PLOrk Beat Science 2.0
NIME 2009 club submission by Ge Wang and Rebecca Fiebrink

Introduction
This document details our proposed NIME 2009 club performance of PLOrk Beat Science 2.0, our multi-laptop, multi-controller, beat-driven, acoustic/electronic duo. We include all submission details in the order they are listed on the NIME website.

Details
Title of Work: PLOrk Beat Science 2.0
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Year of composition: 2009
Estimated duration of performance: 25 minutes (can be adjusted)

PBS 1.0 in 2007

Instrumentation: 1 flute, 2 humans, 5 laptops, a variety of musical controllers (likely including plastic romaine, iPhone, USB golf game controllers, and MIDI drum pads), and 30 audio channels distributed among 5 hemispherical speakers and 5 subwoofers.

Description of Piece
Motivation and technology

   PLOrk Beat Science (PBS) arose from the desire to explore the intersection of traditional and new music paradigms. We experiment with the fusion of divergent genres and forage through the tensions and complementarity between improvisation and automation, acoustic and electronic, spontaneity and control, human and machine.

   PBS 2.0 explores effective production of laptop chamber music and the interaction of human and machine intelligence. Sound emanates from individual laptops via (five) omni-directional hemispherical speakers, used in the Princeton Laptop Orchestra (PLOrk) and the Stanford Laptop Orchestra (SLOrk), providing a distributed array of 30 independently addressable audio channels. These speakers facilitate inter-performer communication and collaboration, much like traditional chamber settings. The coupling of speakers to localized sound sources also spatially informs the listener's relationship to the music. The software system is implemented in the ChucK audio programming language. A server process maintains a shared and precise time grid across all machines, connected via a closed local area network. The machines serve as distributed soundbanks, whose contents are remotely triggered in real-time by performers. Tabla and drum sounds are sampled; all other sounds are synthesized in real-time.

   Layers of human and machine interaction arise and evolve throughout the piece. A live, unprocessed flute solo gradually becomes digitally mediated and dissected, only to then evolve itself into a mediator of the computer output, its timbral and pitch content used to drive synthesis parameters in real-time. The nature of human and machine control over the sound also develops via the mapping function from the various gestural controllers to synthesis and compositional parameters, which starts from a simplistic and static function and develops into an increasingly complex and novel relationship between gestural expression and sonic space. This real-time

evolution of the mapping is a joint effort between human and machine, the result of an interactive machine learning process. Our on-the-fly machine learning approach, used for both real-time controller mapping evolution and construction of the flute timbral and pitch control, is described in a paper submitted to NIME 2009 by Rebecca Fiebrink, Dan Trueman, and Perry Cook.

Aesthetic and form

PBS 2.0 takes inspiration from Tabla Beat Science (TBS) and their fusion of Indian classical music, laptop-generated percussion, and turntablism. While our tabla samples directly allude to TBS, it is the larger notions of improvisation, choices of expressive dimensions, and melding of seemingly incongruent aesthetics that, combined with our concept of laptop chamber music and interactive learning, form the foundation for our piece. PBS is fundamentally an improvisation around a simple, fixed structure. Rhythm is the primary vehicle for expression, and form is conveyed through cycles of rhythmic repetitions, evolutions, and chaos. Timbre and texture are also integral to expression and form. The free-flowing, organic flute arises from the harmonic palette of the synthesized drone. In turn, the live processing weaves artificial and surreal elements into the flute sound. The improvisation unfolds as an exploration of the complementary roles of the flute and laptops within the sonic space. Ultimately, PBS 2.0 is about fusion, juxtaposition, tension, and connections, all supporting a sonic experience that invites performers and audience alike into the computer-mediated jam session.

