Centre for Interdisciplinary Research in Music Media and Technology

Education in Acoustics - Dan Russell

Workshop presented by CIRMMT RA-1: Instruments, devices, and systems
March 21, 2019 9h00-16h30

09h00-09h30: Coffee

09h30-09h45: Jérémie Voix
Acoustic workshop for High School Students at Université du Québec (ÉTS)

09h50-10h05: Pascale Goday
Une approche de l'écologie sonore adaptée à l'école. (présentation en français)

10h10-10h25: Nicolas Bouillot, Émile Ouellet-Delorme, Michał Seta
Toward Acoustic Simulation of real-time Immersive 6DoF Navigation

10h30-10h45: Denis Martin
Dynamic Range Controller Ear Training: Improving Critical Listening Skills through Computer-Assisted Practice

10h50-11h05: Olivier Robin
Acoustics and comics – a silent media put sound into words and pictures

11h00-11h25: Romain Dumoulin
What I learn from introducing geometrical acoustics to architecture students: experiences from the ongoing McGill Bicentennial Performance Stage and Pavilion Project

11h30-11h45: Caroline Traube
Including the musician in the study of musical instruments

11h50-12h05: Daniel Russell
Teaching a graduate level course on the Acoustics of Musical Instruments

Acoustic workshop for High School Students at Université du Québec (ÉTS)
Jérémie Voix
09h30-09h45

“Classe Techno,” is a science fair originating from the “24 heures des sciences” (www.sciences24heures.com) provincial initiative, and organized annually or bi-annually since 2010 by the communication services from École de technologie supérieure (ÉTS), an engineering school part of the Université du Québec network. This event is designed for high school students coming from a variety of socio-economic origins in the greater Montreal area and is designed a full-day workshop with relevant and interactive hands-on experience for students in upper middle grades (K-8 to K-11). As part of this event, the acoustic team of ÉTS offers a dedicated workshop animated by graduate students and researchers within the well-equipped ICAR (icar.etsmtl.ca) acoustical research labs, on the topic of Noise (“Bruit” in French). The “Bruit” workshop exposes the students to a variety of key-concepts and lab experiments about mechanical and sound waves, noise and music. The 60-minutes long workshop is structured around 3 main activities: a) “What is sound?” b) “What is music?” and c) “When is it too loud?” and exposes students to a several experiments, ranging from measurement of frequency and magnitude of mechanical waves, to interference of waves to sound synthesis and Fourier analysis using sound card, to the assembly and calibration of a sound level meter and to the proper use of hearing protection devices. This paper presents the workshop structure and details each of the animation together. It provides some thoughts on what worked since day one in 2010, what has been improved over the years and what could be done in the future.

Une approche de l'écologie sonore adaptée à l'école. (présentation en français)
Pascale Goday
09h50-10h05

L’écologie sonore, concept inventé par Raymond Murray Schafer dans les années 1970, est l’étude des relations qu’entretiennent les êtres vivants avec leur environnement sonore. Adaptée à l’école, c’est pour les élèves la découverte « d’un nouveau continent à explorer » avec ses merveilles et ses dangers. Le son accompagne notre vie, il est fondamental de le comprendre. Les valeurs de nos sociétés contemporaines conduisent les individus à accepter l’inflation sonore voire à la rechercher. Une prise de conscience dès le plus jeune âge semble nécessaire pour préparer un avenir plus serein. Professeure de musique au Collège International Marie de France (CIMF), j’ai été frappée dès mon arrivée par l’environnement sonore « saturé » de l’établissement. Pour essayer d’y remédier, j’ai décidé d’entreprendre une sensibilisation à « l’entendre » et à « l’écouter », en développant une éducation au et par le sonore pour former les citoyens de demain.

J’ai mis en place un projet d’écologie sonore adapté à l’école afin d’amener les élèves à porter un regard critique sur leur environnement sonore. En pensant le son à la croisée de tous les enseignements, j’ai souhaité favoriser l’interdisciplinarité avec la création et l’expérimentation comme outils d’apprentissage et de prévention. Sound ecology, a concept invented by Raymond Murray Schafer in the 1970s, is the study of the relationship between living beings and their sound environment. Adapted to the school, it is for chidren to discover "a new continent to explore" with its wonders and dangers. Sound accompanies our lives, it is fundamental to understand it. The values of our contemporary societies lead individuals to accept sound inflation and even to seek it. Awareness from an early age seems necessary to prepare for a more peaceful future. As a music teacher at the Collège International Marie de France (CIMF), I was struck as soon as I arrived by the college's "saturated" sound environment. In an attempt to remedy this, I have decided to raise awareness of how to "hear" and "listen" it, by developing an education in and through sound to train the citizens of tomorrow. I have set up a sound ecology project adapted to the school in order to encourage children to take a critical look at their sound environment. By thinking of sound as the crossroads of all teachings, I wanted to encourage interdisciplinarity with creation and experimentation as tools for learning and prevention.

