Bone Flute to Auto-Tune:
A Conference on Music & Technology in History, Theory and Practice

April 24-26, 2014
Morrison Hall and CNMAT
University of California, Berkeley

Events take place in the Elkus Room (125) Morrison Hall, except where otherwise noted

Thursday, April 24
1-1:30 Welcome and Opening Remarks (Elkus Room, Morrison Hall)

1:30-3 Lifecycles of Musical Instruments
chair: Adrian Freed (CNMAT)
Kurt Werner (CCRMA), "The TR-808 Drum Machine and its Emulations"
Thomas Patteson (Curtis Institute) and Deirdre Loughridge (UC Berkeley) "The Museum of Imaginary Musical Instruments"
Aaron Allen (UNC Greensboro) "In the Palms of Our Hands: Lifecycles of Portable Media Players"

3-3:30 Coffee

3:30-4:30 Organ-ic Electronics
Chair: Holly Watkins (University of Rochester/Eastman School of Music)
Carmel Raz (Yale University), "Nerves, Reeds and Organs: The Harmonium as a Case Study in Early Romantic Ideas about Sound and the Body"
Tiffany Ng (UC Berkeley), "Electric Organology: Hammond and the Federal Trade Commission, 1936-1938"

5:00-6:30 Roger Moseley (Cornell University), "Digital Analogies" (Room 128, Morrison Hall)

6:30-7:30 Reception

Friday, April 25
9-10:30 "Artificial" Memory (Elkus Room)
chair: Sean Curran (UC Berkeley)
Anna Maria Busse Berger (UC Davis), "Memorization Techniques in the Middle Ages"
Mackenzie Pierce (Cornell University) "Music Stenography and Textual Recording Technologies, 1830-1850"
Margaret Schedel (SUNY Stony Brook) "Documentation vs. Notation in Computer Music"

10:30-11 Coffee

11-12:30 Ages of Technological Reproducibility
chair: Nicholas Mathew (UC Berkeley)
Margaret Jones (UC Berkeley) "Technologies of Print and Tablature in Early Modern Europe"
Roger Grant (University of Oregon), "The Numerical Mediation of Tempo"
Melle Kromhout (Universiteit van Amsterdam), "Dithering: Hiding Noise with Noise in Digital Sound"

Break for Lunch

2-3 Space
chair: Deirdre Loughridge (UC Berkeley)
Joon Park (University of Oregon), "The Monochord = (Motion + Space) = Musical Motion"
Zachary Seldess (UC San Diego) and Steve Ellison (Meyer Sound), "A History and New Implementation of Space-Map"

3-3:30 Coffee

3:30-5 Programming the Performer

Chair: Greg Niemeyer (UC Berkeley)

David Wells (Denver, CO), "The Musical Box: Origins and Development of Mechanical Music"

Lucie Vágnerová (Columbia University) "On Liveness and Labor in the Era of Hologram Singers"

Ritwik Banerji (UC Berkeley) "Setting the Machine Free: Virtual Improvisers, Artificial Intelligence and Decolonization of the Human-Machine Relationship"

7:30 Concert (CNMAT) 1750 Arch Street

John Granzow and Christopher Jette (CCRMA), "LasuDax"

Edmund Campion (CNMAT), CORAIL for tenor saxophone and live electronics, with Steve Adams of the ROVA Saxophone Quartet

Amanda Chaudhary, CatSynth

Perry Cook, "Elaine and D'joan" for voice and electronics (world premiere)

Saturday, April 26
9-10:30 Vocal Technologies (Elkus Room)

chair: James Davies (UC Berkeley)

Owen Marshall (Cornell), "The Birth of Auto-Tune: A Genealogical Praxiography of Pitch Correction"

Peter McMurray (Harvard), "A Media Archaeology of Angels: Sound, Documentary and Islam"

Perry Cook (Princeton), "Choirs of the Future? Past, Present, and Future of Technology and Singing"

10:30-11 Coffee

11-12:30 "New" Instruments

Emily Dolan (University of Pennsylvania), "The Invention of Newly Invented Instruments"

You Nakai (NYU), "David Tudor's Neural Synthesis and the Neural-Network Synthesizer"

David Wessel (UC Berkeley/CNMAT), "Expressive Shaping of Generative Musical Processes in Live Performance"

Break for Lunch

2-3 Roundtable: History, Theory, Practice

Georgina Born, Deirdre Loughridge, Adrian Freed

3-3:30 Coffee

3:30-5 Future Effects

Heather Hadlock (Stanford), "Liveness and Community in Robert Lepage's La Damnation de Faust (2008) and the Metropolitan Opera: Live in HD Simulcasts"

Darien Lamen (UW Madison), "Futurity and Sound System Technology in the Brazilian Amazon"

Martin Scherzinger, Jessica Feldman, Stephan-Eloïse Gras (NYU), "The MIDI Effect"

Thursday, April 24

1:30-3 Lifecycles of Musical Instruments

~~Chair: Adrian Freed (UC Berkeley/CNMAT)~~

Kurt Werner (CCRMA), "The TR-808 Drum Machine and its Emulations"

Roland introduced the TR-808 Rhythm Composer in 1980. Though it represented a leap forward in analog drum machine technology (both for its programmability and the quality of its voice design), it was released just as interest in digital sample-based drum machines (such as the Linn LM-1 and the Oberheim DMX) was taking off. Reception and sales were lukewarm, and "the 808" found only limited use in its intended purpose – the creation of studio demos. Although Roland discontinued the 808 in 1984, it soon found new use (via the bargain bins) as an affordable source of beats for early hip hop and techno musicians.

Today, the 808 remains ubiquitous in many forms of electronic dance music and pop music, as a source of musical material and frequent lyrical reference (see Kanye West's "808s & Heartbreak", Ke$ha's "Your Love Is My Drug", & many others). Ironically, an instrument once prized largely for its cheapness has become an increasingly expensive commodity. Reacting to this trend, many have emulated the 808, in both software and hardware regimes. Software emulations of the 808 range from early software samplers that reproduced the interface of the 808 (Propellorhead's ReBirth RB-338), to signal-model imitations (Tactile Sounds' TS-808, &c.), to modern physics-based simulations of the actual circuitry of the 808 (the D16 Group's Nepheton, &c.). Hardware emulations of the 808 range in scope from single voices (see Eric Archer's work, the XX808 series by TipTop Audio, &c.) to complete clones (AcidLab's Miami, e-licktronic's Yocto, Christian Hartig's TR-8060, &c.). Interest in hardware and software emulations reaches across borders, connecting experts and hackers, corporations and hobbyists, engineers and producers. With Kevin Tong, I (re)designed a hardware 808 "mega voice," capable of simulating many of the 808's voices and creating new hybrids. My current research focuses on creating physically-informed software models of "circuit-bent" and modded 808 voices. In my presentation, I'll examine various approaches to recapturing the 808's original sound and experience, paying special attention to how these emulations track technological progress and social change.

