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### Project Info

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### Note

Requests to subscribe to or unsubscribe from this Newsletter should be directed to [elav@exodus.gr](mailto:elav@exodus.gr) specifying "IMUTUS Newsletter" at the subject line.

All issues of the Newsletter will also be downloadable through the project website:

<http://www.exodus.gr/imutus>.

## Editorial

Dear reader,

the IMUTUS Consortium is pleased to announce the first issue of the IMUTUS electronic Newsletter! IMUTUS is a research project funded by the EC, working on the field of electronic music education, aiming at the development of an open platform for training students on musical instruments.

This Newsletter aims to disseminate information on the current status and achievements of the IMUTUS project, as well as to present articles authored by the IMUTUS partners. These articles are technically and pedagogically relevant to the area of technology-enhanced learning, with focus on technology-enhanced music tuition.

The articles present the work, experiences, accomplishments and lessons learned by the IMUTUS partners in the project's fields of interest. They cover a variety of subjects, ranging from the elicitation of user requirements to the design and development of the different components of the system, the integration of the overall system, and, finally, the validation which is underway. A preliminary list of subjects includes: • the elicitation of user requirements for technology enhanced music tuition, • the issues involved in the automatic evaluation of a student's performance, • the novelties and enhancements of a custom-made integrated score viewer, aiming to provide a visual and sonic mirror to the student, • the special characteristics of off-line and on-line audio music recognition for the recorder, • the advances in optical music recognition techniques, • the introduction of virtual reality for helping the student understand the fingering, • the challenges of on-line score following and off-line score matching, • the design of the distance learning platform, and • the content specifications and authoring for music tuition.

In the next sections you will find a synopsis of IMUTUS' objectives, a short presentation of the participating partners and a description of the project's current status.

We warmly encourage you to communicate with us for any further details, comments, or just to share your experiences in the above fields of interest.

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## IMUTUS Objectives

IMUTUS stands for **I**nteractive **MU**sic **TU**ition **S**ystem. It is a research project funded by the EC, working on the field of electronic music education, aiming at the development of an open platform for training students on musical instruments. The *recorder* is chosen as the target instrument because it is a traditional instrument with no MIDI support, widely taught in European schools. The system is designed to address the needs of beginners (first level), who are usually at the age of *9 to 14 years old*. However, users of any age may use the system to improve their musical skills and acquire music knowledge.

IMUTUS provides an attractive, engaging and easy to use environment equipped with advanced technological tools to increase the effectiveness of music training and learning, allowing the students to proceed at their own pace. Lessons of theory are combined with challenging practising sessions and fun games to create a complete learning setting.

Theory presentations mainly cover the material necessary for successfully coping with the exercises and present a useful source of information for the pupil to refer to when necessary. Delivering an open platform, IMUTUS enables educational units to be dynamically inserted by tutors, allowing the content to be continuously augmented.

*IMUTUS is not intended to replace traditional forms of teaching.* As all music tuition software, IMUTUS is expected to be most successful when used as a supplement to traditional music lessons with a teacher, and will be particularly effective at teaching the more repetitive, yet essential, aspects of learning music. Providing a fun and attractive learning environment IMUTUS will encourage students to practise and master these skills.

The IMUTUS system also provides support for *distance learning*. The students are provided with updated content and the ability to communicate with a specially mandated distance learning teacher group to obtain electronic guidance, feedback and assistance whenever they require it, through asynchronous Internet communication.

The main educational objectives of IMUTUS are to assist (a) *Self-directed learning*. The students are free to decide what musical pieces to practise on and which material to study, when and how, using IMUTUS' learning possibilities at home. Using the distance learning features of IMUTUS, the students are able to benefit from a periodic communication with a remote teacher who provides assistance and direction. (b) *Teacher-guided learning*. After a traditional teaching session, the teacher suggests to the students which material (practise or theory) to study at home or in the lab using IMUTUS. Different exercises from IMUTUS may be assigned to different students, depending on their individual strengths and weaknesses.

The environment and content of IMUTUS are designed to support learning by observation, learning by practise, and learning through communication and collaboration, with emphasis on self-assessment.

The introduction of technological tools, including objective performance evaluation, distance learning and virtual reality, allow for the definition and experimentation with new teaching practices in music, enriching the traditional procedures. Technologically innovative components and tools that are necessary to promote the educational objectives set by IMUTUS are being implemented. The system is based on both audio / optical recognition technology for the transformation of acoustic signals / musical scores to MIDI format, objective performance evaluation and multimedia technology for the definition of an innovative environment for music tuition.

