ABSTRACT
This studio report introduces recent activities in the Music Technology program of the Department of Music and Performing Arts Professions (MPAP) at New York University (NYU) Steinhardt. We first provide an overview of the program – faculty, curriculum, and facilities – and then discuss recent and ongoing research in five main areas: Computer Music, Immersive Audio, Music Cognition, Music Experience Design and Music Informatics Research (MIR). We also summarize ongoing and recent events held at NYU.

1. INTRODUCTION
The music technology program of the Department of Music and Performing Arts Professions at NYU Steinhardt focuses on music, sound, cognition, and audio technologies. The program offers rigorous academic curriculums that cover a wide range of academic fields subdivided in five main areas of research: Computer Music, Immersive Audio, Music Cognition, Music Experience Design and Music Informatics Research (MIR). Additionally, the program covers related fields, such as audio for games, software engineering, and new instruments for musical expression. In the area of music production, NYU focuses on audio-visual production, post-production, mixing/mastering, and multimedia production. Located in the center of downtown Manhattan, the school exposes students to endless opportunities for internships and real world experience in audio and music.

2. FACULTY
The main faculty members of Music Technology are Kenneth Peacock (Director), Agnieszka Roginska (Associate Director), Juan Bello, Tom Beyer, Luke DuBois, Mary Farbood, Paul Geluso, Panayotis Mavromatis, Tae Hong Park, and Alex Ruthman. Ruthmann recently joined NYU as a full-time faculty member in 2014.

The program also includes a distinguished list of professionals in the field of music technology as affiliated or adjunct professors. Currently, Joel Chadabe, Joan La Barbara, Nick Didkovsky, Dafna Naphtali, Morton Subotnick, Saul Walker and Leszek Wojcik teach a variety of courses to undergraduate and graduate students in the areas of Music Technology and Composition.

3. CURRICULUM
Five degree programs are currently being offered in Music Technology—Bachelor of Music (B.M.), Master of Music (M.M.), Doctor of Philosophy (Ph.D.), a five-year degree that combines B.M. and M.M., and a three-summer M.M. program that runs during each summer break.

3.1 B.M.
The undergraduate program prepares students for careers in audio and music. In addition to recording, production, and Digital Signal Processing (DSP) courses, students are required to complete courses in music theory, music history, and performance. Through 128 credits of required and elective courses, we provide each student comprehensive coverage of base knowledge in music technology, as well as in music.

3.2 M.M.
The Master of Music degree requires successful completion of 45 credits across several disciplines. Our core and elective courses are designed to provide each student with a solid foundation in all areas of music technology, leading to specialization in a relevant research area of the student’s choosing. The program culminates with the submission and defense of a thesis under the supervision of one of the full-time Music Technology faculty members. The department also offers an accelerated five-year program that combines the Bachelor of Music and Master of Music programs in Music Technology. Finally, NYU Steinhardt also offers a three-summer M.M. degree program, which runs intensively over the course of three summers.

3.3 Ph.D.
The Music Technology Ph.D. program prepares students for careers in university teaching, multimedia, industry research...
and development. Doctoral students, through two years of coursework beyond the Master’s level, are encouraged to cultivate a truly interdisciplinary academic background, working closely with faculty in team-based research settings. Ph.D. candidates are required to demonstrate academic competence not only within their specialized area of research but also in core areas of music technology study, general music theory and music history by passing a candidacy exam and submitting a portfolio, which includes at least two peer-reviewed research papers and future research plans. After advancing to candidacy, students further develop research topics of their choice to fulfill degree requirements, which culminates in an oral, public dissertation defense. Recent graduates include Oriol Nieto (2015), Areti Andreopoulou (2014), Braxton Boren (2014), and Taemin Cho (2013).

4. FACILITIES

The James Dolan Music Recording Studio is a 7,500 square foot multifunctional teaching, recording, and research space designed by Gensler and the Walters-Storyk Design Group. One of the most technologically advanced audio teaching facilities in the United States, the new facility greatly enhances the existing eight studios which house the Music Technology program. The studio is located at the heart of the Music Technology floor. The new complex is distinguished by a 25-seat control/classroom that features a fully automated 48-channel SSL console and the first Dangerous Music 10.2 surround installation in New York City, in addition to a live room that can accommodate a large ensemble, offices, a conference/seminar room, and a large isolation/drum booth.

