Interactive Music and Media @ Rensselaer: Studio Report 2017

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Fig. 1: Composer and founder of *Deep Listening* Pauline Oliveros

ABSTRACT

The rich history of interdisciplinary electronic music and art at Rensselaer Polytechnic Institute continues, with the launch of a new Bachelor's Degree in Music, a new recording/electronic-music studio, and a set of new faculty members bringing an influx of media-rich musical approaches and vocabularies to the program. Housed within the fiercely interdisciplinary Department of Arts within the School of Humanities, Arts and Social Sciences, the music program at Rensselaer allows students to tightly couple studies in engineering, computer science, gaming, architecture or other technical subjects with sound and music creation, production and research.

1. INTRODUCTION

Founded in 1824, Rensselaer Polytechnic Institute (RPI) is the nation's oldest technological research university. Rensselaer serves undergraduates, graduate students, and working professionals around the world. Across more than 145 programs at the bachelor's, master's, and doctoral levels, students are encouraged to work in interdisciplinary programs, allowing them to combine scholarly work from several departments or schools.

Rennselaer has historically been known for its strength in Engineering, Computer Science and technology-based research programs. The school features a Department of Arts focused on pursuing deep interdisciplinarity between visual and sonic art and research. That Department is the home of the music program at Rensselaer, both deeply rooted in technology and committed to exploring the intersections between sound and music, visual arts, game design and development, creative coding, biological arts and social practice.

1.1. Department of the Arts

Rensselaer's Department of the Arts is generally considered to be the first integrated electronic arts program within a research university in the United States. Founded in 1972, the department initiated the inclusion of electronic media in 1981.The department features an integrated and multidisciplinary approach to the arts with a focus on the use of experimental and electronic media in artistic creation and performance.

A leader in multimedia arts education, the department's MFA in Electronic Arts was created in 1991 and, in collaboration with Rensselaer's Department of Language, Literature and Communication, the BS in Electronic Media, Arts, and Communication (EMAC) was established in 1996. A multi-departmental BS in Information Technology (IT) was instituted in 1998 and in 2002, a BS in Electronic Arts (EARTS) was introduced. In 2007, a multi-departmental BS in Games and Simulation Arts and Science (GSAS) enrolled its first students and a doctorate in the electronic arts was inaugurated. One of the first PhDs of its kind, this program expands the traditions of arts pedagogy through interdisciplinary research in contemporary media theory, practice, and production. 2017 will see the launch of a new BS in Music degree, with a focus on interdisciplinary and a design to allow dual majoring with complementary degree programs like Computer Science, Mathematics and Physics.

1.2. Music @ Rensselaer

Within the EARTS undergraduate and graduate programs, students can choose to focus their creative practices in Music and Sound Art. Specific tracks in Music Technology, History and Performance are all offered as concentrations within the EARTS degree, as concentrations within a Music minor, and as part of the newly launched B.Sc. of Music degree program.

Opportunities for students to take individual lessons in a wide range of instruments are offered as are musical performance ensembles including the Rensselaer Orchestra, chamber music ensembles, Afro-Cuban drumming ensemble and a new electronic performance ensemble named Ensemble Nonlinear. Student run musical organizations on campus include the popular electronic club PULSE (People Using Live Software & Electronics).

1.3. iEAR Studios

The department and studios have historically been referred to as iEAR (Integrated Electronic Arts at Rensselaer)[2]. The iEAR studios at Rensselaer were founded in 1991 to initially support musicians and visual artists in the Arts Department's MFA program in Electronic Arts. [1]. While the initial focus of iEAR was spread across computer music, video art, and digital imaging, the program has evolved over its 26 year history to include such diverse arts practices as gaming, digital animation, bioart, hacktivism and social practice [3].

1.4. EMPAC

EMPAC—The Curtis R. Priem Experimental Media and Performing Arts Center opened in fall 2008, with The New York Times declaring, "The concert hall of the 21st century has arrived." The 220,000-square foot building houses four independent performance spaces and includes many firsts in the fields of acoustics, performing arts infrastructure, and architectural engineering.

Both a performing arts center and research and production facility, EMPAC provides an environment that supports the realization of complex artworks and research projects at any stage, from inception to completion. The EMPAC artist-in-residence program runs year-round, developing new and commissioned projects, many of which receive their premiere here.

Graduate students and faculty in the Arts program regularly present works at EMPAC including recent concert performances, installations and lectures by Jeremy Stewart, K. Michael Fox, Senem Pirler, Eric Miller and Michael Century. To debut its new 496 channel wave field synthesis array, EMPAC sponsored a new work by graduate student Zach Layton and an artistic residency and new work by faculty member Rob Hamilton.

