2 Electronic music and the studio

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In 1996 Yuko Nexus6, a composer and lecturer based in Nagoya, Japan, coined the term *kotatsutop music* to describe the current state of electronic music in Japan. One can find kotatsu, low tables, covered by blankets with a heater underneath, in almost every Japanese household. Nexus6 implied that the tools for making electronic music were just as ubiquitous as this piece of common household furniture: 'Those days when synthesisers and computers were the prized possessions of a limited number of universities and other institutions are over, and instead, these items can be found cluttering the tops of kotatsu in small boarding houses in these same areas' (Nexus6 1998). It should come as no surprise that the face of electronic music has changed dramatically since the 1940s, but the field has changed spectacularly even within the past ten years. My laptop is more powerful today than the fastest computers I had access to ten years ago, and I can store more data on a portable drive no bigger than my finger than I ever could on the hard drives in the studios where I worked fifteen years ago. Technology is no longer a limiting factor for most musicians, but what does this mean for the field as a whole? What are the implications of being able to create electronic music at a local café? Given the portability of recording and production technology, how will electronic music reflect local and even transient cultures? Does the ease of production imply a healthy democratisation of the aesthetic of electronic music or perhaps its corruption? How does the liquidation of the studio change the process of composition and production? How does kotatsutop music differ aesthetically, sociologically and conceptually from the music created at major electronic music centres?

To answer these questions I interviewed electroacoustic musicians of many different ages, nationalities and experiences. Some names, such as Max Mathews and Pauline Oliveros will be familiar to readers who have even a passing acquaintance with the field of electronic music; others, such as Takuro Mizuta Lippit (aka DJ Sniff) and Mara Helmuth will be familiar to only a few. It may be tempting to give more credence to the words of the 'elder statespeople', but I ask the reader to try to think about *what* people have said about the past, present and future of electronic music, rather than focusing on *who* has said it. This chapter is an attempt to provide an inclusive overview of electronic music studios from around the world.

History

> I came to the studio to make noises speak, I stumbled onto music.
>
> Pierre Schaeffer (1998)

Pierre Schaeffer is generally acknowledged as the first composer to create music with pre-recorded media: his sound collage *Etude aux Chemins de Fer* (1948) has a prominent place in most histories of electronic and computer music. These same histories tend to concentrate on the studios of Europe and North America, and indeed most electronic music studios are concentrated in these two continents. Yet this is most likely due to reporting bias, for the most dominant nations tend to control history. While researching this chapter I was determined to overcome this prejudice, and interview people from all areas of the world. I was pleased to discover that important work has been happening in every corner of the globe for many decades. I know composers from many different countries, but I wasn't so aware of the rich international history of electronic music outside Europe and America. During the year in which I was writing this chapter, more attention has been brought to the diverse history of electronic music. Bob Gluck published interviews with several electroacoustic composers from outside North America and Europe for the Electronic Music Foundation Institute's website, and at the 2006 International Computer Music Conference, Larry Polansky (USA) chaired a panel with Erdem Helvacioglu (Turkey), Rodrigo Sigal (Mexico), and Shlomo Dubnov (Israel). They discussed electronic and computer music beyond Europe and North America, exploring 'the breadth and depth of creative expression in the field throughout the regions where its history has not been fully documented' (Polansky 2006, p. 154).

Composers of electronic music in many parts of the world have operated in relative obscurity for years. Often, performance opportunities in countries outside Europe and North America have been limited and resources tight. Wider international knowledge of their work has at times been limited to those with whom they studied, such as in Utrecht and New York City.[1] At times, composers, such as Egyptian-born Halim El-Dabh, discovered new technologies on their own. His experiments, in 1944, electronically processing recordings made with a wire recorder, a medium that predated tape, may be counted among the first works for pre-recorded media:

> [I] emphasised the harmonics of the sound by removing the fundamental tones and changing the reverberation and echo by recording in a space with movable walls . . . some of this using voltage controlled devices. It was not easy to do . . . [I] didn't think of it as electronic music, but just as an experience . . . [I] called the piece *Ta'abir al-Zaar*.[2]

A portion of this piece has been released as *Wire Recorder Piece*, and is now available on CD (ElDabh 2001). El Dabh experimented with sound artistically in his own time with equipment he borrowed from the Middle East Radio while Schaeffer worked in a environment focused on research which was funded by the Radiodiffusion-Télévision Française (RTF). In the second half of the twentieth century much of the electronic music research and composition was done in highly specialised research studios similar to the RTF; in the twenty-first century most composers have high quality artistic studios at their homes with no corporate interest dictating research directions.

