STUDIO REPORT: UNIVERSITY OF VICTORIA MUSIC INTELLIGENCE AND SOUND TECHNOLOGY INTERDISCIPLINARY CENTRE (MISTIC)

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ABSTRACT

The University of Victoria has a new centre for computer music and digital media called MISTIC (Music Intelligence and Sound Technology Interdisciplinary Centre). Research and educational activities pertaining to MISTIC are described.

1. INTRODUCTION

A critical mass of Computer Music researchers at the University of Victoria (UVic) has been created by the arrival of George Tzanetakis and Ajay Kapur from Princeton, joining Andrew Schloss and Peter Driessen already here. In September of 2004, Kirk McNally joined as the Audio Specialist and Recording Engineer. Together, we have organized the Music Intelligence Sound Technology Interdisciplinary Centre (MISTIC)[1]. This studio report describes the research and education activities of MISTIC.

Research activities center around two main topics: gesture sensors, based on Andrew Schloss' long standing history as a virtuoso performer on the radio drum, and music information retrieval, based on George Tzanetakis' association with this topic from its very beginning. In addition, new directions in sound recording techniques, based on Peter Driessen's interests in wave propagation and psychoacoustics is in the early stages.

Educational activities include undergraduate and graduate programs in Computer Music offered by the School of Music in conjunction with Department of Computer Science and Electrical/Computer Engineering.

This studio report summarizes MISTIC resources, education programs and research activities, with a look to the future.

2. RESOURCES

MISTIC's resources in terms of facilities and funding are modest in our early days. MISTIC has facilities in the buildings of the School of Music (four studios), Faculty of Engineering (one lab), and Computer Science Department (one lab). The Computer Music studio is 300 square feet equipped with a G5 IMac running MAX/MSP and Digidesigns Pro-Tools, a Yamaha 01V96kHz console (32 channel), vintage Buchla Series 300 analog synthesizer (with midi control via PaiA midi to CV), various Yamaha FM synths, stereo self-powered monitoring with Mackie HR824 powered monitors, quad monitoring with four JBL 4333A monitors, all wired through a patch bay for easy reconfiguration. A second 160 square foot studio is primarily for audio post-production and mastering using both Sonic Solutions and Digidesigns Pro-Tools. Monitoring provided by Dynaudio speakers and Bryston amplification, A/D & D/A by Mytek Digital. A portable remote recording rig with DAT and mixer are available, microphones include those by Neumann, AKG, Sony and Shure. A third 160 square foot studio has been used for network audio performance experiments. In addition, the 200-seat Phillip T. Young Recital Hall, with exceptional acoustics for live recording and chamber music, has an associated recording booth with Millenia preamps, Schoeps and AKG microphones, DAT and CD recorder. A portable DAT and mixer are available for off-site recordings. Monitoring is with Yamaha NS-10M speakers and Bryston amplification. All studios have networking capabilities and storage space on a multi-terrabyte server.

Funding has already been obtained from the three major granting agencies in Canada: the Natural Sciences and Engineering Research Council of Canada (NSERC) the Canada Council for the Arts and the Social Sciences and Humanities Research Council (SSHRC). Grant titles include "Gesture Sensing and Signal Processing for Live Multimedia PerformanceÓ and "From the Laboratory to the Concert Hall.Ó

3. EDUCATION

3.1. Undergraduate Curriculum

3.1.1 Courses related to Computer Music

Courses related to Computer Music offered at UVic are titled: Music Science and Computers, Recording Techniques, Introduction to Computer Music, Musical Acoustics, Computer Music Seminar, Audio Signal Processing, and Music Information Retrieval. These courses may be taken by undergraduates enrolled in the Bachelor of Music degree program in composition, or in one of two novel programs mentioned next[2].