Toward Acoustic Simulation of real-time Immersive 6DoF Navigation
Nicolas Bouillot, Émile Ouellet-Delorme, Michał Seta
10h10-10h25

We present our recent efforts at designing, testing and developing our GPL audio ray tracer (vaRays) and its integration with our software ecosystem dedicated to the authoring of immersive experiences. We are targeting the acoustic simulation of architectural spaces as a method for audio spatialization, in which audio rendering is strongly correlated with a visual 3D environment. Eventually, vaRays will support 6 degree-of-freedom (6DoF) navigation in audio scenes through live computation of Directional Impulse Response (DIR), according to the positions of sources and listener, as well as a 3D model of the scene. Our approach enables a wide range of possible applications, from artistic experience authoring to navigation in reproduced or synthetic architectures, by way of scientific and educational acoustics-related experimentations. Our preliminary work raises several challenges that we will expose during the workshop: directional Impulse Response (IR) measurement and synthesis, IR interpolation, IR streaming,

performance of convolution reverberation implementations and, among other challenges, correlation with the visual rendering.

Dynamic Range Controller Ear Training: Improving Critical Listening Skills through Computer-Assisted Practice
Denis Martin
10h30-10h45

For a professional audio engineer to work efficiently they must develop their critical listening skills. This involves highly focused listening, paying special attention to the technical features of the recorded sound. Many audio engineering training courses make use of technical ear training programs that aim to efficiently develop students' critical listening skills. The goals are to teach students to hear minute changes in the sound of audio processors, to develop a long-term auditory memory for the various intensities of the processes, and to associate changes heard with the controls on the equipment. Several educators and researchers have developed training tools for equalizers, used to modify the spectrum of a signal, but little work has been done on another important category of signal processors: dynamic range controllers. Dynamic range controllers, a key part of the audio production process, are used to increase or decrease the dynamic range of a recording through automatic volume adjustments. A technical ear training software application was built to focus on dynamic range controllers and used to train eight graduate students from the Sound Recording area at McGill University. The student training data was analyzed to measure improvement within the training environment. In addition, a listening test was administered before and after training to examine student improvement on a related listening task. This work was conducted to answer two questions. Can technical ear training be used to teach students to hear dynamic range processing? Can these learned skills be transferred to practical applications in the field?

Acoustics and comics – a silent media put sound into words and pictures
Olivier Robin
10h50-11h05

Comics are by nature silent but nevertheless convey sound mainly using onomatopoeias and sound symbolisms. They even directly represent or explain some acoustics phenomena or effects. The presentation will (try to) review the main mechanisms used in comics to integrate the dimensions of sound, and also

how comics excerpts can help describing a lot of areas that are being covered by the science of acoustics.

What I learn from introducing geometrical acoustics to architecture students: experiences from the ongoing McGill Bicentennial Performance Stage and Pavilion Project
Romain Dumoulin
11h00-11h25

During this winter, as part of a combined music technology and architecture course, a group of music and architecture students have been working together to design a Performance Stage and Pavilion. As the acoustics advisor of the project, my role was to share insight and experience to guide the students as they make key decisions about the design of the acoustical components of the Pavilion. Although McGill has a very strong and unique history of architectural acoustics teaching, current architecture students have not been exposed to a lot of room acoustics concepts throughout their university career. Having realized that basic acoustical guidelines were not considered in the architectural design, a short introduction to geometrical room acoustics seemed necessary. This presentation will present how geometrical acoustics were introduced to students, the challenges and lessons learnt from this experience.

Including the musician in the study of musical instruments
Caroline Traube
11h30-11h45

At the Faculty of musique of University of Montreal, several courses and seminars address the field of musical acoustics. Besides an introductory course covering fundamental concepts — physical parameters of sound, spectral decomposition of complex sounds, wave propagation, resonance of strings and air columns, room acoustics and musical scales, a seminar on the acoustics of musical instruments is offered to students from all areas (composers, performers and musicologists). Over the years, the content of this seminar has evolved in order to include the perspective of the musician and the study of the musician's gesture in relation to the produced sound. As a result, the format of the seminar now includes a period devoted to a live presentation by a professional performer. The content of the presentation is prepared according to the theoretical content of the course, so that explicit connections can be established as much as possible between theory and practice. For this seminar, students also produce a research paper on a topic of

their choice and present it orally in class. The research questions that they have addressed over the years stand out as quite different from the usual perspective that is adopted in the field of musical acoustics. We propose to present some of these questions and also discuss how students can greatly benefit from learning about the acoustics of their instrument in the process of acquiring expertise in music performance theory and practice.

Teaching a graduate level course on the Acoustics of Musical Instruments
Daniel Russell
11h50-12h05

As a faculty in the Graduate Program in Acoustics at Penn State, I have had the opportunity to twice teach an advanced graduate level elective course on the acoustics of musical instruments. A prerequisite of two courses on the fundamentals of acoustics and vibration allows us to explore some of the physics and mathematical complexities at a fairly detailed level. Due to the decision to delve deep into details rather than simply providing a broad overview, the course focus is limited to wind and stringed instruments. Both types of instruments were explored through the generator-resonator-radiator paradigm. We discussed nonlinear generators for winds (lip reed, mechanical reed, and air-reed) and realistic initial conditions for strings (finger plucked, struck by a nonlinear hammer, and the stick-slip bowing action); realistic resonators for winds (input impedance and the effects of holes, horns, and viscous losses) and strings (realistic boundary conditions and coupled motion); and radiation (bells and soundboards). This talk will describe my experiences of teaching this course, including some of the challenges involved with developing course notes for an advanced graduate student audience, limitations imposed on experimental projects for a blended enrollment of both resident and distance students, and the use of literature review assignments to help students develop their own critical reading and writing skills.