Technology and aesthetics

> Technology precedes artistic invention . . . first came the electric guitar and then came rock and roll. John Adams (1997)

The history of electronic music is tied inexorably to advances in technology. The character of electronic music changes much more quickly than traditional Western classical music because the rapid pace of technological advances influences the aesthetics of any given decade. We have gone through an incredible number of phases, riding on the technology which has become much more powerful with each passing year.[3] Beyond these generational differences, each traditionally professional studio had its own signature sound which came not only from the equipment itself – GRM had handmade phonogenes, Columbia had the RCA synthesiser – but also from 'the operational characteristics of a particular studio [which] exert a considerable influence on the range and type of compositional operations which may be satisfactorily executed. A proliferation of studios equipped with identical synths dictates a single design philosophy to all potential users' (Manning 1985, p. 152).

Aesthetic differences in compositional techniques also dictate a philosophy to studio users. The classic example of this division is of course the ideological schism in the 1950s between GRM's Parisian musique concrète and WDR's elektronische musik from Cologne (Harrison 1989). Composers produced musique concrète by recording and manipulating sampled sound, while elektronische musik practitioners favored the total control of synthesis using sine waves.

In addition to creating a wholly new aesthetic, technology can also augment or influence a practice which is already in place; Kwaito, most often defined as South African hip-hop, uses sequencers, drum machines and samplers to create a distinct style of music which is still based on a symmetrical timeline pattern – additive structures with a base of fast elementary

pulse units. Kwaito producers use a computer to create complex rhythmic structures which reference the past. Even though they are not creating a new aesthetic, Kwaito musicians are still influenced by their new tools: most local productions, even in traditional styles, now use drum machines for reasons of expedience but also to give the music a 'contemporary edge'. Alas, they are often programmed in very blunt ways, both rhythmically and sonically, whereas most rhythms played by African musicians contain a great amount of subtlety and irregularity, arising from idiosyncrasies in phrasing that might vary from place to place, or due to personal style, historical precedence, or even deliberate imprecision in its execution (Ligeti 2007).

If the tools musicians use influence the music they make, what happens when an attempt at standardisation occurs? With Stockhausen's help, Japan's first studio, Nippon Houso Kyokai (NHK), was modelled on his space in Cologne (Shimazu 1994, p. 102). It should come as no surprise that the music coming out of Japan was much more similar to German music, than the geographically closer Korean electronic music. Korea historically never had a major studio, but Sung Ho Hwang believes that this limitation helped Koreans develop as idiomatic composers.[4] While Stockhausen was a proponent of studio standardisation (Stockhausen 2004, p. 377), there is even less homogeny in studio design today than in 1958. In the United States, there was a similar desire to create a standard studio: SUNY Stony Brook and the Jerusalem Academy of Music in Israel built studios modelled on Columbia–Princeton Electronic Music Center.[5] Both schools have since upgraded to different systems.

Today almost every studio has a unique combination of equipment, which should lead to different sounds, but to my ear it seems there is more similarity in the music from different studios today than there was in the past. Perhaps this is a consequence of the information age – ideas are transmitted instantaneously across the Internet, and software is much easier to duplicate than hardware. Thus composers from different parts of the world have many of the same tools at their disposal. Another result of the propagation of home studios is that fewer composers are travelling to use professional studios. Barry Truax misses the days when composers would come to Simon Fraser University to use his facilities; he hopes the custom-built AudioBox, a computer-controlled system for diffusion, will be an incentive for composers to visit again.[6] The AudioBox is a 16×16 matrix mixer produced by Richmond Sound Design, used in combination with ABControl software by Chris Rolfe. Pieces mastered at Simon Fraser using the AudioBox have a unique sound, although it is not timbral; rather the distinction comes from the swiftly moving surround sound experience.

