

Effective Use of Multimedia for Computer-Assisted Musical Instrument Tutoring

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- Introduction
- Potential goals of CAMIT systems
- Enhancing daily practice
- Motivation: Educational games
- Our work: DVT and Meaws
- Future directions

Introduction

- Computer-Assisted Musical Instrument Tutoring (CAMIT):
 - Assists (does not replace) a human teacher
 - Focuses on physically playing an instrument, not on knowledge of music
 - Most student mistakes are due to lack of physical control, not a lack of knowledge

Potential goals of CAMIT systems

- Music lessons
 - Giving lessons when the teacher is not present
 - Enhancing the lessons a teacher gives
- Individual practice
 - Making practice more efficient: ensure that students don't practice mistakes
- Motivation
 - Increase the likelihood that students will practice their exercises every day

Goal: music lessons

- Giving lessons when a teacher is not present:
 - Most student mistakes are due to a lack of physical control, not a lack of knowledge.
 - Good for students who do not have weekly lessons.
- Enhancing the lessons of a teacher
 - Lessons are quite individual
 - Students spend relatively little time in lessons, so any improvements here would be less effective

Goal: individual practice

- Most student time is spent practicing
 - Increasing the efficiency is important
- Students often practice mistakes
 - It is very difficult for beginners to judge whether they are playing correctly
 - For example, consider placing fingers on a violin
 - Finger placement determine pitch, but accurately judging pitch requires years of ear training.
 - Beginners do not have this ear training, so their fingers are placed incorrectly in home practice.

Goal: motivation

- Students should practice every day
- Students should practice exercises
 - Students prefer playing real music
 - In analogy, consider weight training for athletes. Most athletes prefer to play team sports, but still lift weights.
- Motivating students to practice their musical exercises every day would far outweigh the benefit of any other kind of CAMIT system.

Goals: summary

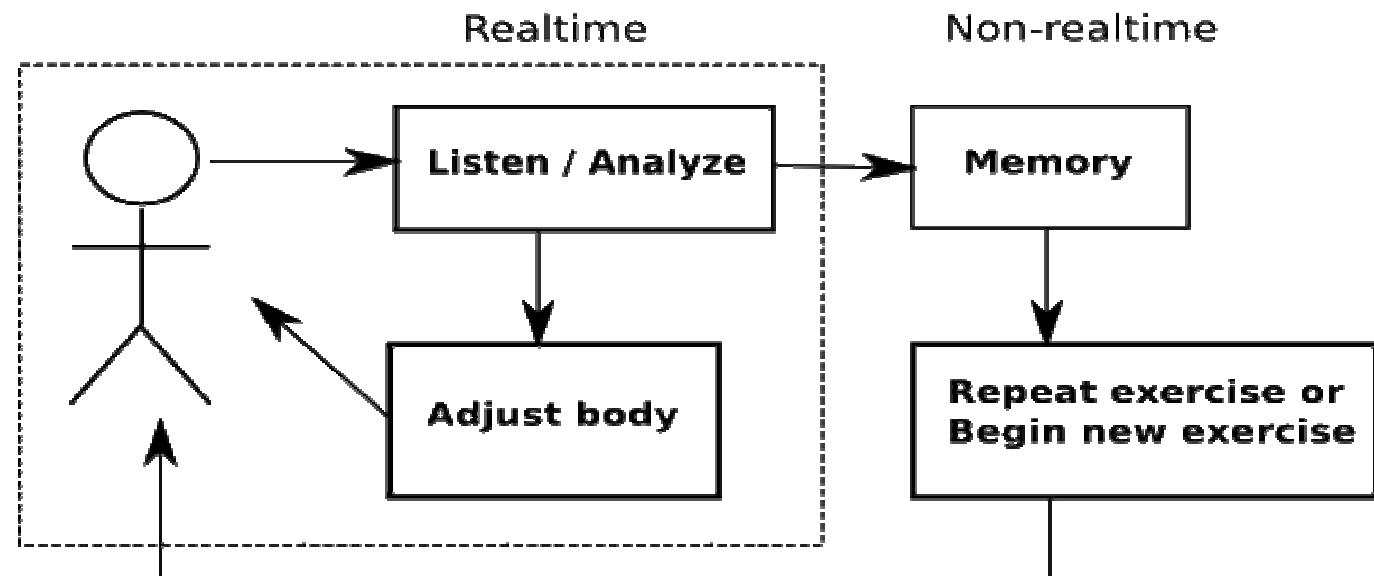
- The most effective CAMIT system would
 - Motivate students to practice every day
 - Judge the student during individual daily practice