A unique research lab dedicated to 3D audio experimentation is equipped with 16 Genelec speakers and two subs in a reconfigurable grid; the speaker array provides multichannel miking, tracking, and playback functionalities. The lab has a 0.2 second reverb time. In addition, the Music Technology program contains eight other studios of varying sizes on the 8th floor of the same building. These include two larger recording studios with separate control rooms, as well as smaller dedicated studios for editing, film music, game audio, and analog synthesis.

The program also features access to the 300-seat proscenium style Frederick Loewe Theatre. The Loewe Theatre, the Dolan Studio, the Immersive Audio Lab, and the sixth floor conference room are fully linked with broadband connections for distributed music performances between these rooms and Telematic Music centers in the US and abroad.

5. RESEARCH

5.1 Overview: Music Audio Research Laboratory

The NYU Music Audio Research Laboratory (MARL), which was created in 2009-2010 has now become a driving force for research in the Music Technology program; at the 2014 ICAD conference Jaeseong You (Composition Ph.D. student) won the best composition prize, and Braxton Boren, Michael Musick and Jennifer Grossman won the best student paper award [1]. Brian McFee, a Data Science Fellow at the NYU Center for Data Science, won best oral presentation at ISMIR 2014 for his paper “Analyzing Song Structure with Spectral Clustering” [2], and Eric Humphrey, Justin Salamon, and Uri Nieto also won Best Poster Presentation award at the same conference for their “MIR_EVAL: A Transparent Implementation of Common MIR Metrics” [3].

The lab also recently launched a redesigned website which facilitates easier sharing of MARL’s research activities, creative activities, events, software, publications, datasets, and compositions.2

5.2 Computer Music Group

The Computer Music Group, directed by Tae Hong Park, focuses on broad topics in computer music through the examination and utilization of technologies for live performances, interactive music systems, new instrument design and HCI, soundscape research, distributed performance systems, computational music analysis, MIR for composition, and computer music composition. Within this group, we collaborate on, and foster support for, a diverse range of research interests and projects.

\[http://steinhardt.nyu.edu/marl/\]
The Citygram project focuses on real-time spatio-temporal sound-mapping and acoustic ecological studies with collaboration and support from NYU’s Center for Urban Science and Progress (CUSP) and Google [4]–[7]. The Citygram group is investigating the urban soundscape via a comprehensive Cyber-Physical System (CPS) approach. plug-and-sense Remote Sensing Devices have been developed and deployed around the NYU campus and Carl Arts campus.

On the software side, the group is in the process of developing SoundBeacon, a cross-platform auto-updatable sound analysis application that automatically switched on and off based on the presence of acoustic event. Another noteworthy side project of the Citygram is Sound Event Annotator (SEA), a web-based sound taxonomy crowd-sourcing system. It is currently operating in collaboration with a number of universities in Korea including Seoul National University, Yonsei University, Sangmyeong University, and many more. The collected data is expected to greatly contribute to the study of acoustic event detection and classifications by providing more valid ground truth for machine learning algorithms.

Electro-Acoustic Music Mine (EAMM) is a project that aims to create a sustainable and growing electro-acoustic music (EAM) crowd-sourced collection, preservation and exploration platform in partnership with the ICMA, NYCEMS, and NYU Libraries. For ICMC and NYCEMF conferences our survey have shown that more 96% of all composers are willing to participate in EAMM for archiving their works at NYU Libraries. The project has recently launched to archive the submitted works of NYCEMF 2015 and SID 2015.

The Sonic Spaces Project is a personal project of Michael Musick. It is investigating the composition of sonic ecosystems, a subset of interactive music systems [8], [9]. In its current phase of the Sonic Spaces Project, Musick is exploring the possibility of distributive computing via a multitude of mini-computers (Raspberry Pi 2) endowing each software agent within the interactive sonic ecosystem an autonomous computing capability.