Brief Program Note

PLOrk Beat Science was first created and performed in 2006 as a Princeton Laptop Orchestra (PLOrk) chamber piece, by Rebecca Fiebrink and Ge Wang. Drawing from our work with PLOrk and taking inspiration (and 2/3 of our name) from Tabla Beat Science, the birth of PLOrk Beat Science reflected our interest in exploring new hybrid performances involving live acoustic instruments (flute, processed) in electronic chamber music settings (via laptops and hemispherical speakers, which radiate sound outwards from each localized instrument), creating crazy interactive beat machines, crafting new performance software and expressive controller mappings, and simply making music together.

The last several years have brought us new inspirations, as Ge has left Princeton to join CCRMA and we have begun to jointly explore new possibilities for expressive musical control using real-time audio analysis and machine learning. As PLOrk Beat Science 1.0 has evolved into PLOrk Beat Science 2.0, our musical practice has expanded to include new types of interaction with our laptops, enabled by application of on-the-fly machine learning to support machine listening and interactive crafting of new, adaptive musical controllers. At our NIME debut, we offer you a structured improvisation fusing our original Beat Science groove with new experiments in machine musicianship, on-the-fly mapping of the weirdest set of controllers we could throw together at the conference, and celebration of East Coast/West Coast harmony.

Artist Biographies

Rebecca Fiebrink is a Ph.D. candidate in Computer Science at Princeton University, where she studies applications of computer science to music performance and analysis. She holds degrees in Computer Science and Engineering and in Music from Ohio State University and an M.A. in Music Technology from McGill University. Rebecca is a flutist and an active developer of the ChucK music programming language. She is also an assistant director, performer, and composer with the Princeton Laptop Orchestra, which performed at Carnegie Hall in April 2008. Her current research spans music information retrieval, computer music performance technologies and practices, creating new hardware and software musical interfaces, and the application of machine learning to real-time, interactive human-machine musical performance contexts.
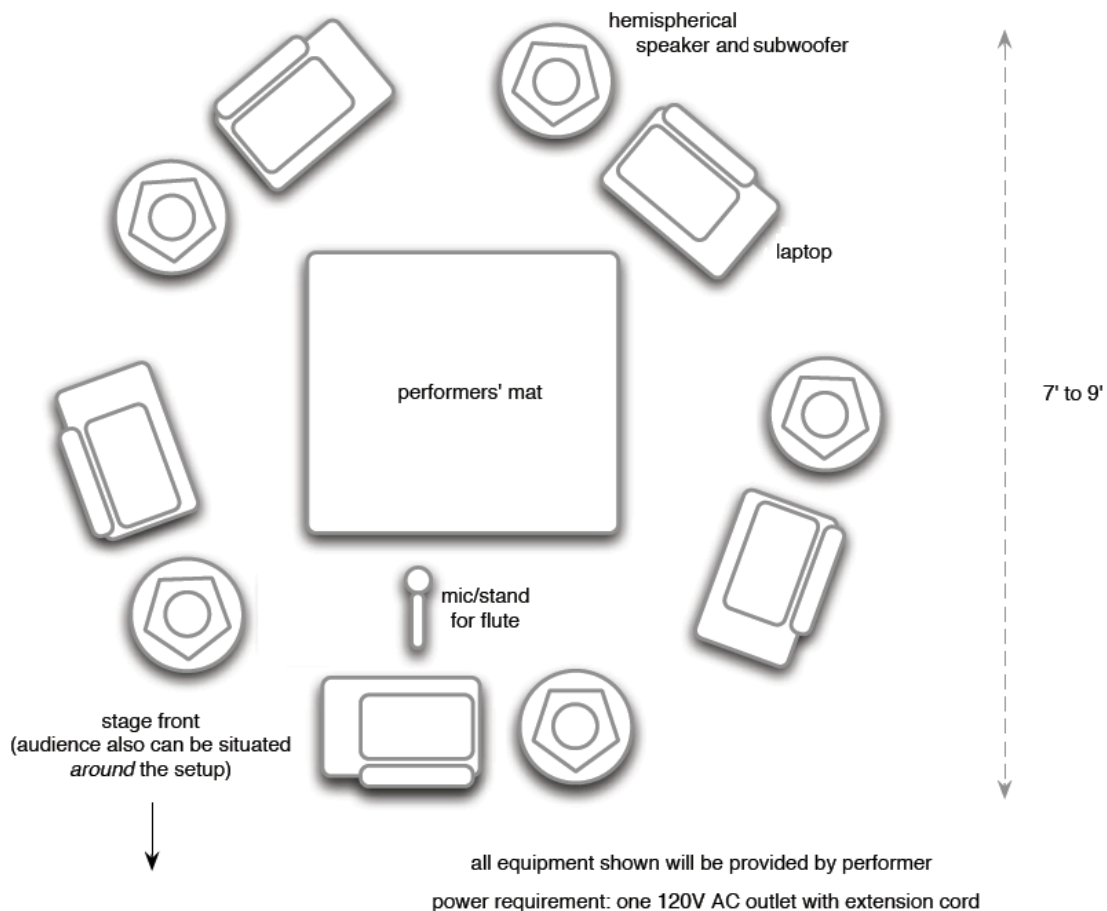
Ge Wang is an assistant professor at Stanford University in the Center for Computer Research in Music and Acoustics (CCRMA). Ge's research interests include interactive software systems (of all sizes) for computer music, programming languages, sound synthesis and analysis, new performance ensembles (e.g., laptop orchestra, mobile phone orchestras) and paradigms (e.g., live coding), mobile music, interfaces for human-computer interaction, interactive audio over networks, and methodologies for education at the intersection of computer science and music. Ge is the chief architect and co-creator of the ChucK audio programming language. He was a founding developer and co-director of the Princeton Laptop Orchestra (PLOrk), and is the founder and director of the Stanford Laptop Orchestra (SLOrk) and of the Stanford Mobile Phone Orchestra (MoPhO). Ge composes and performs via various electro-acoustic and computer-mediated means. Additionally, Ge is the co-founder and CTO of Smule, a startup company exploring interactive sonic media (starting with the iPhone), and is the designer of Ocarina, an expressive wind instrument for the iPhone.