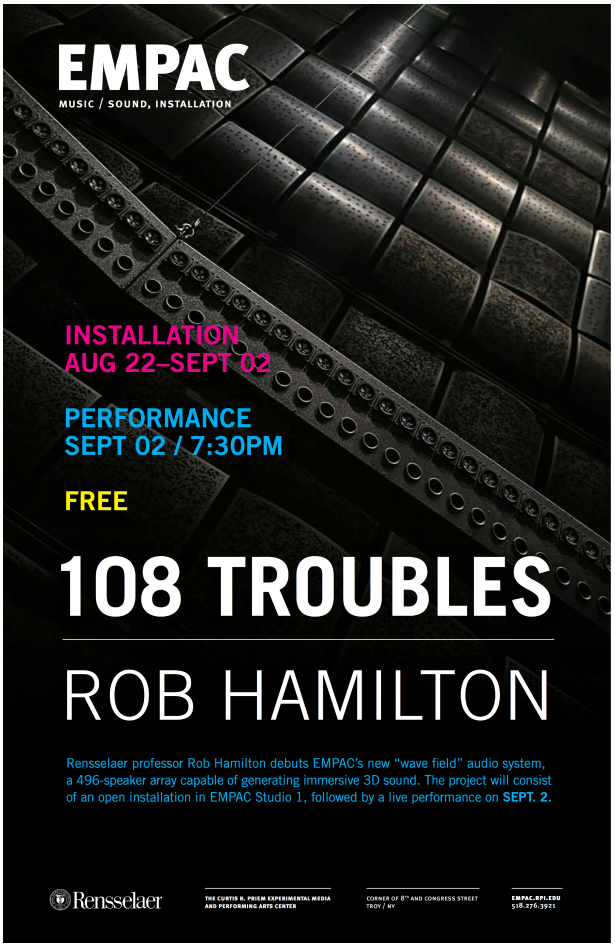

Fig. 2: EMPAC's new 496 speaker wave field synthesis array was featured in Rob Hamilton's recent composition *108 Troubles* for piano and speaker array.

2. NEW INITIATIVES

2.1. Bachelors Degree in Music

Building on the increasing demand for and quality of music creation and performance among students and faculty, and on the unique interdisciplinary capabilities within Rensselaer to support music studies in combination with other fields in science and the media arts, a new B.Sc. in Music degree has been launched starting Fall 2017. The new major will be offered both as a single disciplinary degree, as a dual major with various science and engineering disciplines, and as a music major combined with a media arts concentration. Dual major possibilities include but are not limited to Computer Science, Mathematics, Physics, and Information Technology and Web Science. In addition, there are three concentrations in the media arts that students can combine with Music: Filmmaking, Animation, and Interactive Arts.

The new B.Sc. in Music focuses on preparing musicians for careers in creative professions combining depth in music with breadth in one other discipline. It advances music study within the technological university by preparing students for the multiplicity of roles available to musicians in the 21st century. These include designers of new musical instruments and interfaces; designers of creative software applications, games and online services, and architectural spaces for music experiences both physical and virtual; and entrepreneurs in music/media companies or arts organizations.

2.2. Art_X

The role and scope of a Music program within the context of an interdisciplinary Arts Department at the nation's oldest engineering school is by nature one that thrives on interdisciplinary challenges. This dynamic is currently strongly supported by new initiatives at Rensselaer designed to foster cross-departmental and cross-discipline collaboration and innovation.

The Art_X school-wide initiative, chaired by composer and performer Curtis Bahn, actively seeks to bring together researchers and artists across the campus, creating discourse between artists and engineers, computer scientists and musicians, biologists, architects and creative coders alike to explore how scientific process and data can be affected by and can affect art and music. To highlight projects that combine art and science, a series of Art_X interdisciplinary seminars, concerts and presentations have been carried out, including works by Michael Century, Shawn Lawson, and Ryan Ross Smith.

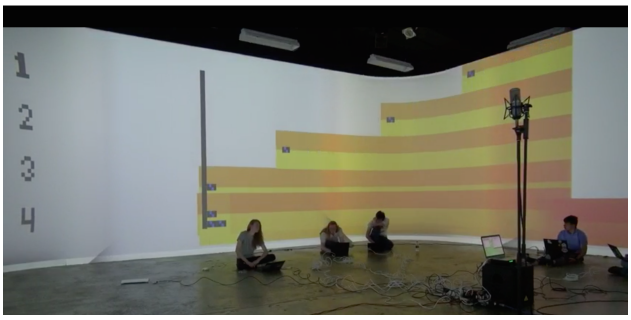

Fig. 3: Ensemble Nonlinear rehearses in the CRAIVE lab.