Daily practice

- Most daily practice includes
 - Scales (generally testing intonation and speed)
 - Technical exercises (an un-musical exercises which train one or two specific skills, such as playing fast notes or holding steady tones. 5-30 seconds each.)
 - Study or étude (a musical exercise which trains a couple of skills at once. 2-10 minutes long)
 - Repertoire (actual pieces of music)

Daily practice

- While the student is practicing, she must constantly evaluate herself:
 - Realtime evaluation: adjust body in order to fix small problems while playing
 - Non-realtime evaluation: repeat the exercise or not



Enhancing daily practice

- Do not interfere with realtime evaluation
 - Students must develop an unconscious realtime feedback cycle.
 - By analogy, consider the human sense of balance: we need to adjust our balance unconsciously.
 - The indiscriminant use of realtime visualization tools could inhibit the development of this unconscious feedback cycle.
 - Students might learn to adjust their bodies in response to the visualization, instead of listening to the sound.

Enhancing daily practice

- In general, supply information to the student after the student has finished performing.
 - Computer should be used to verify the student's own judgement.
- Exception: technical exercises
 - Since these are very short and each exercise tests a different skill, realtime visualization which aid technical exercises will not hinder the long-term development of the student's feedback cycle.

Technical exercises

- Music education's opinion:
 - They are not practiced very often -- students want to play music repertoire, not exercises.
 - They are useful for focusing on specific skills.
- Multimedia analysis' opinion:
 - Short audio: can be analyzed quickly.
 - One or two skills per exercise: a limited set of features to extract from the audio.
- Technical exercises are perfect for CAMIT

