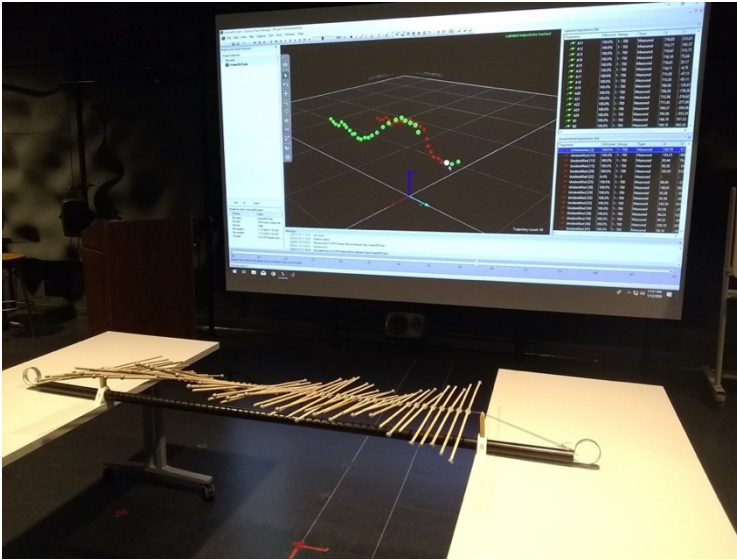


## VISUALIZING TELEMATIC MUSIC PERFORMANCE



Telematic music encompasses a vibrant field of research and practice exploring the aesthetic, technical, and cultural implications of real-time music-making by people in disparate geographical locations. Even when not facing a global pandemic, telematic music is being widely explored for its potential to enable new modes of artistic collaboration, and in the process is suggesting entirely new artforms that are native to the network medium.

In the context of the COVID-19 pandemic, telematic performance is emerging as a necessity. The need for physical isolation and distancing has brought into relief the degree to which creative musical

collaboration is reliant on sharing physical space. Musicians employ a variety of explicit and implicit gestural cues to coordinate their actions—a subtle nod of head, an exaggerated rise of the torso, or a fleeting glance can all signal vital information to co-performers. Our previous experiments, and those of others, have shown that this ability for visual coordination among performers, and visualization of remote performers for audiences, are among the most pressing needs in telematic performance.

The technologies underlying telematic performance currently allow us to achieve “CD quality” audio with sufficiently low latency between locations on the same continent to enable rhythmic music performance. Video, however, is a different story. The very process of encoding a digital video signal can be too slow to enable rhythmic coordination, not even factoring in transmission and decoding time. Even if we could push the limits further with video, there is evidence that video might not actually be the most effective way to support what musicians and audiences need. Research has shown that even at the same scale and information rate, physical movement in space is more engaging than video, and supports more effective interpretation of gestures. Video has limited ability to communicate complex human qualities such as “effort” and “tension” that are essential in music, but which involve extremely subtle and highly nuanced gestures or isometric muscle activations. Finally, video suffers from aesthetic deficiencies. In telematic performance, where we rely on the network to support metaphors of extending or sharing space, video only highlights spatial disjunction. We will always see artifacts of the “other” environment; we’ll never make it “look” like we’re sharing space, even if we can make it sound like it.

The goal of this project is therefore to explore methods of incorporating visual communication of effort, gesture, and movement into telematic performance without video transmission. We will conduct a series of practical experiments with different sensing techniques in isolation and combination, including infrared motion capture, inertial measurement, electromyography, and force sensing. These will be coupled with novel digitally fabricated mechatronic displays—simple moving avatars or kinetic objects that display the actions and efforts of remote musicians in 3-dimensional, physical space.

The immediate goals of the UARTS Faculty Engineering/Arts Student Team (FEAST) will be to:

- experiment with / evaluate different sensing techniques for capturing performers' movements and effort;
- design, fabricate, and evaluate at least one 'finished' mechatronic display for communicating musicians' movement and effort in performance;
- hold at least one public concert to exhibit the technology, test it in a high-stakes environment, and gather qualitative feedback from audiences and performers to inform future research.