Thomas Patteson (Curtis Institute) and Deirdre Loughridge (UC Berkeley) "The Museum of Imaginary Musical Instruments"

The Museum of Imaginary Musical Instruments (MIMI) opened its virtual doors in 2013. Its collection is made up of instruments for manipulating sound – but instruments that have never been physically realized. As fantastical ideas, imaginary musical instruments hold a certain curiosity appeal. Like the weird and wondrous artifacts that populated early modern *Wunderkammern*, they delight through their strangeness and blurring of boundaries. Whether impossible or simply impractical, defying the laws of physics or the bounds of social propriety, these instruments point to unrealized possibilities both technological and musical.

From the standpoint of conventional histories of technology, however, imaginary musical instruments are doubly negligible. First, of course, because they are "merely" speculative; but second, because instruments and the broader category of "aesthetic technologies" to which they belong are typically absent from universal histories of human invention. Why is this? Are aesthetic technologies of a fundamentally different kind than the more practical devices that populate the standard narratives of techno-history? Or is their exclusion the product of specious yet deeply wired distinctions between the playful and the practical, the superfluous and the necessary? We take up these questions by comparing common types and functions of imaginary musical instruments to theories of technological fantasy developed by historians of technology and media archaeologists such as George Basalla, Siegfried Zielinski, Eric Kluitenberg and Jussi Parikka. While on the one hand the music-technological imaginary may be seen as a distinct domain, shaped by concerns with sound and its manipulation, it can also be seen as part of the wider world of technological fantasy – a world that spans courtly, industrial and digital conditions, and that at once distorts and clarifies, encourages and critiques its practical counterpart. Our taxonomy of imaginary musical instruments thus

provides the basis for a new generalized theory of technological fantasy, and for a critical examination of the taxonomical thinking that has – until now – hidden imaginary musical instruments from view.

Aaron Allen (UNC Greensboro) "In the Palms of Our Hands: Lifecycles of Portable Media Players"

Portable media players — iPods, smartphones, tablets — function as passive listening conduits and as active musical instruments. Studies have emphasized the social mediation that portable media players (PMPs) facilitate and the ways these technologies change musical experiences (Levy 2006, Bull 2007, Bergh and DeNora 2009). These small objects have done remarkable cultural work in a short time. Yet these new toys perpetuate old values of exploitation and colonialism. Scholars have focused primarily on music and cultural experience at the expense of negative social and environmental impacts. The minerals for the circuitry that creates the innovative and desirable features are "conflict minerals" if they come from war ravaged central Africa. Chinese factory workers producing Apple (and others') devices have suffered indignities and death due to poor working conditions. Desire for the social status that PMPs afford has resulted in theft and murder in the U.S. PMPs consume electricity that contributes to global warming. And when consumers upgrade and discard old PMPs, they become pollution or, worse, e-waste exported to India where children burn off plastics to recycle conflict minerals.

An ecomusicological approach considering lifecycle cost analysis can elucidate the myriad social and environmental impacts of PMPs (and serve as a methodological model for other music technology studies). Then we might ask how we could balance the positive and negative of PMPs. Some negative aspects can be avoided: they can be made and recycled more responsibly, run on solar energy, and eschew conflict minerals. Can we harness PMP's capacity to do musical/cultural work and channel it toward ameliorating their negative impacts on people and the planet? Indeed, as sustainability advocate Van Jones implores us to stop using these devices as toys and instead use them as problem solving tools, we may be able to effect positive change from the palms of our hands.

3:30-4:30 Organ-ic Electronics

~~Chair: Holly Watkins (University of Rochester/Eastman School of Music)~~

Carmel Raz (Yale University), "Nerves, Reeds and Organs: The Harmonium as a Case Study in Early Romantic Ideas about Sound and the Body"

The development of harmoniums in the early nineteenth century presents a remarkably rich case study with which to explore the influence of neuroscience upon contemporaneous musical culture. Romantic audiences prized the instrument's fine nuances of dynamic expression and multiple timbres, facilitated through the new technology of free reeds. The sounds of the harmonium were often regarded as a domestication of the wind-blown strains of the Aeolian harp, an established metaphor for nervous sensibility. Specific neurophysiological assumptions further influenced the reception of the harmonium within musical, literary, and medical culture. This can be seen most notably in the writings of Honoré de Balzac, who evokes free-reed instruments including the physharmonica, orgue expressif, panharmonicon, and accordéon, in order to express conditions affecting the nervous system. A variant of this idea can also be found in René Théophile Laënnec's introduction of the stethoscope in his treatise, *De l'Auscultation Médiate* (1819). Using Laënnec's classifications of "bellows sounds" by timbre, doctors were able to make diagnoses based entirely on the quality of sound revealed by the disease, a development that revolutionized the medical practice of the era.

By examining the intersection between conceptualizations of the nervous system and the reception of musical instruments, I explore the extent to which ideas about sympathetic resonance and neurophysiological vibration continued to inform the development and significance of musical instruments in the Romantic era. Inheriting the nervous associations of the glass harmonica as well as the Aeolian harp's status as a mediator between internal and external mental states, I argue that medical and literary usage of harmoniums reflects a larger cultural context whereby nervous transmission was typically understood as vibration, and musical timbre held the key to unlocking various mental conditions, ranging from catalepsy to delirium and otherworldly visions.

Tiffany Ng (UC Berkeley), "Electric Organology: How Hammond Fooled the Federal Trade Commission"
In 1938, the Federal Trade Commission (FTC) took on the role of national legal organologist in deciding whether the Hammond Clock Company could fairly use the word "organ" to brand the Hammond Organ, although the FTC acknowledged it as a "musical instrument." Through a close examination of FTC Docket No. 2930, I argue that organs served as an initial battleground over the ontology of electronic instruments. Organs were already the musical prototype of choice for the application of electricity, with electro-pneumatic action developed in the mid-nineteenth century to lighten the keyboard as the instrument outgrew human capacity to play it. Yet organhood hinged not on the electrification of keyboards, stops, or even wind production, but on the substitution of tone generators for pipes, electricity for material sound generation. The defense's evidence included a blind listening test between the University of Chicago's famed E.M. Skinner organ and a Hammond, in which musicians were unable to distinguish between them—the organist's deliberately unorthodox stop combinations made the Skinner sound electronic, revealing the dependence of the pipe organ's sonic authenticity on conventional constructions of sound. John Hammond's attorney portrayed him as an ingenious American inventor and small business owner bringing affordable organs to the public, hoping to outweigh the philosophical classification of electric instruments with the folksy authenticity of democracy.