2.3. Ensemble Nonlinear

Launched in the Spring of 2017, Ensemble Nonlinear is a new electronic performance ensemble for students at Rensselaer. Using a wide-array of audio, visual and interactive gaming technologies, students create new musical works for the ensemble and perform them live in concert.

The class is open to both undergraduates and graduate students who explore topics related to musical composition and performance, software design and development, computer networking, sound design and synthesis and human-computer interaction.

Similar in pedagogical structure to existing "Laptop Orchestra" courses [4], Ensemble Nonlinear eschews the familiar hemispherical multichannel speaker arrays connected to each student workstation and instead drives audio and visual servers with control data sent from light client machines. In this manner, sound can be spatialized using ambisonics or direct speaker panning while students can control sound using their own laptops with no necessary audio interfaces.

3. CENTER FOR DEEP LISTENING

The Center for Deep Listening (CDL) in the School of Humanities, Arts, and Social Sciences (HASS) at Rensselaer Polytechnic Institute was founded June 1, 2014 with a mission to carry on the work of HASS professor and Deep Listening Institute founder Pauline Oliveros. The mission of the center is to steward the continued development of artistic expression, humanitarian scholarship, and understanding of human perception and cognition begun by Oliveros with her innovative deep listening practice decades ago. Oliveros, who taught courses in deep listening at Rensselaer since 2001, described the practice as "a way of listening in every possible way to everything possible, to hear no matter what you are doing."

Deep Listening, as developed by Oliveros, explores the difference between the involuntary nature of hearing and the voluntary, selective nature of listening. The practice includes bodywork, sonic meditations, interactive performance, listening to the sounds of daily life, nature, one's own thoughts, imagination and dreams. It cultivates

a heightened awareness of the sonic environment, both external and internal, and promotes experimentation, improvisation, collaboration, playfulness and other creative skills vital to personal and community growth.

Oliveros, a pioneer in electronic music, passed away in November of 2016, leaving the Center for Deep Listening to steward her legacy in deep listening for future generations of artists. Courses in deep listening are offered at the undergraduate and graduate level as well as seminars and certification courses for the general public.

The CDL is now led by Director Tomie Hahn who has been continuing to offer Deep Listening courses on RPI's campus and online. In conjunction with the Rubin Museum's "The World is Sound" exhibition, CDL will be offering Deep Listening workshops each month until the end of the year.

4. STUDIOS AND LABS

4.1. Computer Music Studio

Courses that require specific recording and computer music software such as Pro Tools, Max/MSP, ChucK, Pure Data, Supercollider and Ableton Live are currently taught in the main Computer Music Studio. In addition to a teaching station, the Computer Music Studio consists of six Apple desktop computers with MBox Pro multi-channel interfaces, stereo speakers and an array of commercial and open source audio software. The room is a flexible "black" space with capabilities for 8-channel sound, a Disklavier piano, a full lighting grid for audio-visual production work, and can be reconfigured for multi-channel sound and solo performances.

A new recording and electronic-arts studio space is currently under construction, with an opening date of Spring, 2018. Designed by the Walters-Storyk Design Group, the new studio combines state-of-the-art recording capabilities with a flexible multi-media performance-capable classroom, supporting multi-channel sound and large-scale projection systems.

Fig. 4: Artist's rendering of the new recording and electronic-arts studio space. Image courtesy of Walters-Storyk Design Group.

Fig. 5: The VAST lab features high-end graphics machines for courses teaching gaming and interactive media.

4.2. VAST Lab

For interactive media design and development, as well as gaming classes, the VAST (Visualization, Animation, Simulation Technology) Studio is an advanced digital imaging and animation lab. The goal of the facility is to provide students with access to professional grade tools in a classroom environment. This classroom has capacity for 19 students and 1 instructor. It is equipped with dual HD projectors and a large-scale 8.1 multi-channel audio system.

Fig. 6: The Emergent Reality Lab uses a flexible immersive CAVE-like virtual reality system.

4.3. Emergent Reality Lab

The Emergent Reality Lab (ERL) is a platform for research in virtual reality and mixed reality, combining the real world with immersive virtual environments and the immersion of storytelling and gameplay. The ERL is a CAVE-like virtual reality system that can be reconfigured for different project needs.

The ERL is designed to support new research in education, intervention, culture and the arts, and applied games and simulations. The ERL currently acts as the research home to the Intelligent, Immersive Environments (IILE) Core Research Group, comprised of faculty from three Rensselaer departments (Arts, Cognitive Science, Communication and Media).