Unlike Berio's now defunct RAI studios (Manning 1985, p. 81) and the analogue synth room at the Institute of Sonology,[7] which were filled with

custom-made audio equipment, most studios in the later half of the twentieth century contained a mixture of commercial machines joined together by a giant patch bay and mixer. The trend is now swinging away from commercial hardware and software and back towards custom-built as people seek to give their sound a unique quality; the challenge now is to create things other people can't.[8] Instead of simply being filled 'with equipment that was built for other purposes' (Stockhausen 2004, p. 377), studios are once again 'seen as both a school of musical thought and a laboratory' (LaBelle 2006, p. 26). It remains to be seen if studios will be able to retain a cohesive aesthetic within this renewed pioneering spirit of do-it-yourself electronics.

Accessibility: cost, size and speed

> The dynamaphone [Telharmonium] weighed two hundred tons, was over sixty feet in length and cost two hundred thousand dollars.
>
> Peter Manning (1985)

The barriers to electronic music have dropped significantly in the past twenty years; cost, size and speed are the three main factors in this revolution. In contrast to the 1897 dynamaphone, Pauline Oliveros's favourite new piece of equipment is a portable audio recorder[9] which weighs 0.0001 tons (including a memory card and batteries), is 9.1 centimetres long and costs four hundred dollars (Nakamura 2006). It is obvious from these numbers that the exponential growth of microprocessors has changed the landscape of electronic music radically (Manning 1985, p. 155). The total number of people working in the field is staggering when compared to the 1960s, when maybe a few hundred people were involved; there are now millions alone with access to the music editing software that comes pre-installed on Apple computers.

> While producing highly virtuosic music, early electronic music composers were nevertheless constrained to construct their pieces via painstaking tape-manipulation techniques; cutting and splicing tiny sections of recorded electronic material. Expensive and enormous electronic equipment was confined to well-funded research centers and radio stations . . . fast forward to the early 1990s. A technologically adept generation raised on home computer and video games begins to explore the equipment at its disposal . . . in their own bedrooms and basements they begin to recapitulate the experiments and discoveries of early electronic music.
>
> (Cox and Warner 2004, p. 366)

It wasn't just difficult to gain access to electronic music equipment in the early decades of electronic music, it also took a tremendous amount

of time. Musicians using analogue equipment had to spend untold hours physically grappling with tape and razor blades. Those using the earliest digital tools suffered from delays ranging from overnight to several days between creating a program and hearing the resultant music. A trip across the city was sometimes necessary to complete a work because the digital to analogue converters were only found in a few locations, while computers were more plentiful (Manning 1985, p. 240). Now laptops are so fast that there is virtually no delay between composing and hearing the result, so powerful that most musicians do not use their full capacity, and priced so low that it is not uncommon for musicians, even in developing countries, to own several machines.[10]

The tipping point in the accessibility of digital music technology came in 1983 with the release of the Yamaha DX-7, a programmable digital music synthesiser. Takayuki Rai believes: 'It was a revolution in the digital music world . . . starting up computer music studios and keeping them became much cheaper and we didn't need to rely on the huge subsidy from the government any more.'[11] The minimum cost of the previous generation of machines capable of music synthesis, the general purpose PDP-11 computing system, was a hundred thousand dollars; only schools and research institutions could afford them. Yamaha priced the DX-7 at an attractive 'two thousand dollars – a fifty-fold difference – and the number of people and institutions doing digital work increased almost overnight'.[12] The DX-7 wasn't just an inexpensive synthesiser; its programmability made the possibilities of music creation quite interesting.[13] Yamaha most likely sold 160,000 of these synthesisers between 1983 and 1988 (Kolb 2002), permanently changing the world of electronic music and democratising access to sound synthesis equipment.