Trial exhibits of Hammond's illustrated advertisements show Hammonds played effortlessly by women in churches and funeral homes; yet this instrument would make its way from houses of worship and of the dead to houses of jazz and funk, from illustrated white women to iconic black men. The Hammond's slippery definition would ultimately enter a postwar feedback loop between pipe organs and synthesizers, leading to an asymptotic convergence of electronic and acoustic designs precisely when Americans were certain that their new "neo-baroque" organs were historically authentic at last.

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Friday, April 25

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9-10:30 "Artificial" Memory

Chair: Sean Curran (UC Berkeley)

Anna Maria Busse Berger (UC Davis), "Memorization Techniques in the Middle Ages"
Singers in monasteries had to commit an enormous amount of music to memory. There were more than 3,000 antiphons to memorize, and the eighth- and ninth-century Gradual contained approximately 70 Introits, 118 Graduals, 100 Alleluias, 18 Tracts, 107 Offertories, and 150 Communions, in other words about 560 chants. We, who are entirely dependent on writing, cannot understand how monks could have memorized all this music.

I will discuss the main tools for committing all of this material to memory. Musicians used exactly the same techniques for memorization that were advocated in treatises on the art of memory, which relied on organization and classification, but adapted them to music in new ways.

Mackenzie Pierce (Cornell University) "Music Stenography and Textual Recording Technologies, 1830-1850"
The shorthand methods developed by Hippolyte Prévost, August Baumgartner, and V. de Stains adapted the quill strokes of speech stenography to the seemingly analogous domain of music. Music stenography, as its advocates conceived it, promised an impressive feat: efficient notation would enable the practitioner to record in "real time" both improvisations and a composer's musical inspirations, both of which were prized and lamented for their immediate and ephemeral qualities. Abandoning the traditional staff and note-heads, these authors developed systems for notating music at the speed it was heard. As such, each attempted to create a means of recording, preserving, and ultimately transmitting musical sound through textual media. In this paper, I bring these virtually unexplored treatises and their contemporary reception to light, interpreting them as a window onto notation's technological affordances.

Reconstructing music stenography's techniques and aspirations works to complicate the relation between textual and sonic music in the nineteenth century. While Lydia Goehr famously considers veneration of score and text to be concomitant with the entrenchment of a "regulative" work concept, this paper shows that standards of permanence and textuality were significant even in practices on which the work concept had little bearing. By arguing for a cul-

ture of musical textuality and preservation independent from the realm of "works," I underscore long-range continuities in the history of stenography and sound recording. Édouard-Léon Scott de Martinville considered his first-ever mechanical sound recordings to be a form of "natural stenography," a means of writing sound through vibration. Of course, music stenography remained inextricably dependent on traditional ear training and the techniques of writing. Nevertheless, in bringing quill strokes closer to the speed and form of musical sound, it prefigured the stylus's own mechanic imitation of sound, notated upon the smoked glass of the first mechanical recordings.

Margaret Schedel (SUNY Stony Brook) "Documentation vs. Notation in Computer Music"
A live concert engages its audience in a unique way, where each member contributes to its shape, actively participating in its realization. Audiences engage with the composers, performers, and the music in a collaborative elaboration of meaning. The live event is thus a site of encounter and exploration. Each of these encounters is bound to a particular moment in history, and this context cannot be mechanically reproduced. By contrast, the viewer takes on a much more passive role when listening to a recording, or watching documentation of a musical performance. Instead of providing a shared site of artistic communion, the video and audio recordings are a space of private consumption. There is a fundamental difference between seeing an event live, and experiencing it later through documentation. Although telematic performances are bridging this divide between performance and documentation, many pieces of music are meant to be experienced live in the concert hall.

In a world where technology is continuously changing, influencing how we create, circulate, consume and even conceive of music, how do we ensure the ability to "re-perform" works with out-dated technology? Is it even necessary? Do we need to keep an archive of computers and synthesizers so we can perform on period technology? Or will these works exist only as documentation? Notation has always served as a flexible representation of the music being performed. Modern instrumentalists can play music written 500 years ago. In 2006, I edited an issue of Organised Sound on Sustainability asking researchers to think about how the computer music of today will be played 500 years from now. I don't think composers are doing enough to preserve their work for future generations. Recordings are not enough, music is a living art form and proper notation is the path forward.

11-12:30 Ages of Technological Reproducibility

~~Chair: Nicholas Mathew (UC Berkeley)~~

Margaret Jones (UC Berkeley) "Technologies of Print and Tablature in Early Modern Europe"
The early seventeenth century saw many publications geared toward a growing audience of guitar and lute players, presenting each author's own variation of tablature geared toward simplifying and demystifying the experience of playing from sheet music. In Italy many composers referred to their tablature systems as "inventions". Later in the century French publishers boasted charts of not only "French" styles of tablature but also Italian and Spanish systems in their music books, granting wide access to most western-European music for their readers. For aspiring amateur musicians in early modern Europe, these instruction charts, and similar ephemeral sources of music notation are not only records of new music to be read and enjoyed, but also self-contained instructions for how to read music. Tablature is a technology of transmission, and while it was not necessarily new to audiences at the turn of the seventeenth century, it was promoted as such by its publishers. Though not a complete departure from manuscript transmission of music by any means, published books of tablature offered some of their readers direct access to written music that previously could not have been supplied without the aid of another skilled musician. These tablature books, and the explanatory prefaces contained within them, gave less skilled players instruction on their instrument in supplement to, or even in lieu of, a teacher. This presentation will examine the newness of these intabulations in the context of notation as a technology. It will explore the boundaries between tablature systems and the system we now know as "standard notation", the tensions between the kinds of information each of these systems contain, their effectiveness as pedagogical tools for early modern instrumentalists, and their social context as technologies affording human performance on a musical instrument.