5.3 Immersive Audio

Led by Agnieszka Roginska, the focus of the Immersive Audio group lies in the capture, analysis, synthesis and reproduction of auditory environments. This includes spatial and 3D sound using binaural, transaural and multi-channel presentation methods, audio display devices, virtual auditory environment simulation, characterization and classification of spaces, and augmented audio reproduction realism.

5.4 Music Cognition

The Music Cognition group, led by Mary Farbood, focuses on modeling the complex mental processes involved in the perception and production of music. The general approach integrates multiple perspectives, including theoretical modeling, experimental psychology, and computation. Current topics being explored range from the cognition of basic musical structures, such as harmony and rhythm, to higher-level phenomena like expectation, tension, and expression. An important research goal of the group is to understand and utilize the implications of cognition for analysis and modeling in the domains of performance, composition, and improvisation.

5.5 Music Experience Design Group

The Music Experience Design team, led by Alex Ruthmann, researches, designs, and develops new technologies and experiences for music making, learning and engagement together with community and industry partners. This includes incubated student-led entrepreneurial projects, industry/community sponsored-research and development, and external foundation-funded research.

5.6 Music Informatics Research

The members of the Music Informatics Research Group, headed by Juan P. Bello, are concerned with research aimed at extending the understanding and usefulness of digital music data, through the research, development and application of computational approaches and tools. This specialization of informatics, spanning fields as diverse as music, signal processing and machine learning, shows great potential for scientific, cultural and commercial profit that can benefit consumers, music scholars and creators, and support the archiving and dissemination efforts of libraries, music stores, content owners and radio stations. Our research interests include the automatic modeling of temporal dynamics in music, the creation of interactive visualizations of music and the content-based analysis of digital music collections.

6. EVENTS

6.1 Recent Events

MARL has been hosting a weekly music technology seminar series every Friday during the academic year. Finn Upham, who has been organizing the MARL guest lecture series, has featured notable scholars and professionals in the fields of music, audio, technology, informatics, composition, and cognition to share updates on their work to the NYU Music Technology and neighboring communities. The most recent speakers have included composers Paul Lansky, Pauline Oliveros, Pierre Alexander Trembaly, and Carla Scaletti, as well as multidisciplinary music researchers, such as Simon Zagorski-Thomas, Naresh Vempala, and Michael Casey.
The Department of Music and Performing Arts Professions successfully hosted the 2014 International Conference on Auditory Display (ICAD) in June 22-25. The conference was co-organized by Agnieszka Roginska and Tae Hong Park, under the theme of Big Data. On the creative side, NYU’s signature EAM concert event—Interactive Arts Performance Series (IAPS)—created by Robert Rowe, has continued its mission of sharing and programming interactive computer music works since the 1990s. Under the direction of Tae Hong Park since 2012, IAPS 2014 has featured composers and performers, including Bent Frequency, Joan La Barbara, Michael Frengel, Lvey Lorenzo, Tristan Perich, Cort Lippe, Jeff Herriot, Luke DuBois, Patti Cudd, David Durant, Monte Weber, Jaeseong You, Esther Lamnek, Elizabeth Hoffman, Brad Garton, Tae Hong Park, Diarmid Flatley, Cadillac Moon Ensemble, Maja Cerar, Robert Scott Thompson, Douglas Geers, Michael Musick, Morton Subotnick, Julia Wolfe, Joel Chadabe and Brian Paul Zimmerman.

6.2 Future Events

The Department of Music and Performing Arts Professions will be continuing to host a series of conferences and festivals, including the 2015 Sound, Image, and Data (SID) conference organized by Aceti Lanfranco and Tae Hong Park. In addition, NYU’s Music Technology and Composition programs are partnering with NYCEMS in hosting events as part of NYCEMF 2015. Finally, in cooperation with Columbia University and Syracuse University, the Music Technology program will organize the International Society of Music Information Retrieval (ISMIR) conference, in 2016.

7. REFERENCES


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3 http://nycemf.org
4 http://www.ismir.net