## Meeting the IMUTUS Consortium

The IMUTUS Consortium comprises of seven partners from four EU countries, namely Greece, Italy, France and Sweden. These are:

### 01 Institute for Language and Speech Processing Project Coordinator



Institute for Language and  
Speech Processing (ILSP)

<http://www.ilsp.gr>

The Institute for Language and Speech Processing (ILSP) was founded in Athens (Greece) in 1991 under the auspices of the General Secretariat of Research and Technology of the Ministry of Development.

ILSP began its activities in May 1992. The goal of ILSP is to support the growth of Language Technology in Greece. For this purpose it has brought together a team of experts and has created the necessary technical infrastructure in accordance with the EC policy towards safeguarding the European cultural heritage through technology. ILSP aims to be a pole of attraction for the language industry, which will grow both in Greece and in the rest of Europe, thus contributing to the expansion of activities in this particularly important area of modern IT.

The industrial direction which it maintains, the experience of its researchers and the close

relations, which it keeps with key research centres in other European countries, are the three basic elements in the profile of ILSP.

ILSP carries out applied research in Speech Processing, Text Processing and Language Learning Technologies. Expertise used by the Institute includes basic fields as NLP, DSP and Pattern Recognition. Its mission is mainly to support basic research, promoting on the other hand the development of new products in the form of laboratory prototypes.

ILSP coordinates the IMUTUS project, leads the user requirements, design, integration, documentation and validation activities and is responsible for the development of the on-line and off-line audio music recogniser, the score follower and matcher, and the integrated environment of the IMUTUS prototype.

### 02 EXODUS S.A.



EXODUS S.A.

<http://www.exodus.gr>

EXODUS S.A., is an IT company, specialising in Content Management and electronic solutions, to small, medium and large organisations. EXODUS is located in Athens – Greece, founded in 1994 and since 2000 is a member of the Piraeus Bank Group of Companies, the third largest bank organisation in Greece. Currently EXODUS S.A. employs 80 highly skilled professionals.

EXODUS S.A. designs, creates and offers the Greek and international markets software solutions and services in the area of electronic business. Exodus offers integrated solutions and services for intranets and extranets, implement systems for workflow, knowledge

management, document management and business intelligence (data ware housing, data mining). In addition, Exodus develops applications for e-commerce (B2B) and e-procurement and offers powerful infrastructures for e-learning and for contemporary and efficient project management.

EXODUS is responsible for the development of the Distance Learning platform and Communication tools, the Content Authoring modules and the content transfer between the local and the remote system. EXODUS also guides the project's dissemination and exploitation activities.



## 03 Systema Technologies S.A.



Systema Technologies S.A.

<http://www.systema.gr>

Systema Technologies specialises in the development of advanced information technology applications in the areas of Multimedia Databases and Networking, Virtual Reality, and Image & Video processing and archiving.

In the area of Cultural Information Society Technologies, Systema has a long tradition and large experience in developing integrated solutions especially utilising digital 3D

surrogates of physical objects (e.g. e-Islam Benaki Museum Islamic Branch Athens). In addition the company has taken up in many cases technological solutions for exploitation in the Cultural and Tourism Markets (e.g. Regnet Ontology mapping).

SYSTEMA's responsibility is the development of the Movement Authoring Tool, the Fingering Viewer and the presentation of fingering to VRML.

## 04 Dept. of Systems and Informatics, Univ. of Florence



Department of Systems and Informatics (DSI)

<http://www.dsi.unifi.it/>

The Department of Systems and Informatics, DSI, Faculty of Engineering, University of Florence, Italy presents several different competencies: artificial intelligence, software engineering, multimedia, systems, automatic control, environmental aspects, operative research, speech recognition, database navigation, image modelling. At the DSI there are few research groups. Prof. P. Nesi is the coordinator of a group which is strongly active in the field of: software engineering, HPCN, computer music, parallel architectures, object-oriented, formal methods, visual languages,

CASE tools, real-time techniques, logic languages, temporal logic, object-oriented user interface, vision, scheduling, distributed systems, multimedia, graphic user interfaces, software quality and assessment, testing, object oriented languages, verification and validation techniques, image processing, optical music recognition, simulation, and electronic design.