Roger Grant (University of Oregon), "The Numerical Mediation of Tempo"
In 1815, Johann Maelzel patented a machine that would change musical life forever. The metronome was by no means the first musical chronometer, but it nevertheless became the device that set the standards we still use for tempo today. Unlike the various timekeeping technologies that preceded it, the metronome rose to popularity in an age that was increasingly anxious about the ability of musical notation to communicate tempo; musical chronometers were little more than curiosities in the early modern era, when musicians could dependably discern the proper or "just" tempo from the combinations of meter signatures, note lengths, and Italian terms on the notated page. As this paper will demonstrate, the end of the eighteenth century witnessed the slow dissolution of the system that had once afforded this type of tempo communication, and Maelzel's metronome offered a solution. But not everyone was excited about the metronome. In fact, the reason it was so celebrated was also the basis on which some critics rejected, reviled, or even feared it. The metronome was able to communicate tempo reliably in a system of numbers, mediating a vital component of musical feeling and affect in a widely translatable form. Numbers were thought to be universal, translatable, cool and impersonal: devoid of sentiment and signification. And yet, in the technique of tempo indication that coupled numbers with the metronome machine, they gave rise to music that spoke with force. In what must have been a bizarre turn of events, the abstract quality of metronome numbers was exactly what allowed them to create feeling. Examining the confluence of discourses in the music criticism and music theory of the period, I aim to uncover an early and abiding indifference to the work of this most ubiquitous musical instrument.

Melle Kromhout (Universiteit van Amsterdam), "Dithering: Hiding Noise with Noise in Digital Sound"
In digital sound production, the truncation of bits of information, necessary for the conversion from analog to digital signals as well as the requantification from 20-bit files used in studios to the 16-bit standard of the CD-format, introduces undesired sonic artifacts. As a solution, random noise is added to the sound prior to truncation. Such 'dither' replaces the correlated, narrow-band, harmonic distortion of quantification errors with a slight layer of uncorrelated, broadband noise. This procedure, amongst others also used in image and video processing, essentially means there is a trade-off between the removal of unwanted harmonic artifacts and the addition of a slightly higher noise floor that smoothens the hard edges of digital errors. "The effect," writes Curtis Roads, "is that of a "soft landing" as the tone fades smoothly into a bed of low-level random noise."

A conceptual reading of "dithering" offers a compelling possibility to redefine the continuity and discontinuity of the analogue and the digital, based on the importance of noise. Whilst digital sound technologies – computing discreet signs instead of processing continuous signals – theoretically enable noise free reproductions, dithering testifies that it remains impossible to operate completely without noise. On the contrary: noise improves the final recording. The fact that this simultaneous reduction and employment of various kinds of phenomenological and conceptual noise is crucial for both analogue and digital sound technologies supports the idea that, as Friedrich Kittler puts it, it is noise that ties information to its materiality. As the physical world is permeated by contingency and randomness, dither, the paper argues, reinstalls part of the analogue into the digital. It constitutes a necessary negotiation between the slightly incongruent layers of digital technology and analogue sound.

2-3 Space

Joon Park (University of Oregon), "The Monochord = (Motion + Space) = Musical Motion"
In this paper, I argue that the movability of the bridge on the ancient Greek monochord played a crucial role in the development of the Western conceptualization of music. The language of Western music assumes, often without overt reference, the general concept of space in which various musical events occur. This assumption of space, by no means the only way to conceptualize music, is a necessary condition for any modern concept of musical motion. While musical motion gained some scholarly attention in recent years, there have been fewer studies on the underlying space. Drawing from works by Andrew Barker, David Cohen, and David Creese, I reinvestigate the role that the monochord played in the conceptualization of musical space among the earliest Greek writers on music.
The word "motion," as it was defined by Aristotle, referred to four species of change (substance, quantity, quality,

and place). Although change of place is today's primary definition of motion, it was not used in musical contexts initially. Yet, as treatises became more descriptive of the construction of the monochord (as in Ptolemy's *Harmonics*), changes in Pythagorean-Platonic ratio became changes of place through the shifting of the monochord's bridge. This, in turn, redefined pitch as an entity navigating through a prescribed space. Drawing attention to ancient Greek definitions of motion—too often read uncritically in musicological literature—I demonstrate the crucial role that the monochord played in the solidification of pitch as an entity in space, a foundational concept in music theory.

Steve Ellison (Meyer Sound) and Zachary Seldess (UC San Diego), "A History and New Implementation of SpaceMap for MaxMSP"
Over the past 30 years, sound designers for live entertainment have developed new design approaches that utilize more and more loudspeakers in custom configurations, and with this a greater need for flexible, large-scale audio automation. An algorithm was developed to address this that had its roots in the realm of "electro-spatial art" and was made possible by technologies including the personal computer, Musical Instrument Digital Interface (MIDI), FM Synthesis, and the computer languages MacFORTH and Max. This algorithm, SpaceMap [tm], was initially created in 1986 to help distribute sound in a 16 channel sound system in a geodesic dome for computer music compositions, later developed for live sound reinforcement to control analog matrix mixers, and subsequently implemented on three generations of digital audio mixers.

Sound spatialization tools and techniques (e.g. VBAP, DBAP, Ambisonics) typically deal in real-space metaphors by providing methods for composers and sound designers to choreograph sound as a virtual extension of the listening space. By abstracting the speakers away from their 3D origins and providing an environment for flexibly re-situating them within one or more 2D spatial "maps", SpaceMap allows sound designers to construct their own unique physical rules and constraints for the way sound moves between speakers and in space.

The origins of SpaceMap and its evolution from a representational surround sound panning system to a technique that encourages a more abstracted view of a loudspeaker system are explored. Examples from over two decades of SpaceMaps will be shown. We will also present new, freely available implementations of SpaceMap for use within the MaxMSP (and eventually Pure Data) real-time visual programming environments. It is our hope that these new implementations will provide the wider community of artists and engineers working in real-time spatial audio with a valuable vehicle for exploring and using abstracted spatial mapping methods in their work.

3:30-5 Programming the Performer

Greg Niemeyer (UC Berkeley)

David Wells (Denver, CO), "The Musical Box: Origins and Development of Mechanical Music"
Informed by decades of experience restoring nineteenth-century musical boxes, this presentation will explore their origins and development from the beginnings of mechanical music to the present day. In particular, the themes of technical refinements towards the goal of expressiveness, the introduction of industrial forms of manufacture, and the legacy of pegged-cylinder devices in current systems like Yamaha's Disklavier will be addressed.