Sound technologies are more than just tools for the creation of music; they are social artefacts. The human ear on Alexander Graham Bell's phonautograph 'marked the collision of acoustics, physiology, otology, the pedagogy of the deaf, the state's relation to the poor, and Western Union's research agenda' (Stern 2003, p. 338). For years, electronic musicians have been influenced by the competing agendas of audio research, commercial profit, government programs and artistic expression. For poorer countries, such as Mexico, where there has never been a governmental investment in electronic music, falling equipment prices have meant that the government can now help to fund studios. The new Center for Music and Sonic Art in Morelia, Mexico is funded half by the federal government and half by the local government,[14] hopefully creating a lasting socio-political musical entity.

It is very easy to explain the explosive growth in computer music by tracing the falling costs of tools, but the culture of 'how-to-do-it' has gradually

spread as electronic musicians have learned to share information and software more efficiently.[15] For example, the Center for New Music and Audio Technologies at the University of California at Berkeley recommends that all students purchase a laptop and also provides them with site licences for software.[16] Today, even in Mexico, all students have their own laptops, even though most of them have to run open source software, or cracked copies of commercial software.[17] At Rensselaer Polytechnic Institute all students are required to have their own laptop, 'liberating them from the tyranny of having to sign up to use a studio'.[18]

Electronic musicians now have unfettered access to most of their tools, and they can access information on the World Wide Web, from their home, the studio and even their local café. Before he started working at STEIM, Takuro Mizuta Lippit had never even spent time in a professional studio; he learned everything from the internet, and he freely admits that about eighty per cent of the code he uses is written by someone else.[19] This kind of self-education would have been unheard of even ten years ago. The internet is more than a repository for code; it has allowed for many other possibilities including the download of audio, the study of history, and the creation virtual communities.[20] Over the past decade the internet has helped spawn a new movement in digital music. It is not academically based, and for the most part the composers involved are self-taught (Cascone 2004, p. 392).

Does this accessibility have its own cost? In the early days of electronic music, composers had to have a true commitment to their craft; they had to plan out what they wanted to do with the limited time available to them, and program their machines carefully so time wouldn't be wasted tracking down bugs. Today's environment is much more immediate: when I program in Max/MSP I can listen to the results instantaneously and adjust parameters or debug on the fly. Do the astonishing capabilities of today's realtime performance systems result in our losing a certain gravitas with effortless editing? R. Luke Dubois thinks the ease of creation has an impact on the quality of his work; therefore, he deliberately creates projects which have to 'render', forcing him to think through his process completely before programming.[21] Although many of the people I interviewed expressed some nostalgia for the old way of 'having to think before you create', no one thought the rewards of deliberation outweighed the advances in computer technology.

The democratisation of tools extends to all areas of music production; the composer can be his/her own 'copyist, proofreader, conductor and orchestra . . . this is the most staggering breakthrough in the art of music since the invention of counterpoint' (Russcol 1972, p. xvii). The invention may be staggering, but the world of experts has been replaced by the world of technology, creating a desultory effect on much music.[22] Rather than

taking pieces to an expert to be mastered, musicians do it themselves because they have access to the technology. Most of the musicians I interviewed believe that this ease of construction has led to a decided increase in the percentage of poor pieces with electronics, but because the number of people writing for electronics has increased, the actual number of good pieces has increased. Paul Berg put it best: 'In the past when you only had one hundred people working in the field, maybe five pieces a year were interesting. Now you have ten thousand people working in the field, and out of those works between fifty and one hundred pieces are interesting.'[23] Despite having to listen to more bad music, no one misses the days of fighting for studio time, long waits and unreliable equipment. Pauline Oliveros was the only person interviewed to miss equipment – specifically the warmth and ruggedness of tube amplifiers – but she also regrets that there are now more conformity enforcers than innovators.[24] Paul Berg concurs: 'Before there was a sense of excitement and discovery, now everyone has pre-conceived ideas about electronic music. I enjoyed the field before there were definitions.'[25] As composers in modern computer culture we are working with technology which is approximately fifty years old, is still in its infancy and primitive in its own right,[26] yet some are already trumpeting its demise:

> Back in the 'old days', the electronic technology used in music was quite primitive, yet the range of music that was attempted was staggering, and a freewheeling spirit of adventure was prevalent. Today, we have computers with technical capabilities inconceivable at the time of Varèse and the early works of Cage and Stockhausen. Yet as the technical capabilities have expanded, the range of musical possibilities which are being explored has become increasingly restricted. (Ostertag 2001)