DSI is responsible for the development of the Optical Music Recognition module and the Music Notation to Hand Positioning Module.

## 05 Music School of Fiesole



Music School of Fiesole

<http://www.scuolamusica.fiesole.fi.it>

SMF (Scuola di Musica di Fiesole - founded by M. Piero Farulli of the Quartetto Italiano in 1974) is a European Foundation musical institution that welcomes students from 3 to 90 with the core school for all instruments, the master classes, the master classes for orchestra and the Italian Youth Orchestra directed by C. Abbado, C.M. Giuliani, R. Muti and G. Sinopoli.

SMF's program includes professional level seminars taught by world renowned musicians, composers and directors, but the most successful objectives of SMF are the instrument and chamber music courses that cultivate

young talents from their first approach to music to active participation in one of SMF's three orchestras and numerous chamber groups.

SMF has always prided itself in experimentation of innovative teaching techniques and is in the avantgarde for implementation of computer technology applied to music instruction.

SMF represents the user community (students and teachers) within IMUTUS, providing valuable input for the user requirements and system design, as well as the system validation and evaluation.



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## GRAME, National Centre for Music Creation



GRAME,  
National Centre for Music Creation

<http://www.grame.fr>

Grame is a National Center for Music Creation supported by the French Ministry of Culture, the Rhone-Alpes region and the City of Lyon. The main mission of the center is to encourage and promote contemporary music creation in a rich and pluridisciplinary environment associating artistic and research activities. The activities of Grame are organized in four main departments: music creation, concert and festival organisation, music education and research in computer music. Grame is strongly involved in international music and research

activities and provides many opportunities for composers, performers and researchers to collaborate. The areas of expertise of Grame in computer music research are: real time and distributed systems, music operating systems, composition environments and music programming languages.

GRAME is responsible for the development of the Musical Score Processing modules, namely the Score Viewer and the Graphical Score Editor.

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## Royal Institute of Technology (KTH)



Royal Institute of Technology  
(KTH)

<http://www.speech.kth.se>

KTH is the largest and oldest technical university in Sweden. The Music Acoustics Group within the Department of Speech, Music and Hearing teaches and performs research in the areas of the acoustics of musical instruments and voice, computer analysis of sound, music and gestures, and computer performance of music. The KTH generative music performance grammar Director Musices,

which transforms MIDI files into musically expressive performances with emotional colouring, is an application which has attracted widespread attention in computer music science.

KTH's responsibility is the development of the Performance Evaluation and Skill Grading module.



## Highlight of the Current Project Status

**Note:** The content of this section depicts the status of the project till the time it was written. The information will be updated in subsequent issues of the Newsletter as the various project components and functionalities are finalised, interlinked and brought together into the overall system.

IMUTUS is currently in month 26 (of 30). The development of the majority of modules has reached a final stage and the current focus is on their integration into a functional prototype.

The next milestone of the project is the finalisation of version v1.0 of the overall prototype, which will trigger the beginning of the first phase of validation activities, targeting mainly at the verification and testing of the IMUTUS practicing session.

At its first phase, IMUTUS devoted considerable effort in identifying requirements and needs for electronic music tuition. The project is addressing a very young audience (9-14 years old) and an area of particular idiosyncrasy characterised by traditional teaching practices, emphasis on the student-teacher relations, lack of widely available prior knowledge on the principles and best practices for applying technology enhanced learning and, definitely, very low computer penetration. To this end, a set of questionnaires has been designed and employed for students, teachers and experts, supplemented by free and structured teacher interviews during meetings or discussions in different countries. The outcomes of this process have been compiled into a User Requirements document, which tries to categorise and review existing software, profile the targeted end-users, define the context and environment of use for the IMUTUS system, and analyse the results obtained from the questionnaires filled-in by 229 students and 34 teachers in 3 countries. Clues from the direct contacts and interviews with teachers and experts concerning the current teaching practices in music tuition are also included. The document concludes with a set of scenarios of use that capture the envisaged functionality of the IMUTUS system.

It has been clearly identified within the project that the core functionality and value of the envisaged IMUTUS system mainly lies in its support for the practicing sessions. This is the place where the most pedagogically and technologically relative and innovative parts of the original project vision were integrated. Though various commercial systems exist claiming to assist in teaching instrument practice, in most of the cases their performance is far from satisfactory.