Lucie Vágnerová (Columbia University) "On Liveness and Labor in the Era of Hologram Singers"
Hatsune Miku is a humanoid hologram pop star voiced by Vocaloid software. She regularly signs in front of large audiences in Japan, complicating the concept of Live performance. I discuss how the ideology of Liveness perpetuates the cultural inequality of performers and audiences, and the dualities of gender, race, and class that govern musical culture. I show that Hatsune's position within the Manga/Anime genres enables the radical redefinition of the valued sites of labor in her concerts and focuses attention on audience intimacy rather than on the stage.
Hatsune sings the songs of independent songwriters who participate in online communities and so she participates in a utopian-futuristic creative ethos uncharacteristic of the modern music industry. Her fan communities consistently foreground the traditionally invisible labor of songwriting and make transparent the step-by-step vocal, visual, and animated assembly of the pop star on music-sharing websites and in online discussion forums. And yet, Hatsune's undergroundism rubs elbows with major corporate stakes: Yamaha/Vocaloid, Crypton Future Media, and

SEGA all profit from her brand.

Building on Philip Auslander's critique on Liveness and Nina Eidsheim's exposition of Vocaloid's interpretation of race, I argue that post-Live musical practices are technologies of Otherness. de Beauvoir's maxim "one is not born but rather becomes a woman" gathers new meanings in the post-Live era when women are literally programmed – complete with unlikely legs and floor-length teal ponytails. Hatsune does not have a body, she merely represents embodiment; she does not perform gender, she is only a representation of its signifying practices. The audiences of Hatsune thus enter intimate attunements that eschew subject-object relations. I propose that Hatsune's Manga aesthetics only encourage this redefinition of concert relationality because the genre commonly experiments with representations of subjectivity, biology, and genealogy. The familiarity of Manga in Japan then practically ushers post-Live musical agent into mainstream pop, while at the same time lending them a certain radical edge.

Ritwik Banerji (UC Berkeley) "Setting the Machine Free: Virtual Improvisers, Artificial Intelligence and Decolonization of the Human-Machine Relationship"

Beginning with George Lewis' Voyager, several projects in computer music have developed virtual improvising agents capable of listening and interacting with human improvisers. Technically, these projects can be considered artificial intelligence in their aim to computationally reproduce recognizably human behavior. Politically, however, they are acts of emancipation. For most of human history, the machine has been a slave to man. In these moments of software-based machine improvisation with a human partner, the slave is engaged as the equal of its former master, as two coexisting free beings. In this paper, I explore two unrelated processes, artificial intelligence and decolonization, by stripping both down to reveal the unity of their structures. Both actions perform the gradual relinquishment of power over an extremely productive object, machine and colony, such that they become the equal of their former master, human and metropole. I look at these two processes in tandem to facilitate an understanding of the conceptual and practical challenges of both. Crucial to the production of equity is the ability of the former master to engage in self-analysis and share these knowledges. More broadly, I explore the fear of artificial intelligence, cultivated strongly through science fiction, as a reproduction of older fears of slave and colonial revolt. What are we doing when we set a machine free in the course of musical performance? How does the development of virtual free improvising systems recall or refract the memory and continuance of decolonizing social processes? What does it mean to teach a former machine to play like a human being?

5:30-7:00 Roger Moseley (Cornell University), "Digital Analogies"

Mythological, etymological, historical, and media-archaeological evidence suggests that musical generation and representation can be understood to have shuttled between digital and analog before the terms became locked in a binary opposition. Focusing on the interface of the keyboard, I propose that musical technologies be conceptualized via the critical trope of the digital analogy, which situates "digital" and "analog" phenomena relationally rather than insisting on a sharp distinction between the discrete and the continuous. The *digital analogy* is a recursive maneuver insofar as it can account for the nesting of techno-musical configurations: it attends to 1) material formations, 2) their technological entanglement across human and inanimate realms, 3) the forces that have shaped the relation of 1) and 2) over time, and 4) the shifting epistemological strategies that have framed 1) - 3). By way of keyboard instruments ranging from the fourteenth-century *chekker* to the *Doom* Piano, I explore how the digital analogy might inform our genealogical understanding of musical technologies while simultaneously prompting us to apprehend those technologies in terms of the ludic and musical play that they afford.

move to Thursday, after Tiffany Ng's abstract and change time to 5:00-6:30

Saturday, April 26

9-10:30 Vocal Technologies (Elkus Room)

~~Chair: James Davies (UC Berkeley)~~

Owen Marshall (Cornell), "The Birth of Auto-Tune: A Genealogical Praxiography of Pitch Correction"
Auto-Tune was conceived, so the story goes, at a dinner party in the early 1990s when recently retired seismic oil exploration engineer Andy Hildebrand was challenged by a fellow partygoer to "invent a box that would allow her to sing in tune." This paper, in two parts, offers a more complex history of Auto-Tune (as well as related pitch correction techniques and technologies such as the Eventide Harmonizer and Celemony's Melodyne software), unpacking its origin stories and examining the dynamic interpretive processes of social, technical, and practical negotiation that underlie its current form and mode of use. Beginning with a genealogy of Auto-Tune as an autocorrelation-based pitch correction technology, I trace its conceptual and technical underpinnings from to cybernetics and information theory research of the 1940s, noting out its roots in military communications, sensory prosthesis, educational psychology, and broadcast time-compression technology. These conceptual threads, I argue, tie into the electrical engineering and signal processing work which Hildebrand studied at the University of Illinois in the 1970s, and allow us to understand the particular conceptions of control, communication, emotion, and the voice which are (to use Madeleine Akrich's term) "inscribed" into Auto-Tune itself. Having established Auto-Tune's technical inscription – the sorts of uses and users it imagines and pre-configures in advance of its actual practical application – I trace the ways in which it was re-interpreted by a variety of users – namely engineers, producers, songwriters, performers, and critical listeners. By connecting this interpretive frame with the story of AT's multiplication and variation as an artifact over time, I consider the ways in which AT reconfigures the political economy of the recording studio and troubles once-stable notions of skill, authorship, and the human-nonhuman boundary.

Peter McMurray (Harvard), "A Media Archaeology of Angels: Sound, Documentary and Islam"
What are the ethics of documenting religious sound? During my fieldwork on Turkish Islam, a sheikh granted me permission to film the zikr he led, saying that "angels were already documenting everything they were doing" so my own filming would simply be a partial and reduced version of that extant, heavenly documentation. He then continued on to compare the finished product of that angelic record to a film that would be screened in the hereafter—a cinematic judgment day in which the sins of those who had repented would be snipped out of the film. Another sheikh, the late Bawa Muhaiyaddeen, wrote that he is only a medium for channeling the voices of past prophets: "The sound [of their teachings] comes through as sound comes through a microphone. I am nothing." Islam has long been recognized as having a sonically rich liturgical practice, in which sounds of recitation, prayers, calls to prayer and other rites draw heavily on sound production. I trace here an archaeology of sound mediums in Islam from the Quran to contemporary amplification practices, considering how sound and sound technologies have been understood by various Muslim theologians over the centuries. I then draw on my own fieldwork experiences to explore how sound technologies are currently affecting Islam, both in the practice of religion and the production of theologies to account for these new forms of mediatization. This mediatization in turn creates environments that are saturated with mediation through official channels (e.g., mosques broadcasting their own sermons) and also unsanctioned personal actors who are shifting Islamic practice in significant ways through their own documentary interventions on smartphones.