There is clearly no singular design outcome that would 'solve' the research problem, so future teams will likely iterate and improve on the designs that are generated as well as generate new ones. The designs will also likely be specific to different instruments and even individual performance styles, so we anticipate expanding to different instruments, musicians, and musical contexts. Assuming these practice-based explorations are fruitful, we also envision conducting formal experiments with both musicians and spectators that will compare the effectiveness of audio, video, and mechatronic displays. The results of those experiments in turn will inform future design phases.

This project will be conducted in collaboration with Prof. John Granzow, Assistant Professor of Performing Arts Technology.

### **MEETING TIME AND LOCATION**

Tuesdays, 6-8pm, E.V. Moore Building

### **STUDENTS SOUGHT**

#### **DIGITAL AUDIO & MUSIC PERFORMANCE (3)**

- Student skills: college-level performer on a traditional musical instrument, with experience playing chamber music; digital audio applications including music recording and production software, microphones and analog/digital signal flows in recording environments
- Likely majors: PAT, INTERF, EECS, AMCULT

#### **MECHATRONICS / ROBOTICS & INTERACTIVE SENSING (4)**

- Student skills: actuators, feedback control, simple motion control algorithms, sensors, computer programming; sensors, embedded computing using platforms such as Arduino, analog data capture using data acquisition devices, communication and data transfer between embedded and host computers
- Likely majors: ROB, EE, ME, CE, CS

#### **NETWORK PROGRAMMING (1)**

- Student skills: computer programming, experience with low-level programming for network applications, sockets, network protocols, open source software and github
- Likely majors: CS, CE, EE

#### **DIGITAL DESIGN, FABRICATION & PROTOTYPING (2)**

- Student skills: CAD (computer-aided design), CAM (computer-aided manufacturing), 3D modeling software such as Rhino or SolidWorks, experience with laser cutters, 3D printers, CNC, additive and subtractive manufacturing
- Likely majors: ARTDES, ARCH, PAT, ME, EE, SI

## MOTION CAPTURE / BIOMECHANICS & NONVERBAL COMMUNICATION (2)

- Student skills: marker-based infrared motion capture system such as Qualisys or Vicon, other biomechanics measurement techniques such as electromyography (EMG), force plates, inertial measurement; theories of nonverbal human communication and coordination using gesture and movement, psychology and physiology of entrainment, kinesics
- Likely majors: ARTDES, PAT, ME, EE, SI, KINESLOGY, MOVSCI, PSYCH, COMM

### FACULTY PROJECT LEAD



**Michael Gurevich's** highly interdisciplinary research employs quantitative, qualitative, humanistic, and practice-based methods to explore new aesthetic and interactional possibilities that can emerge in performance with real-time computer systems. He is currently Associate Professor in the Departments of Performing Arts Technology and Chamber Music at the University of Michigan's School of Music, Theatre and Dance, where he teaches courses in physical computing, electronic music performance and the history and aesthetics of media art. Other research areas include

network-based music performance, computational acoustic modeling of bioacoustic systems, and electronic music performance practice.

His creative practice explores many of the same themes, through experimental compositions involving interactive media, sound installations, and the design of new musical interfaces. His book manuscript in progress is focused on documenting the cultural, technological, and aesthetic contexts for the emergence of computer music in Silicon Valley. An advocate of "research through making," his creative practice explores many of the same themes, through experimental compositions involving interactive media, sound installations, and the design of new musical interfaces.

Prior to the University of Michigan, Professor Gurevich was a Lecturer at the Sonic Arts Research Centre (SARC) at Queen's University Belfast, and a research scientist at the Institute for Infocomm Research (I2R) in Singapore. He holds a Bachelor of Music with high distinction in Computer Applications in Music from McGill University, as well as an M.A. and Ph.D. from the Center for Computer Research in Music and Acoustics (CCRMA) at Stanford University, where he also completed a postdoc.

During his Ph.D. and M.A. at Stanford, he developed the first computational acoustic models of whale and dolphin vocalizations, working with Jonathan Berger and Julius Smith as well as collaborators at the Hopkins Marine Station and Stanford Medical School. Concurrent research with Chris Chafe and Bill Verplank investigated networked music performance and haptic music interfaces.

Professor Gurevich is an active author, editor and peer reviewer in the New Interfaces for Musical Expression (NIME), computer music and human-computer interaction (HCI) communities. He was co-organizer and Music Chair for the 2012 NIME conference in Ann Arbor and is Vice-President for Membership of the International Computer Music Association. He has published in leading journals and has presented at conferences and workshops around the world.