The IMUTUS' practicing session exploits a rich set of technological components developed by the project, aiming to provide innovative and enhanced forms of feedback focusing on performance skills. IMUTUS' innovation lies in the combination of

- Real-time and off-line audio music recognition and feature extraction technologies customised for the recorder,
- real-time score following for tracking the current position in the score and supporting automatic page-turning during a student performance,
- score matching to identify the mapping from the overall performance to the score,
- automatic performance evaluation to extract higher-level information from the student performance and to provide prioritised structured feedback adapted to the student's skill level.

The overall practicing session is centred around an efficient score viewer that acts as a mirroring user interface to support the operation of the other modules and address the requirements of the practicing session, featuring graphical helpers and annotations (be it annotations authored by the teacher or the feedback from the performance evaluation), playing back of MIDI, reference, or student performances, page-scrolling and look-ahead strategies, and a metronome.

The practicing environment is complemented by a 3D fingering viewer that is able to render fully navigable animations of a realistic model of the recorder and hands for any music piece, also providing the option to include suggested viewpoints and textual comments at predefined times. Animations are dynamically created employing a music notation to hand position component.

Each of these modules separately, as well as the overall integrated result, introduce a number of innovations, enhancements or customisations to their particular fields, both on a technological and on a pedagogical dimension, advancing the current state in the area of technology enhanced music tuition.

To assist in the separate development and facilitate the integration of this demanding practicing environment, an efficient software layer has been developed in the context of the project; the core services layer. The core services are a general integration platform well

suitable for parallel team development that can be readily adapted to any other development project and provides significant benefits such as dynamic identification and automatic loading of available modules at run-time, event exchange mechanism among modules for message passing, signalling and synchronisation, data exchange through managed shared memory, unified access to basic user interfacing, and centralised support for multilinguality.

The IMUTUS system is accompanied by a set of educational content, consisting of theory lessons, exercises (melodies) and games. A

subset of it has been developed and will be used for validation.

Version 2.0 of the prototype will integrate additional components and features, such as complete support for the different target languages, improved user interface, user profiling. Version 2.0 will be launched on mid November triggering the beginning of the main validation activities.

Some of the features of local content management, distance learning and content authoring will be integrated in version 2 while their main body will be integrated at the final version of the IMUTUS prototype.

## Currently Planned Dissemination Activities

IMUTUS partners plan on participating to various conferences in the fall 2004. You may meet with them and receive more information about the project and its results in the following venues:

### 2004

- **Sound and Music Computing 2004.**  
October 20-22 2004, IRCAM, Paris, France  
Conference on IMUTUS. (For more information visit <http://smc04.ircam.fr/>)
- **Press conference by SMF for the 30th anniversary of SMF foundation.**  
November, 2004, Florence, Italy  
In this circumstance a conference will be held by SMF in cooperation with DSI in which the EU projects (IMUTUS in particular) will be described.
- **IMUTUS Demonstrations**  
The IMUTUS prototype will be demonstrated by SMF at public schools and at SMF premises throughout the fall.

### 2005

- **International Computer Music Conference (ICMC 2005)**  
Sep 5 – 9, 2005, Barcelona, Spain.  
The Performance Evaluation strategies in IMUTUS will be presented by KTH.  
(For more information regarding ICMC visit <http://www.icmc2005.org>)

An updated list of dissemination activities is also available at the project's website.

## More information?

For additional information about the project please refer to IMUTUS' **project website**, at <http://www.exodus.gr/imutus>.



At the website you may find information regarding:

- **Project Overview.**  
General information related to the project and descriptions of the main objectives, innovation, approach and status.
- **Partners.**  
List of the partners, containing a short profile, contact details and links to each partner's Internet sites.

- **Links.**

Links are offered to a series of sites available on the Internet that address issues related to the project. Examples include websites regarding other music projects, distance learning, recorder lessons, related components, etc.

- **Resources.**

This section contains all the Deliverables which are "Public", as well as any other documents that the Consortium would like to make widely available (flyers, posters, etc.).

- **Dissemination.**

Information about upcoming events, conferences, presentations, articles, and other dissemination activities related to the project.

- **Contact us.**

Here visitors are welcome to give us feedback or ask questions regarding the project.

Moreover, at the website visitors may fill-in questionnaires regarding the project. In the future a link to IMUTUS prototype will also be available.