Perry Cook (Princeton), "Choirs of the Future? Past, Present, and Future of Technology and Singing"
AutoTune™, Melodyne™ and other studio/live effects continue to make humans sound more robotic, while Vocoloids™ and other singing synthesizers make computers sound more human. Meanwhile, Laptop Orchestras (LOrks), turntablism, controllerism, mobile devices, and other machine-mediated performance technologies are reshaping notions of conventional music making. This talk will first briefly review the 100,000-year history of augmenting the human voice through technology. These technologies range from architecture and bio-engineering (castrati), to other

more obvious topics such as amplification, broadcast, and recording. There will be a brief overview of electronically augmented vocalists and vocal ensembles of the modern era (1970+). I will also report on a series of my own experiments, ensembles, and performances which connecting singers to various technologies (bio sensors, DSP, singing synthesizers, gesture trackers, etc.). The talk will conclude with a look forward to a number of potential scenarios for expanding our vocal world via technology.

11-12:30 "New" Instruments

Emily Dolan (University of Pennsylvania), "The Invention of Newly Invented Instruments"
At the 1851 Exhibition of Works of Industry of All Nations, juries were assembled to evaluate the objects assembled in the Crystal Palace. Musical instruments, Class Xa, were evaluated according to:

> Novelty of invention, or novelty in the whole or part of the instruments; ingenuity of construction; new applications of old principles; application of new principles, improved beauty of form; increased durability, and more extensive application.

The jury, which was chaired by Sir Henry Rowley Bishop and included Sigismund Thalberg and Hector Berlioz, awarded five council medals, fifty-one prize medals, and fifty-six honorable mentions. Almost all of these medals recognized improvements; only Adolf Sax, who received a Council medal, was recognized for the invention of wholly new instruments (the saxophone and saxhorn). Charles Wheatstone received a council medal for his "novel invention of a portable harmonium," though this instrument—the concertina—had been invented in 1829, and already improved and patented in 1844. Newly invented instruments—with brand new names to match—still proliferated in the Crystal Palace, but in the context of the official evaluation procedures they were overshadowed by improvements to well-established instruments. Berlioz, who also served on the jury for the Paris Exposition Universelle in 1855, expressed frustration over new instruments, declaring that most were "fatal" to music.

In this essay, I explore the status of "newly invented instruments," considering display, evaluation, and patenting practices in England in the mid-nineteenth century. In particular I examine the establishment of the canon of musical instruments as a collection of instruments that were understood to improve and evolve over time, in comparison to the many musical stillbirths of one-off inventions. I argue that the notion of the newly invented instrument—with its patina of quirkiness and historical irrelevance—emerged with these evaluation practices.

You Nakai (NYU), "David Tudor's *Neural Synthesis* and the Neural-Network Synthesizer"
In 1989, Forrest Warthman, an engineer/technical writer based in Palo Alto, attended a concert of Merce Cunningham Dance Company at UC Berkeley. Not knowing much about experimental music that was the Company's trademark, Warthman was nonetheless struck by a musician who sat amidst a myriad of electronic devices, manipulating them in an intricate manner. This was David Tudor, a long-time musician for the Cunningham Company, who was once hailed as the foremost pianist of new music (most notably as the performer of John Cage's works), but had left his instrument to become a composer of electronic music in the late 1960s. During the intermission Warthman approached Tudor and proposed to build a computer system that would integrate the proliferation of his electronic devices. Tudor was intrigued. Over the course of next three years, the initial plan of an integrating computer turned into something quite different: a synthesizer which operated on an analog neural-network chip (80170NX) recently developed by Mark Holler at Intel. Tudor subsequently used this 'neural-network synthesizer' to create his last major work "Neural Synthesis." This paper presents a detailed study of Warthman's instrument and Tudor's composition, based on interviews with Warthman and others related to the project, analysis of Tudor's notes stored at the Getty Research Institute, and examination of the actual synthesizer archived at Wesleyan University. It surveys the peculiarities of the neural-network synthesizer in relation to Tudor's well-known dislike for commercial synthesizers and von Neumann computers. Through an analysis of Tudor's distinct approach to the synthesizer, which incorporated a curious use of a thermal noise in the circuitry that Warthman had initially attempted to remove, the paper explores the nebulous line between the 'instrument' and the 'composition,' against the backdrop of an idiosyncratic goal that Tudor had set for his music since the early 1970s: "to discover an instrument as a natural object."

David Wessel (UC Berkeley/CNMAT), "Interaction Design for the Active Experience of Music"
Computer-based musical instruments offer the possibility of going beyond the performance of individual notes. Gestures can be applied to the shaping of entire phrases produced by generative algorithms. A variety of gestures and the auditory features they control are examined. Gestures that control dynamics are essential. They are typically applied to the overall level, but polyphonic control of perceived sound intensity – it is argued – has important advantages for musical expressivity. Expressive gestural transformations of intonation, rhythm, and timbre within full phrases are treated. This requires a characterization of the musical structure of generated phrases, and where in them transformations can be applied with advantage to expression. Examples from machine improvisation using variants of the factor oracle will be presented, with emphasis on procedures for navigating the oracle. Emphasis will be given to continuous or signal representations of gestures rather than discrete or triggering gestures. Demonstrations of gestures on surface-sensing systems will be provided.

2-3 Roundtable: History, Theory, Practice
Georgina Born (Oxford University), Deirdre Loughridge (UC Berkeley), Adrian Freed (UC Berkeley/CNMAT)

This roundtable addresses the intersection of history, theory and practice in the study of music and technology – the potential for developing truly interdisciplinary approaches to and exchanges between doing and discourse, making questions and making things. Each panelist will give a brief opening statement based on their own work and experience, to be followed by wide-ranging discussion with the audience.