Set-up and rehearsal time required
15 minutes to set up; this goes the fastest if we have some place off-stage to unpack our equipment before setting up on stage.

Detailed technical requirements
We provide all our own equipment; we just need some extension cords to supply power.
We require a stage area approximately 7 to 9 feet on each, as shown below. This can be flexibly rearranged for a longer and narrower stage.

hemispherical speaker and subwoofer

laptop

performers' mat

7' to 9'

mic/stand for flute

stage front
(audience also can be situated *around* the setup)

all equipment shown will be provided by performer

power requirement: one 120V AC outlet with extension cord

Images
The images on the following page illustrate our 2007 PLOrk Beat Science 1.0 setup. Our PBS 2.0
NIME club performance will look very similar, with the following changes:
- We will be using our new speakers, which are a bit smaller than those pictured, and we will
  have more subs, which fit under the speakers
- We will be using a variety of controllers throughout the performance

Additional audio and video documentation
PBS 1.0 audio and video is available at http://plork.cs.princeton.edu/beatscience/#audio.
This is representative of the aesthetic and overall form of PBS 2.0, but it does not involve the
more complex control strategies of PBS 2.0.
    Performers of the Princeton Laptop Orchestra have recently performed a new composition,
nets 0, in which 6 humans use our on-the-fly interactive machine learning infrastructure to
construct and evolve controller/sound mappings over time in a performance context. Video of this
performance is available at http://wekinator.cs.princeton.edu/video/nets0.mov. In this case, the
technology is representative of the methods we will use for control and interaction at NIME, but
the aesthetic is very different.
    Of course, the new performance will be improvisatory in nature, and we plan to take
inspiration (and perhaps actual controllers) from our yet-unknowable experiences at NIME!