I believe 'academic electronic music' is on the verge of a second upheaval. A revolution is brewing, a revolution based not on technical innovations but on aesthetic growth. As people from all different cultures, experiences and aesthetics gain access to music technology, the field will be compelled to accept the influences of music outside the Western canon. Academic electronic music initially grew out of the European avant-garde, serialism and algorithmic composition. Today electronic music is ubiquitous and the internet-educated music technologists are making inroads into the academy; J. Anthony Allen notes that 'many composers at conferences . . . present a tape piece that is extremely abstract and avoids even a hint of a beat. During a post-concert discussion over a few drinks, they offer a copy of their techno album, referring to it as their "real music"' (Allen 2005, p. 9). As these young composers begin to assume positions of power within established studios, they will instigate a change in the restrictive definition of academic electronic music.

Studios

> We have also sound-houses, where we practise and demonstrate all sounds, and their generation. Francis Bacon (1626)

As early as the 1600s there was a desire to create a space dedicated to sound in all its forms. In 1937, John Cage called for 'centers of experimental music [to] be established . . . where the new materials, oscillators, turntables, generators, means for amplifying small sounds, film phonographs etc. will be available for use' (Cage 2004, pp. 26–7). Many electronic musicians saw the need for specialised studio spaces, yet few dared to dream that those spaces could one day be found inside every home. Max Mathews was one of the few visionaries to foresee the day when each home has its own computer, enabling music as a means of self-expression to be accessible to all (Mathews 1969, p. 16). 'The latest generation of computers and software has now made it easy for the musician to record, create, produce and edit music alone in his or her own studio' (Assche, Ranciere and Diederichson 2004, p. 8). With the advent of home studios, what is the purpose of the public studio today?

The advantages of having a home studio are numerous: primarily, it liberates the composer, promoting flexibility and freedom of self-expression. In South Africa, especially, the affordability of computers and open source software has had a strong impact in less advantaged communities, allowing home studios to flourish.[27] The difference between working at a public studio and a private home is huge: 'instead of eking out every last bit of energy to stay alive in the studio late at night, bringing in snacks and coffee and taking naps on several chairs lined up, [musicians] can now do most of their work at home, with tea, food and rests anytime needed.'[28] Most home studios resemble the earliest recording studios as musicians use any available space with 'crude soundproofing and physical separation [to] optimise the room to the needs of the tympanic machine and ensure the unity and distinctness of the sound event being produced' (Stern 2003, p. 236).

As home studios become ever more complex, the role of the public studio must change. The institutions must switch from being providers of computers to being providers of ideas and intelligent criticism about electroacoustic music.[29] A notable exception is the Institute of Sonology where the mission statement has remained the same. Their intent was never to provide equipment, rather they have always created an environment to explore programmed music, make noise at the sound level, and use waveforms and concepts as control structures.[30] Most other studios have had to reinvent themselves, as they try to reverse the exodus of musicians who own their own tools. Today's studio managers see their spaces as a kind of ultimate plug-in. Professional studios have been redesigned for multi-channel work,[31] and offer rigorously tested environments with engineered acoustics as

extensions to the home studio.[32] The SARC studios in Belfast, Ireland have a Sonic Laboratory which provides a unique space for cutting-edge initiatives in the creation and delivery of music and audio within a purpose-built, variable acoustic space. Most home studios will never have room for extreme sound diffusion, anechoic experiments, or a large recording stage. The public studio remains viable largely by virtue of its size.