3:30-5 Future Effects
Heather Hadlock (Stanford), "Liveness and Community in Robert Lepage's *La Damnation de Faust* (2008) and the Metropolitan Opera: Live in HD Simulcasts"
The term *live*, already familiar to opera audiences from decades of "Live from the Met" on radio and TV, has acquired a new significance in the Metropolitan Opera: Live in HD simulcast series' construction and marketing of a cinematic opera experience that unfolds in time with a live performance. As James Steichen (2009, 2013), Christopher Morris (2010), Melina Esse (2010) and Brianna Wells (2012) have recently argued, simulcasts to movie theaters are replacing an ideal of fidelity as "as good as live" with new notions of a hypermediated experience as "better than live." This paper will situate simulcasts to cinemas (and to theatricalized spaces such as ballparks and plazas) within a taxonomy of opera for film, television, and video, in order to explain how the new technology both facilitates new types of operatic experience and employs long-standing visual and formal conventions to render that experience recognizably and pleasurably "live".

 Building on Philip Auslander's analysis of liveness (1999, rev. 2008) and digital liveness (2012) and the stricter ontologies of performance asserted by Peggy Phelan (1993) and Carolyn Abbate (2004), I will examine aspects of "liveness" in opera simulcasts, including a drastic dimension of vulnerability and risk, an irreversible temporal flow, an ephemeral and unrepeatable experience, a social and ritual dimension, and a spectator's awareness of her/his power to influence or disrupt the performance. I will analyze the Live in HD simulcast of Robert Lepage's production of Berlioz's *La damnation de Faust* (November 22, 2008) as a case study in the new medium's claims to and liveness. The production, originally staged with then-advanced video elements in 1999, was revised to incorporate new "live" real-time responsive video technologies. These, in conjunction with the simulcast rituals of geographically dispersed consumption/participation in the real-time live event, illuminated *La damnation*'s themes of alienation, disaffection, mechanical repetition, mindlessness, and the limits of individuality and community. The production employed "hypermediative" technologies both on the stage and in the performance's distribution to globally dispersed audiences via simulcast, in ways that foregrounded existential questions about the meaning of "liveness" for human actors and spectators as well as for operatic performances.

Darien Lamen (UW Madison), "Futurity and Sound System Technology in the Brazilian Amazon"

For over fifty years, mobile sound collectives in the Amazonian metropolis of Belém, Brazil, have brought marginalized communities together and made a living in the informal economy by transforming sound systems into live instruments. Since the 1970s, Belém's sound-system subculture has been especially notorious for its constant pursuit of technological novelty (Vianna 2012), whether in the form of taller and more powerful speaker towers, or ever more elaborate light and pyrotechnic displays. Populist defenders of this highly stigmatized subculture have argued that sound systems, far from representing a cut-and-dry case of alienation or capitulation to hegemonic modernist logic, are collective rituals in which the performance of sonic and visual excess stages a temporary vanquishing of scarcity (Dias da Costa 2008) and an audible incursion by the marginalized other into an urban space that would seek to silence them. On the other hand, national propagandists for digital democracy and creative economy have celebrated Belém's sound systems as models for both a more inclusive nation-state and a more productive economy yet to come. In this paper, I will examine the way sound system entrepreneurs and national technocrats attach ideas of "futurity"—i.e., what Steve Goodman defines as "the immanence of the future in the present, marked by anticipation or dread as a future feedback effect" (2010, 196)—to new forms of technology in an attempt to "pre-program the present." On the Amazonian frontier, as elsewhere along the global peripheries, it is imperative that this association of new media technology with the exercise of a "speculative" or "preemptive power" be understood in light of capitalist expansion and an ongoing postcolonial struggle for social, political, and economic alternatives (Brennan 2005).

Martin Scherzinger, Jessica Feldman, Stephan-Eloïse Gras (NYU), "The MIDI Effect"

This project examines the ramifications of MIDI on contemporary music production in a global frame. We trace the roots of MIDI as an extension of the keyboard interface and outwards, from a handful of companies serving a small group of electronic musicians to a broad, international network of commercial and amateur users. Although MIDI now seems less ubiquitous in experimental and academic music, it still holds sway over many aspects of commercial music production (popular music, music for video games, advertising jingles, ringtones, ambient music) and amateur music applications on mobile devices. Moreover, the widespread dissemination of MIDI-enabled electronic keyboards increasingly characterizes non-Western cultures, which previously had centered their musics on different bodily interfaces and sonic vocabularies altogether. Today the MIDI template has become immortalized as the archetypal digital representation scheme for musical form in our times: from Sufi *mugham* music in Azerbaijan to Shona *mbira* music in Zimbabwe, the pitch sequences of the world's music are gradually coalescing around the MIDI standard.

We have interviewed the inventors of MIDI, the head of the MIDI Manufacturers' Association, computer music professors, commercial and non-commercial producers and composers about the design and utility of MIDI. We couple this with a semiotic analysis of the pitch and time vocabularies present in the main software and hardware using MIDI today (ProTools, Logic, Ableton Live, DP, Sibelius, iPads, smartphones, etc.) How does the interface code action? What actions count as part of this language? Finally, we consider alternate approaches: OSC, gestural interfaces, sampling, and non-Western instruments. We consider MIDI as a user-interface that formalizes interactions and patterns and structures human activities. Such a grammar captures the user in a conduct and a discipline that is never purely "technical" but always "sociotechnical" in nature: it is a normative force that relates to a larger sociopolitical structure.

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Concert: Music Now
Friday, April 25, 7:30 pm
Center for New Music and Audio Technologies (CNMAT)
1750 Arch Street

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John Granzow and Christopher Jette (CCRMA), "LasuDax"

A machine is operated, a musical instrument performed. The distinction encodes our expectations for replication or interpretation. But the boundary quickly unbinds when we consider technologies in music history, such as the piano. It indeed affords innumerable degrees of freedom in the velocities of the pressed key, the contributions of pedals, lids and under-the-hood preparations. And these are the interpolations of the hand and the perceived domain of performance. Yet downstream from this expressive hand the mechanism of the hammers execute an invariant arc, striking the strings in that way. To the degree that this attack is replicated across performances, it is embedded as a component of the recorded gesture within the instrument. The piano is in this way also operated, and operable by anyone who can hammer the playback of that mechanical gesture.

Similar nuances accrue to machines. Early operators of the gramophone were so active in the supervision of the machine that such acts were perceived not only as the facilitation of playback, but also a kind of performance: balancing and leveling the table, cranking the motor, aiming and dexterously placing the needle, deftly removing it at the recordings end.

LasuDax is a project that instigates such intersections of playback and performance. The media is at once explicitly performed as well as fixed on a laptop. Bowing of the defiant daxophone provides broadband noise for downstream filters that follow the polyphonic scores of Orlande de Lassus. The result is to instill the mechanics of the body into the rarified reproduction of digital recordings, bringing the file out of the cloud, and into the stick and slip of horse hair across a wooden tongue. The voices are channelled to 3d printed vocal tract models, manufactured through fusion deposition modeling, and performed as vocal prosthetics.

