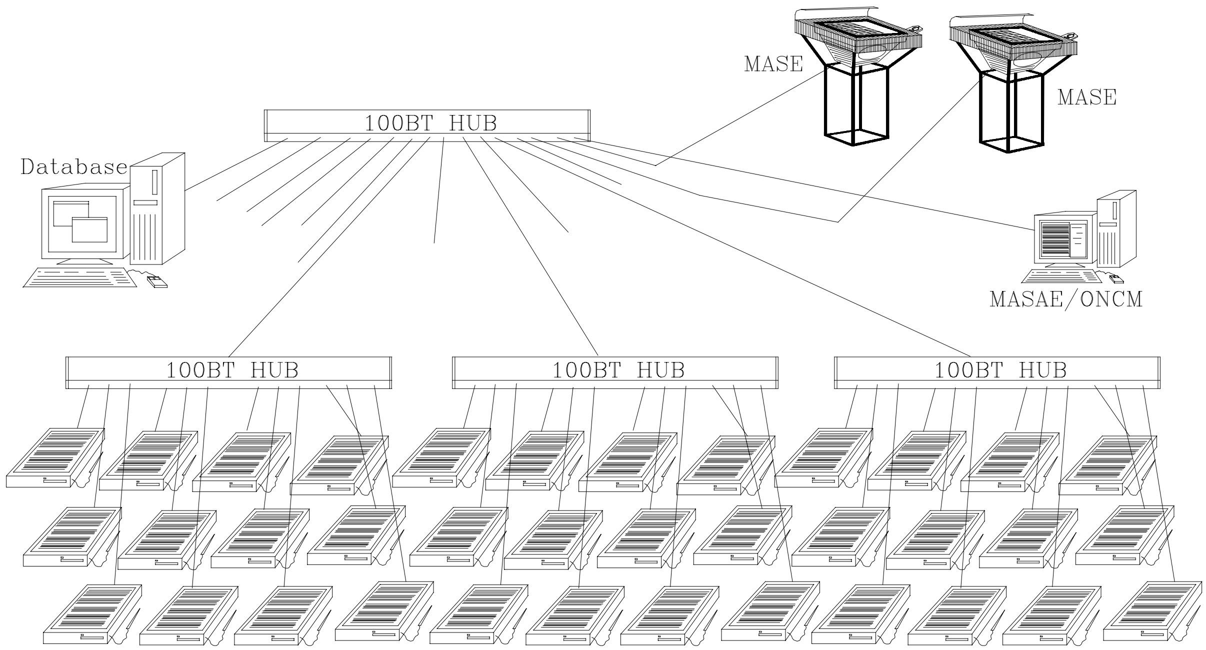

Fig. 3 -- MOODS, Music Object-Oriented Distributed System of lecterns

The MOODS project addressed several interlaced aspects:

1) The definition and implementation of a user-friendly user interface to interact with music scores by considering the positioning, adjusting, and justification of notation symbols independently according to lectern dimensions, instruments, and their relevance in the orchestra.
2) The definition and implementation of mechanisms for the automatic decomposition of the main score into parts while maintaining a unique model of the information managed (typically, scores for musicians and for the conductor are formatted differently).
3) The definition and implementation of a support for distributed and cooperative editing of music: cooperative rules, configuration issues, etc. This allows cooperative editing in different formats, showing changes performed by one operator (e.g., MASE) to the others (DLIOOs, other MASEs, and the MASAE) in real time.
4) The definition and implementation of synchronization mechanisms for automatic page turning during performances and for cooperative manipulation of music scores.
5) The implementation of drivers for converting music scores available in other formats (e.g., Score, MIDI, etc.) into MOODS format.
6) The definition and implementation of mechanisms and rules for managing the versioning of music scores, considering as distinct and separable the changes performed on each individual lectern, by each individual execution, etc.
7) The definition and implementation of a policy for managing the versioning of scores and their components in terms of the changes performed, classified by type and by author.

The main obstacle we found to adopting the available music models for solving the above problems was the lack of a formal model for music. Without a formal model, all relationships between visual notation constructs are difficult to maintain. To this end, as a first step, we modeled all music notation components with a unified object-oriented formal model and language. The object-oriented model of MOODS is used as a music representation model and coding language, as well as a network message interchange protocol. The MOODS language and model integrate aspects of analysis-based, notation-based and interchange-based approaches.

The same unified object-oriented model and language were used to design the MOODS user interface by using mechanisms that are typical of editors for visual languages: (i) a visual parser based on the grammatical rules of the symbols; and (ii) a visual analyzer for the automatic arrangement of symbols on the basis of lexical rules.

The system can operate in two modalities: EDITING or EXECUTION. The MASAE station controls the switching of modalities. Before it can be used, the MOODS system has to be configured according to both the orchestra structure in terms of instruments and the cooperative work rules imposed by the relationships between musicians.

In the EDITING modality, the system is a fully cooperative distributed editor of music; thus musicians use the lecterns to adjust the current music score in a cooperative manner. This modality is typically used during rehearsals, in classrooms, and during composition.

Each lectern can navigate its assigned part independently by scrolling measures forward and backward. The visualization of the music page depends on the lectern's hardware. Different dimensions of DLIOO screens are used for visualizing different numbers of pentagrams and thus a different justification of measures in the score page. Thus, each lectern may have a different vision of the same information, i.e., the main score. The work of score modification/adjustment is cooperative, in the sense that all musicians may perform changes at the same time on the same score. Different lecterns/musicians can modify the same part and/or the same measure contemporaneously. Each change performed on a lectern (DLIOO) is sent in real time to the MASAE and from there to the other musicians/lecterns using the same part, and to the main score lecterns: MASEs. Changes on the score are visualized on the other lecterns on the basis of the point at which they are visualizing the music page.