[1] http://www.mistic.ece.uvic.ca

[2] programs.csc.uvic.ca/music

3.1.2 Joint degree program in Music and Computer Science

A novel joint degree program in Music and Computer Science includes the essential courses for both a Music and Computer Science degree, omitting only private lessons in voice or an instrument. Music courses include theory and history, as well as the computer music-related courses mentioned above. Computer Science courses include programming techniques, algorithms, data structures, operating systems, networks, multimedia systems, digital signal processing and artificial intelligence. The degree awarded is either a Bachelor of Fine Arts or a Bachelor of Science. There are seven students enrolled in the first year of this program.

3.1.3. Computer Music Option in Electrical Engineering or Computer Engineering.

The Electrical or Computer Engineering programs at UVic include a co-operative education component, with alternating study and work terms. The Computer Music Option replaces one of the work terms with an extra study term to free up space for the Computer Music-related courses. Engineering students enrolled in the option typically take one of the Computer Music-related courses in each study term, in addition to Engineering courses such as circuits, electronics, microprocessors, communications and control theory. There are already fourteen students taking this option, and the first one graduated in Spring 2005. This program is particularly attractive because it provides exciting musical applications of potentially dry theories of signal processing and control, and helps students to understand these theories in greater depth. The degree awarded is a B.Eng. in Electrical Engineering or Computer Engineering with the Computer Music Option.

3.1.4 Student Projects

Undergraduate students in Engineering are required to carry out a capstone project. Several students do a computer music-related project each year, supervised by MISTIC faculty or graduate students. Undergraduates may also do a directed studies project for course credit.

3.2. Graduate Curriculum

Graduate students in Computer Music participate in MISTIC, and typically take a graduate version of selected Computer Music-related courses that includes additional project work. The curriculum also includes directed study courses in which the graduate student work one-on-one with a professor on advanced topics such as: Machine Learning for Audio Retrieval and Real-Time Systems for Musical Robotics.

Graduate students have the option of applying to the Interdisciplinary program at UVic, having multiple advisors in different departments to help learn disciplines needed to become versatile musical scientists. Graduate students are co-authors on almost all MISTIC publications listed in the References.

4. RESEARCH

Current research covers several topics: Gesture capturing techniques, music information retrieval, networked audio tools, musical robotics, with some interesting overlap between them all. A major emphasis is the development of tools for live multimedia performance.

4.1. Gesture capturing

Research on gesture capturing systems fall into three categories: sensors on instruments, motion capture body movements, and audio-based gesture extraction.

4.1.1. Sensors on Instruments

These research projects fall under the category of putting sensor technology directly on the instruments performed by a musician in order to obtain gestural data for musical expression. The Radio Drum continues to be a center point of development [7,8] which we now have interfaced using the Teabox by Electotap[1]. We have designed a flexible system [5] for analyzing gesture data from the Radio Drum using MAX/MSP.

The ETabla, EDholak, [4] and ESitar [1] continue to be used in performance setting now being integrated with Marsyas and ChucK. New designs are being developed using a PIC[2] microcontroller.

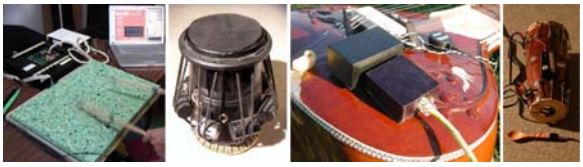

Figure 1. Controllers used at MISTIC: Radiodrum, ETabla, ESitar, EDholak.

4.1.2. VICON Motion Capture

We are fortunate to have access to a VICON[3] Motion Capture system. We have conducted initial experiments to capture performances of Tabla and Violin. We have built a framework in order to sonify data of the gestural movements using Marsyas, ChucK and STK Toolkit. We have also conducted initial experiments with machine-based emotion recognition, known as affective computing.

[1] http://www.electrotap.com/teabox/
[2] http://www.microchip.com/
[3] http://www.vicon.com/

4.1.3. Audio-Based Gesture Extraction

These research projects fall under the category of extracting human gestures directly from the audio signal of the traditional instruments. These methods involve machine learning techniques and audio feature extraction. There is work to differentiate snare drum timbres produced by different strike positions and strike techniques [10,11]. We have also done experiments with the ESitar on training a computer to map the appropriate audio-based features to look like sensor data, in order to potentially eliminate the need for sensors [2].