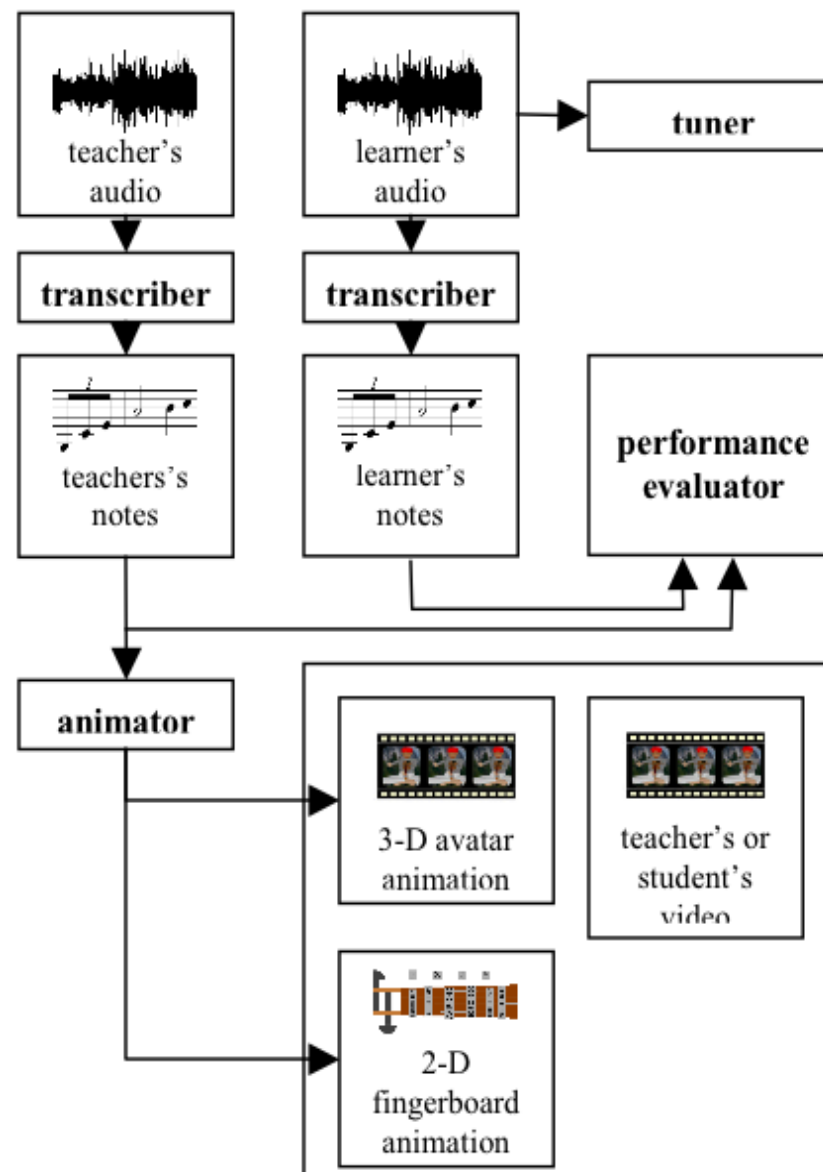
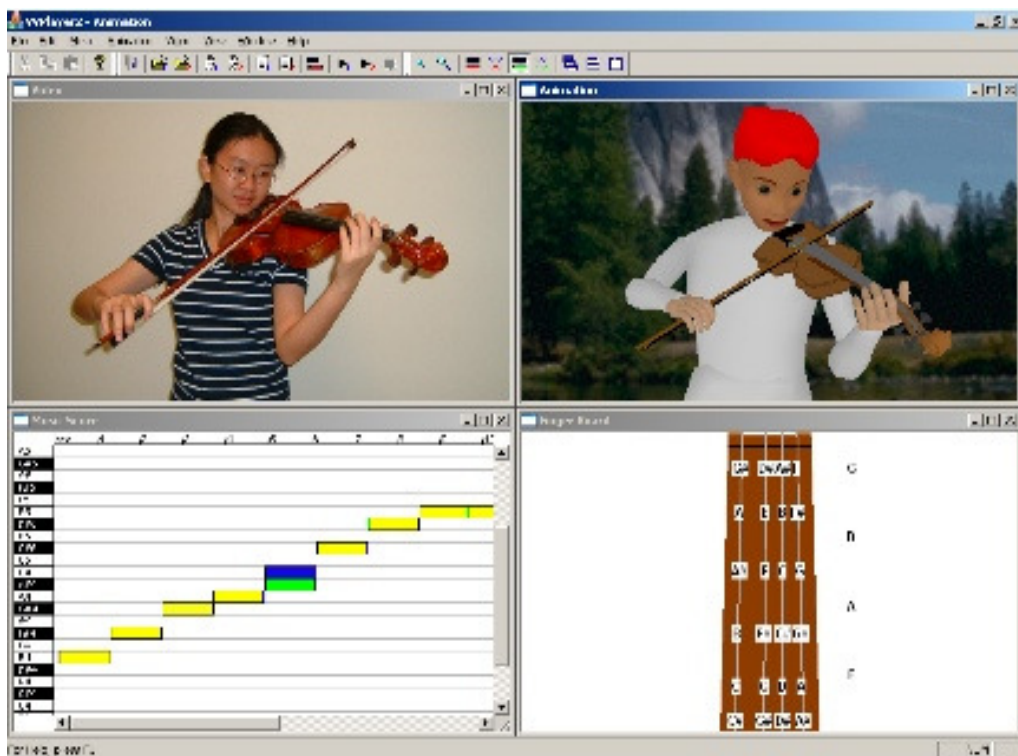
Motivation: Educational games

- To encourage students to practice technical exercises, place them within the context of a computer game
- For example, suppose the student is exploring a dungeon in a game.
 - Attacked by a “D major scale” monster.
 - To defeat the monster, he performs the relevant technical exercise.
 - If he performs the exercise badly, the monster not killed or wounded.

Our Work: DVT

- Digital Violin Tutor: provides feedback in the absence of human teachers.
 - Transcribes student performance
 - Detects errors
 - Displays correct motion with animation
- Optimized for beginning violin students
 - low quality microphones
 - recordings levels set poorly