During EXECUTION, MOODS distributes pages of the music score to all lecterns. The page turning is automatic in the sense that musicians do not have to worry about it; the system provides the right page at the correct time to both DLIOOs and MASEs. It should be noted that different lecterns have page turning at different times; this is due to the different amount of written music that has to be executed by each instrument and to the dimensions of the lectern.

The automatic page turning presents several advantages, including: (i) the musicians and the conductor do not lose their concentration because of page turning, (ii) the avoidance of noise produced by turning pages, and (iii) the reduction of discontinuities in the sound caused by turning the page. The latter is presently reduced by trying to ensure that rests occur in the last measure of the page. This solution is obviously not always feasible, and it depends on the part and on the music. This is the reason why several pianists have someone to turn pages for them, and why, when two musicians read music from the same lectern, the one on the left has to turn the pages while the other continues to play.

In MOODS, the execution rate, both ideal and as adjusted by the archivist, can be saved for reuse. Thus, MOODS is capable of regenerating the registered execution rate of each performance and rehearsal. This has a relevant impact on improving the quality of orchestra work and for studying the performances of important conductors and musicians in music schools.

The process of Orchestra/Network Configuration and Management, ONCM, is performed on the MASAE to establish the configuration relationships between lecterns and to define rights for manipulating music symbols.

The process of network/orchestra configuration has to map the few parts of the main score (from 4–5 to 30) to a high number of musicians according to the structure of the orchestra in terms of instruments/musicians and their hierarchical relationships. On each DLIOO, different sets of interpretation/instrumental symbols have to be provided depending on the instrument assigned to it.

A MOODS system has to manage a large number of music scores in more than one version (caused by modifications made during rehearsals) and format, including configurations and permission profiles. To this end, a database support provides cataloging services according to ARCHImusica, a software package especially devoted to musical libraries and archives, customized within the MOODS project with a versioning system integrated with lecterns. This may serve as the local database for theaters or as a remote database for publishers. A WWW user interface allows the archivist to use the system either from his/her office on Windows NT or from the MASAE workstation in the concert hall. This module has been engineered from a prototype developed in another EC co-funded project, CANTATE (Computer Access to NoTation And TExt). The database support and versioning are very useful for music schools. Students can examine (and perform) different interpretations of the same score.

4 Discussions and Conclusions

In recent years, almost all publishers have come to use professional programs, instead of the traditional hand-processed technologies. Since 1991, the adoption of such programs has led to the computer-based production of a large quantity of scores. However, owing to the constant evolution of music programs and the fact that up to now there has only been a viable market for paper versions of scores, the electronic versions remain in publishers' archives. MOODS will be a way to open a new market for such products.

It is clear how MOODS may lead to a significant saving of time and money, storing precious information concerning the music customized for a specific conductor with a specific orchestra, etc. The relevance for the orchestra and for the publisher has already been discussed in this paper. But it is also extremely relevant from a cultural point of view and for music schools. Students could examine different interpretations of the same score. Different scores and versions could be viewed in a few seconds on students' lecterns, allowing swift comparison of music scores and interpretations.

From the first end-users' tests, MOODS has been considered a useful tool for orchestras and music schools. MOODS' functionality frees composers and conductors from mundane, time-consuming tasks, allowing more space for experimenting (instantaneously) with new solutions or effects. It also means an enormously increased level of creative feedback between a conductor and the performing group/orchestra toward the common goal of effective interpretation of the music score. MOODS opens the path to what, in the next few years, could be a real revolution in the world of music publishing and in musicians' approach to music scores.

MOODS: Music Object Oriented Distributed System (ESPRIT IV HPCN TETRApc Project n.25968)
WWW site: http://www.dsi.unifi.it/~hpcn/wwwmoods/wwwpag.html

A demo version of MOODS (tinyMOODS) is available for testing. Please visit the above WWW site.

CARNET 12/98

Il computer entra nella buca

E' stato recentemente presentato al Teatro alla Scala **MOODS** (Music Object Oriented Distributed System), un progetto dell'Universita' di Firenze finanziato in parte dalla Comunita' europea che permettera' di sostituire i tradizionali spartiti su carta con piu' comodi monitor. Il sistema e' predisposto addiritura per richiamare gli spartiti via Internet direttamente dagli archivi delle varie case editrici. Gli orchestrali vedranno la propria parte scorrere in sincronia con l'esecuzione, mentre il direttore d'orchestra disporra' di fronte a se dell'intera partitura su un monitor piu' grande. Durante le prove, qualsiasi annotazione potra' essere apposta direttamente sui leggii elettronici con una speciale penna. La commercializzazione di MOODS e' prevista per la seconda meta' del 1999.

SUONARE novembre 1998

ADDIO SPARTITI

Professori d'orchestra, attenzione: e' pronto un prototipo di leggio elettronico che nel prossimo millenio potrebbe prendere il posto delle tradizionali partiture da scarabocchiare a matita. La musica in digitale scorre su "appositi monitor interattivi", che dovrebbero permettere di apportare le necessarie indicazioni di arcate, diteggiatura e agogica. Il progetto e' finanziato dalla Comunita' Europea ed e' coordinato da Paolo Nesi dell'Universita' di Firenze. Per il momento i potenziali utenti sono il Teatro alla Scala, la Casa editrice Ricordi e la Scuola di musica di Fiesole.


PVCCINI