4.2. Music Information Retrieval

There are many directions of Music Information Retrieval research currently under exploration at MISTIC. Some representative example are: 1) innovative interfaces for querying collections for music such as Query-by-Beatboxing [3]. 2) The use of similarity graph for exploring music collections 3) comparison of features derived from auditory filterbank front-ends with more traditional feature 4) sensor-based interfaces and controllers for interacting with large music collections.

Another major activity is the design and implementation of Marsyas-0.2[1] a dataflow-based, software framework for rapid prototyping of audio analysis and synthesis applications. Marsyas-0.2 is used at UVic for a variety of student projects and around the world for MIR research. In Spring 2005, a course in Music Information Retrieval was offered for the first time in the Computer Science Department.

4.3. Networked Audio

We participated in initial experiments with Chris Chafe at CCRMA on a Distributed MahaVishnu Orchestra, with a three- way internet performance between California, Montana and Victoria. As mentioned above, one of our studios is currently dedicated for network audio experiments.

Audio feature extraction forms the basis of many audio and music analysis algorithms such as segmentation, clustering, classification and similarity-retrieval. Processing of audio signals requires a lot of storage space and computational resources especially for the large collections needed in Music Information Retrieval. Therefore, frequently performance becomes a bottleneck in experimenting with large collections. We are exploring the use of clusters of machines for Distributed feature extraction using Marsyas-0.2.

[1] http://marsyas.sourceforge.net

4.2. Musical Robotics

We have also taken an interest to the idea of automated mechanical systems for generating sound. The most recent visitor to MISTIC was Trimpin, who brought his installation of eight robotic turntables (Figure 2). Students composed pieces using these turntables and performed them at a concert dedicated to Trimpin and his life work. Ajay has been collaborating with both Trimpin and Eric Singer, guided by his Mechanical Engineering advisor Afzal Suleman, and his dissertation will involve the production of automatic mechanical machine-based Indian instrument performance.

Figure 2. Trimpin and his Eight Robotic Turntables visiting University of Victoria.

5. ACTIVITIES

5.1. Seminars and concerts

MISTIC runs weekly meetings, many of which include a seminar by faculty, students or visitors. The meetings serve to help team building, information sharing and collaboration amongst students.

Andrew Schloss has formed a trio with virtuoso Cuban pianist/composer Hilario Dur‡n and classical violinist Irene Mitri that features jazz and Afrocuban styles mixed with interactive computer music techniques. The trio has performed at major festivals across Canada and the United States and continues to explore new musical territory. Plans include a European tour and a tour of the island of Cuba. The trio is a proving ground for ongoing research in interactive performance and gesture sensing done at MISTIC. [9]

LUVLEE, the Live University of Victoria Laptop Ensemble is a computer music trio formed by Adam Tindale, Kirk McNally and composer Michael Berger. The group uses contemporary computer music languages to create new and explorative musical instruments for use in live improvisational pieces. The group was featured most recently in the 5th Annual West Coast Student Composers Symposium.

MISTIC researchers also collaborate with researchers at other institutions, including Princeton University, Stanford University, McGill University and Wake Forrest University.

MISTIC is working with Mercurial Innovations Group[1] supporting their vision in the area of alternative controllers and new musical instruments. We are testing the performance characteristics and creative potential of their STC-1000 and earlier model touchpads.

6. FUTURE WORK

MISTIC future activities include sponsoring a festival using MISTIC-developed technology for live multimedia performance. This annual MISTIC Exhibition will foster artist and engineering collaboration, going from the laboratory to the concert hall. Again, our overall agenda is to create live performance systems that can be used real-time in a live setting.

7. REFERENCES

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[1] http://www.thinkmig.com/