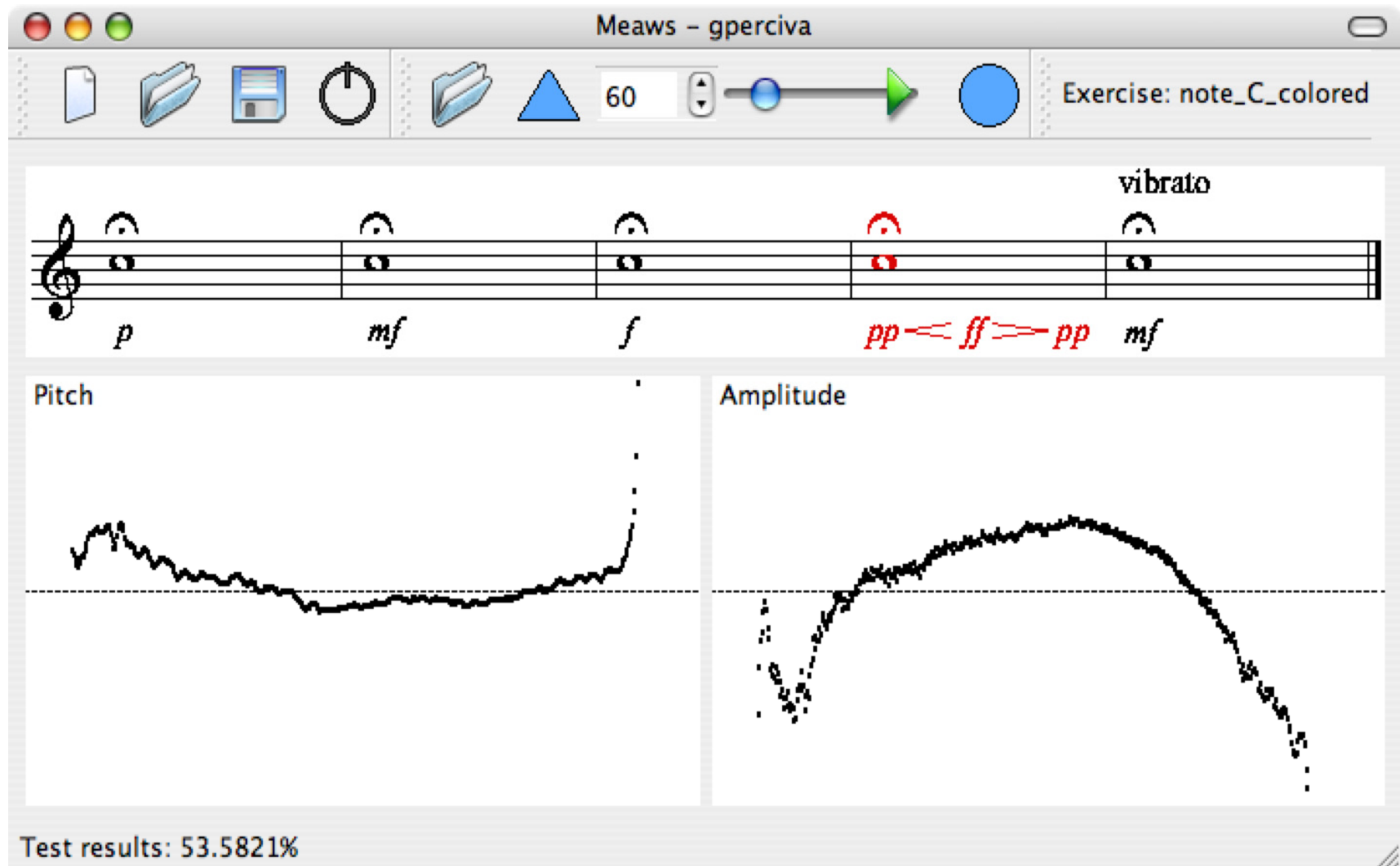
Our Work: DVT



Our Work: MEAWS

- Musician Evaluation and Audition for Winds and Strings: an objective test for technical exercises.
 - The music teacher assigns an exercise
 - The student practices the exercise at home
 - MEAWS assigns a grade to the student's performance, and displays problems.
- The frontend of MEAWS could be replaced with games aimed at different age levels.

Our Work: MEAWS



Future Directions

- CAMIT is supported by three technology areas
 - Human-Computer Interface and Visualization
 - Microphone, screen... anything more natural?
 - Music transcription
 - The computer must understand the music.
 - User modeling and Network support
 - Categorize musical errors, decide which error(s) should be pointed out to the student
 - Allow students to compare themselves to other students around the world.

Future: music transcription

- Multimedia fusion
 - Gathers information from audio, video, tactile sensors, and other sensors.
- Meaningful constraints
 - Instrument-specific knowledge: analyzing violin music is very different than analyzing sitar music.
 - Application-specific knowledge: analyzing student performances for mistakes is very different than analyzing recordings of folk music for archival.

Conclusion

- Computer-Assisted Musical Instrument Tutoring has great potential for helping music students.
- The focus should be motivating students and enhancing their normal practice.
- Technical exercises allow much easier computer analysis without sacrificing educational value.
- Educational games can make technical exercises more fun for students.