Edmund Campion (UC Berkeley/CNMAT), CORAIL for tenor saxophone and live electronics, with Steve Adams of the ROVA Saxophone Quartet

CORAIL (CORAL) attempts a sonic analog to the contention that only when human culture moves within an ecological niche can it relate appropriately with all the fields of forces of nature, something of which it is inextricably a part. Just as we can move freely within our own environment, the saxophonist moves within his sound world—one from which he is constantly drawing his inspiration and upon which he interacts. From the sonic well of the live saxophone, the computer extracts fine details of pitch, dynamics, durations and silences using the composer's special grammar and syntax to transform the data into an oceanic flow. The player must learn to play through playing. The musician is constrained and guided by the ocean, adapting to the conditions of the environment. Each musician is charged with finding his/her own voice within the work. Improvisation is an important element of the piece, but the sonic identity of "Corail" will always be present because the compositional constraints are designed into the programming. The piece was premiered at the AGORA festival in Paris in 2001 and is dedicated to John Campion. The program note is adapted from a text by John Campion.

Amanda Chaudhary, CatSynth

Amanda Chaudhary is a composer and performer specializing in contemporary and electronic music; an artist; and a developer of advanced software for creativity. She performs regularly around the Bay Area and beyond, both solo and with various bands and ensembles. Her solo work involves experimenting with innovative sounds via analog synthesis and custom software with computers and mobile devices for new modes of expressive musical performance. She often incorporates folk and toy instruments from around the world, along with jazz, dance music and other idiomatic styles into her visually captivating performances.

Perry Cook, "Elaine and D'joan" for voice and electronics (world premiere)

Perry R. Cook is a computer music researcher and professor emeritus of computer science and music at Princeton University, where he founded the Princeton Sound Lab. Professor Cook works on algorithms for real-time computer synthesis of sound from physical models, audio at the human-computer interface, and controllers for expressive real-time artistic performance. This evening's performance is a world premiere.

MAP OF LOCATIONS

There are numerous additional restaurants and cafes within easy walking distance of the conference venues on Telegraph Ave. South of campus (two blocks West of College Ave.), and Euclid Ave. North of campus (same street as The Pho Bar).
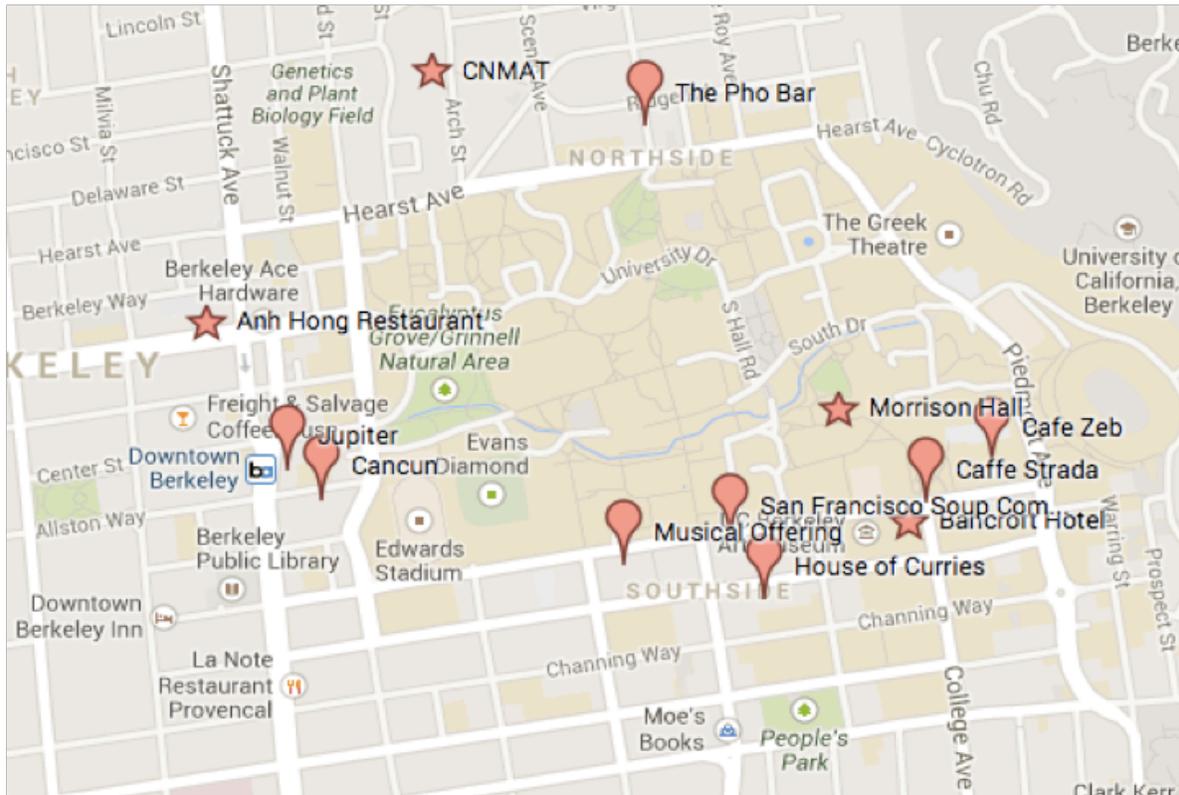
Important Locations

Bancroft Hotel
2680 Bancroft Way

Morrison Hall (Music Department)

CNMAT (Center for New Music and Audio Technologies)
1750 Arch Street

Anh Hong Restaurant
2067 University Ave

Recommended Restaurants

Caffe Strada
2300 College Ave
Perfect for a morning coffee
(cash only)

Cafe Zeb (in the Law School)
Boalt Hall
Sandwiches and salads

Cancun
2134 Allston Way
Farm to table Mexican food with amazing salsa bar

House of Curries
2520 Durant Ave. (between Bowditch & Telegraph Ave.)
Indian and Pakistani food

Jupiter
2181 Shattuck Ave.
Brick oven pizza and a focus on West Coast beers

Musical Offering
2430 Bancroft Way
Cafe (sandwiches and salads) plus CD shop specializing in classical music

San Francisco Soup Company
2512 Bancroft Way
Soups and salads – limited seating, so plan to take your food back to campus and find a spot outside

The Pho Bar (near CNMAT)
1828 Euclid Ave