Stanford University actively encourages its users to merge the home and public studio by creating the same work environment at the home and at school. Fernando Lopez-Lezcano created a software suite called Planet CCRMA which is installed on every Stanford studio machine, and ideally on the home computer of every user of the studio as well. Users become familiar with the software on their own time, and can use the programs to their fullest extent at the university.[33] Interestingly, in Korea electronic music practitioners have not had to address the dichotomy between home and professional studio, because they 'did not have any important computer music studio at the Universities or Laboratories which focused on musical composition and technical research, since none of the associations recognised the necessity to support computer music'.[34] Electronic music in Korea has always been created in home studios; institutions are only slowly beginning to support the field. The Korean University of Arts and Hanyang University now have studios and degrees in computer music. Seong-Ah Shin finds it is difficult to encourage her students to use the school's studio because they are more comfortable at home.[35]

The auditory field produced through technicised listening becomes a kind of personal space (Stern 2003, p. 158). People have always had a strong connection to the studios in which they work; spending hundreds of hours a year in a space creating works of artistic expression cements a relationship which goes far beyond the technological resources available; over ten years later, I can still draw a detailed diagram of the studio at my undergraduate school. Although I have always had a strong connection to my studio space, I never felt entirely comfortable composing in a room where my time was limited, where I couldn't leave a mess of papers and sketches laid out on the floor, or even leave the EQ settings on the mixing board set for a particular piece. As soon as it was feasible I started my own home studio. Before entering a doctoral programme in composition I was able to use the dining room in my apartment as my main studio because I had amassed enough personal equipment. Having a space of my own definitely enabled me to do better work. Mara Helmuth also has a home studio that gives her 'a peaceful and natural-feeling workspace without distractions, allowing the spiritual element of composition to come forth'.[36]

Most people interviewed for this article consider their home studio to be their main studio; the large public studios serve to augment these private

spaces. In America we can see this as returning to our roots. Unlike the early European studios which were funded by radio stations and audio companies, both the Columbia–Princeton Electronic Music Center and the Mills Tape Music Center started in living rooms as groups of people with an interest in working with electronics pooled their resources. Institutional funding came only after the proven popularity and success of these ventures.

Community

> All music, any organisation of sounds is then a tool for the creation or consolidation of community. Jacques Attali (2004)

The studio is much more than a collection of equipment; the members of a studio form a special personal bond. The studio offers a place for people to share ideas, to collaborate on projects, and criticise one another's work. I believe Max Mathews was being reductionist when he said 'the role of an electronic music center is to tell people that electronic music exists',[37] but it seems that today, more than ever, the main attraction of a studio is the community which surrounds it. After a trip to the University of Virginia, Brad Garton, director of the Columbia Computer Music Center (CMC) wrote:

> Essentially, we've all had to redefine the purpose of our studios over the past decade, moving from a situation where the purpose was obvious (i.e. only few people had computers at home that could do computer music easily) to one where that obvious purpose has totally disappeared. So then you look beyond that and ask 'what *can* a studio provide that people don't have at home?' In our case (and University of Virginia), we've set up a lot of hardware-hacking workbenches; a lot of the Computer Music Center users are becoming involved in building installations, circuit-bending, performance interfaces, etc. I know others who are providing good spaces for critical listening, performance rehearsals, collaborative meeting-places, etc. But all this also points to a deeper rationale for studios – there was a period before we created the hardware-hacking spaces where the scene at the CMC was at a low ebb. Now the energy and 'vibe' of the place is at a high again, and it made me aware and appreciative (again) of the social role that a studio can play. I think this is almost more important than the specific services being provided – a context can truly make the work happen.[38]

Everyone interviewed for this article eventually mentioned community as a necessary aspect to a studio. John Chowning said at one point he realised that not being in proximity to engineers was a real handicap. Paul Berg misses the time when everyone at the Institute of Sonology would stop working for a 10:30 communal coffee break. Today, studios' communities are

strong, but they tend to be centred around the internet rather than personal contact. Chowning misses the immediacy of the early years at Stanford before they installed an audio switch; if one person was testing out a sound for a piece everyone in the building would hear it. During this time Xavier Rodet made a quick advancement in his vocal synthesis program Chant after he heard some of Chowning's sounds and incorporated the idea of random periodic vibrato into his own program. This never could have happened if an audio switch had routed the sound just to Chowning's workstation. Of course awful/loud/hurtful sounds came through the speakers as well, but this communal listening created a close-knit social structure. Today, Pauline Oliveros uses sound to create a community in a similar way, albeit virtually; her students are required to post all of their work to a public site, and they are actively encouraged to manipulate the sounds made by others.