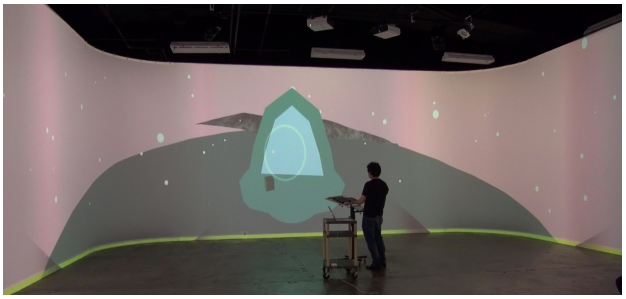

Fig. 7: Prof. Ben Chang pilots an immersive networked game performance of the *New Atlantis*[1] project in the CRAIVE lab.

4.4. CRAIVE Lab

The Collaborative-Research Augmented immersive Virtual Environment Laboratory (CRAIVE) houses a specialized virtual-reality (VR) system for the study and enabling of communication-driven tasks with groups of users immersed in a high-fidelity multi-modal environment located in the same physical space. The lab features a large-scale (18m×12m×4.3m), multi-user, multi-perspective, multi-modal display. For the visual domain, multiple-point-of-convergence rendering techniques are be used to (re-)create scenes on a seven-projector display. For the acoustic domain, the CRAIVE features a 192-loudspeaker-channel system for Wave Field Synthesis (WFS) with the support of Higher-Order-Ambisonic (HoA) sound projection. The CRAIVE is run by the Department of Architecture but has been used for many music, telematic and multi-media concerts.

5. FACULTY

Music courses at Rensselaer are directed by a core group of music faculty including Michael Century, Curtis Bahn, Tomie Hahn, Ade Knowles Nicholas deMaison, Nina Young, Rob Hamilton and Pauline Oliveros, until her passing in the Fall of 2016. Interactive media, gaming, graphics and virtual reality courses are taught side-by-side with music offerings by faculty including Ben Chang, Shawn Lawson, Robert Nideffer, Sylvia Ruzanka, Kathleen Ruiz and Rebecca Rouse.

5.1. New Hires

To further complement the department, senior lecturer, composer and conductor Nicholas deMaison joined Rensselaer in 2014 and leads the orchestra, chamber music and instrumental lessons program. In 2015, researcher and composer Rob Hamilton joined the department as Assistant Professor of Music and Media, teaching courses focused around Music Technology with a dual appointment in the Games and Simulation Arts and Sciences (GSAS) program. In 2016 composer Nina Young joined the department as an Assistant Professor of Music to lead new initiatives in composition and pedagogy. And in the Fall of 2017, Rensselaer was fortunate to bring in two new lecturers to complement our existing faculty: Matthew Goodheart and Justin Yang.

5.2. Recent Work

Dr. Tomie Hahn's research currently explores the physical and cognitive nature of synchronicity and anticipation in creative movement. In 2017 & 2018 she will be a fellow at FRIAS (Freiburg Institute for Advanced Studies) and present her creative and scholarly work on anticipation at the Anticipation conference in London in Fall 2017.

Dean Mary Simoni is currently exploring new techniques to analyze electroacoustic music. Her research has led to the creation of an an interdisciplinary research group known as Plural Analysis, focused on researching the application of diverse methodologies to the theory and analysis of music.

Professor Shawn Lawson has been developing and performing with a browser-based platform for live coding audio and visuals. Capable of interpreting two languages simultaneously (Tidal-Cycles, OpenGL Fragment Shader) the IDE additionally functions tele-matically permitting multiple users to edit the code concurrently. Only code changes and line execution numbers are transmitted between users reducing latency and bandwidth. Playback is exactly the same as a live performance with the output quality only limited by the playback hardware.

Graduate Zachary Layton (Ph.D. 2017, Electronic Arts), will premiere a new work for orchestra and multichannel electronics in June 2018 for the Montreal Symphony under the baton of Kent Nagano, which came out of the research done for his degree and involving the Rensselaer Orchestra, EMPAC, and the CRAIVE lab.. The work will use the immersive infrastructure of the SAT-osphere at the Société des Arts Technologiques.

Current Electronic Arts Ph.D. student Ezra Taboul has been busy exploring the musicality and spatialization of 3D printing during an artist residency at at Sporobole in Sherbrooke, QC. Other recent projects include a chapter in the Guide to Alternative Computing for Music (Miranda (Ed.), Springer, 2017) and a soundtrack for the short film Refuge (Best Experimental Film award at the Polish International Film Festival).

6. REFERENCES

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[4] Wang, G., Bryan, N., Oh, J., Hamilton, R., "Stanford Laptop Orchestra (SLORK)" In Proceedings of the International Computer Music Association Conference, Montreal, Canada, 2009.

[1] http://newatlantis.world