



IMUTUS

Interactive Music Tuition System

A Virtual Music Tutor and Practice Environment



Objectives

IMUTUS aims at the development of an interactive music tuition multimedia system for training users on traditional instruments with no MIDI (Music Instrument Digital Interface) support. The project will focus on a specific wind instrument, the recorder, because it is a widely used instrument in most European schools.

IMUTUS employs, extends and integrates various key technologies into a virtual music tutor and practice environment that offers advanced interaction capabilities.

The IMUTUS project involves two major tasks; the development of Enabling Technological Tools and the building and compilation of the Digital Music Content. The Technological Tools will realise the envisioned functionality while the Digital Music Content will provide the necessary corpus to drive the learning procedure.

Enabling Technological Tools

The **Enabling Technological Tools** can be grouped into two categories, namely the Signal Processing Tools and the Human-Computer Interaction Tools.

The **Signal Processing Tools** include:

- Speech/music discrimination
- Speech recognition
- Music recognition (audio-to-MIDI)
- Optical music recognition (score-to-MIDIFILE)
- Objective performance evaluation

The **Human-Computer Interaction Tools** include:

- Voice commands
- 3D visualisation of actual and target fingering
- Multimedia presentations
- MIDIFILE editing
- e-Learning and coaching by a distant teacher

Digital Music Content

The **Digital Music Content** comprises of extensive tuition material compiled, arranged and organized by experts and experienced teachers. It is appropriately organized in a database containing Theory Lessons and Exercises.

The **Theory Lessons** contain multimedia material in the form of rich documents, imaging, audio, video, MIDI files, etc. covering general musical theory as well as specifically designed theory lessons for the recorder wind instrument.

The **Exercises** cover different student levels ranging from low, to intermediate and more advanced levels.

Theory and exercises are fully interlinked allowing the students to retrieve the exercises that will help them practice on specific topics of theory, or consult the theoretic lessons that will assist them in understanding and improving their performance in particular exercises.

Project Information

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



Key Technologies

Speech/Music Discrimination

An "open microphone" approach will be employed. IMUTUS will give the student the possibility to keep the microphone active either for directing voice commands to the system or for music input. A speech/music discriminator will separate music and speech, so that the incoming sound drives either the music recogniser or the speech recogniser. This enables the users to give oral commands to the system without putting their instrument aside. Therefore, a significant amount of time wasted on redundant movements will be saved and, most importantly, the user's attention will be concentrated entirely into the actual playing of the instrument.

Voice Commands via Speech Recognition

Available speech recognition technologies will be adapted to the needs of IMUTUS. Issues related to the efficiency of the algorithms in respect to environmental noise will be considered and appropriate solutions implemented. In case of low recognition rates, the speech recogniser will support training and adaptation to the particular voice of each user through a simple and friendly interface.

Music Recognition (Audio-to-MIDI)

Special signal processing techniques will be utilised for the identification of the elements of the musical piece (pitch, rests, dynamic level, durations etc.) and the subsequent configuration of the MIDI format. The target is a music recognition engine optimised for the recorder.

Optical Music Recognition (Printed score-to-MIDIFILE)

This feature will enable the user to scan and convert available printed musical scores to MIDI format and store them in the database of the musical pieces of the system. This is a very important tool for music teachers because a vast amount of sheet music is not available in MIDI or other digital format. This requires, however, that the material is not protected by copyright and could therefore be directly used.

Distance Learning

The learning process will be assisted by remote teachers. The communication of the students with the teachers will be periodic and based mainly on the exchange of emails and various files, e.g. the recorded student performance in MIDI or wave format. The remote database will be periodically enriched with new material and additional resources.

3D Visualization (MIDI-to-VRML) and the Movement Authoring Tool

The fingering technique, the positioning of the instrument in the mouth, and the posture are some of the most important aspects in learning. IMUTUS will provide visual 3D representations of the movement of the fingers of a virtual teacher synchronized with the music played. The 3D representations present a superior solution to simple video because the students will have the possibility to freely navigate within the 3D space and observe the movements of the teacher from different viewpoints, zooming in and out, and emphasizing on the aspects they consider more difficult. The introduction of virtual reality will allow experimenting with new pedagogical mechanisms for teaching music, in particular, for correcting hand positioning. IMUTUS will also provide an error visualisation module depicting the wrong fingering as it is detected from the recognised MIDI file of the student performance.

Objective Performance Evaluation

A tool assessing the level of the user performance is the last link in the objective evaluation chain. The user's performance is compared to a "target" performance stored in MIDI format in the database. The scoring of the current performance and the type of feedback will depend on the overall skill of the player, as compiled from the history of the student's earlier performances. The beginner will receive feedback regarding basic musical elements such as pitch and note values only. The more advanced student will get feedback about tempo, intonation and phrasing as well.

MIDIFILE Editing

This module involves the editing of the score of a musical piece, its restoration in MIDI format as well as the possibility of listening to the transformed score. Therefore, the user will be provided with the means to monitor the acoustical effects of changes in pitch and note values and will thus obtain a direct realization of basic musical phenomena through an interaction with the system.