In my experience, the internet communities which spring up around an electronic music centre are usually more robust than those formed by user groups. Even though the digital computer brings strangers closer together (Johnson 1999, p. 39), it seems that in-person connections, however brief or tenuous, define a group. This observation may not hold true in other fields, because those participating in the process of making music, whether individually or together are involved in the fundamentally social process of human being itself (Filmer 2004, p. 97). Music, technology and community have successfully collided in Jamaica where over the past forty years reggae sound systems (three speaker stacks in a triangular configuration pointing inward) 'have become institutions on par with the local churches and football teams . . . the current Dance-Hall Reggae is so named because it could only be heard on the sound systems in open-air dance halls' (Henriques 2004, p. 445). Music technology leads to an aesthetic which leads to a community: the 'need for advice, microphones, speakers, quiet spaces and audiences continues to draw us together'.[39]

Personal performance

> To each his own bubble, that is the law today. Jean Baudrillard (1988)

As home computers become more powerful, it is not just audio professionals who have their own home studios: almost every family has a machine capable of editing audio at home. The interest in music in the home began long before the age of the computers, with home audio systems. Some composers created works to explore the performance possibilities of living room hi-fi sets. The recorded version of *HPSCHD* by John Cage and Lejaren Hiller contained instructions for the listener to control the settings of a stereo during playback (Manning 1985, p. 242), incorporating the listener into the

performance of the piece. In 1966 Glenn Gould saw the home becoming an idealised listening space.

> The listener is able to indulge performances through electronic modifications with which he endows the listening experience, imposes his own personality upon the work and his relation to it, from an artistic to an environmental experience. Dial twiddling in its limited way is an interpretive act. Forty years ago the listener had the option of flicking a switch inscribed 'on' and 'off' and with an up-to-date machine, modifying the volume just a bit. Today, the variety of controls made available to him requires analytical judgment. And these controls are but primitive regulatory devices compared to these participational possibilities which the listener will enjoy once current laboratory techniques have been appropriated by home playback devices . . . permit[ting] him to create his own ideal performance. (Gould 2004, p. 122)

Today it isn't the home stereo system which allows novice musicians to manipulate music, it is the home computer with free audio software such as Garage Band, Audacity and Soundhack.

In 2005 Nine Inch Nails released *The Hand that Feeds* in Garage Band format, which allows users to remix the song using the same digital tracks produced by the band (Mac Minute 2006). Markus Popp of Oval has gone a step further suggesting 'a model for one possible alternative approach to audio productivity in contemporary electronic music, along the lines of music-as-software' (Inglis 2002). *Ovalprocess* is both software and an album; it hands over control of the audio to the audience under very controlled circumstances (Toop 2004, p. 246). In a more academic vein, Christopher Bailey has created a piece called *Sand*, a twenty-five minute long acousmatic composition with a listener interface. It can be experienced as a complete piece of music, listened to from beginning to end, or explored at one's own pace, examining and taking apart its sonic events, in any order one wishes (Bailey 2004, p. 243). The basic home computer is an incredibly sophisticated machine, which gives even a casual user a home studio where (s)he can experiment with sound.

Conclusion

> Considered as a social process, sound reproduction has irreducible social and spatial components. Without studios, and without other social placements of microphones in performative frames that were always real spaces, there was no independent reproducibility of sound. The studio in particular implies a configuration of bodies and sounds in space, a particular ordering of practices and attitudes. Its significance is at once technical, social and spatial. The studio becomes a way of doing things, and a social frame for reproducibility. Jonathan Stern (2003)

Today's electronic music studio is a metaphor,[40] a conceptual transfer involving the withdrawal of schema from an initial literal application, into a new application effecting a different definition (Goodman 1979). Electronic music centres used to be highly specialised literal spaces where a few lucky individuals could work on rare and expensive equipment. Today, through technological advances and an effort of philosophical transformation, a studio can be a laptop sitting on a kotatsu in Japan, it can be a Kwaito community in South Africa, it can be a portable audio recorder in a park in Mexico, a reggae dance-hall in Jamaica, a family home in the suburbs, or even a virtual studio created by a suite of software. The studio is no longer defined by its contents; rather it has become a context created by the user.