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From the Editor

Music technology, computer music, electro-acoustic music, and electronic music are just a few of many ways to describe the diversity of the music our Journal attempts to represent and capture. In some ways, the term *music technology* has acted as an umbrella term to reflect the multidimensionality of electro-acoustic music, which includes the practice and theorization of composition, technical research, musicology, performance, and everything in between. It is, then, no surprise that in this issue, we again have articles that span the various subfields of electro-acoustic music, including Bob Gluck's interview with celebrated composer Mario Davidovksy, who, to be sure, does not need introduction. In resonance with efforts in the historical documentation of electro-acoustic music, we have also an article by Michael Gatt, who introduces the *Online Repository for Electro-Acoustic Music* (OREMA). This is a project that approaches the electro-acoustic music database issue from the perspective of a community-driven content management system (CMT) for uploading, sharing, discussing, and analyzing electro-acoustic music. On the hardware side of the spectrum, Miha Ciglar writes about ultrasound transducer technologies that can be commonly found in motion detection applications. Ciglar's article discusses his highly directional loudspeaker designs and their applications in the context of tactile feedback interface to allow users to "feel" and "touch" musical signals generated via ultrasonic speaker arrays. On the software side, Rachel Foote provides an insightful article on sound synthesis by revisiting granular synthesis that has been a critical part of Barry Truax's work. The final article, contributed by Michael Musick, focuses on the very topic, definition, and culture of "music technology" and its many nomenclatural variations, by bringing to the fore important concepts that we, as practitioners, theorists, and educators, may not necessarily think about on a daily basis.

In the *Reviews of Events, Recordings, and Publications* section we have a number of intriguing articles, including a report on a unique conference called *Cinesonika* – a gathering of communities that specifically celebrates the film soundtrack. Other articles include reviews of *Electroacoustic Music Network* (EMS) 2012, *International Conference on Auditory Display* (ICAD) 2012, and a concert by John Sampen and Mark Bunce at Western Michigan University in Kalamzoo, Michigan.

As usual, we finish off with the *Tips & Tricks* portion of Journal SEAMUS, with a second iteration of (or more aptly entitled "second squeeze" of) a step-by-step tutorial and introduction to JUCE, a cross-platform development IDE for real-time audio applications. Enjoy!

Tae Hong Park, Editor

Interview with Davidovsky

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Conducted by Bob Gluck, via telephone, September 24, 2005

Mario Davidovsky (1934-) was born near Buenos Aires, Argentina. He was one of the first fellows of the Columbia-Princeton Center for Electronic Music, arriving in 1960. He later served as the Center's Director, following the retirement of Vladimir Ussachevsky in 1970. A composer of electronic and instrumental music, he is well known for his *Synchronism* series of works that combined the two. Davidovsky has served as director of the Fromm Foundation at Harvard University, where he is Fanny P. Mason Professor Emeritus of Music, and as director of C.R.I. recordings. His work has been widely commissioned.

This interview took place on September 24, 2005

Bob Gluck (BG): When did you first become aware of electronic music?

Mario Davidovsky (MD): I first became aware of electronic music in 1956 or 57. I had heard recordings of Stockhausen's *Studie I*, *Studie II*, and *Gesang der Jünglinge*. I had also heard Luciano Berio and Bruno Moderna's pieces from the Milan studio. I also knew about *musique concrète* and we heard recordings of contemporary instrumental music, such as Rene Leibowitz conducting Schoenberg. There was quite a bit of radio exchange at the time between Radio France and Radio Argentina. There was a late-night hour-long radio show once a week where they played contemporary music.

BG: Where did you compose your first electronic music work?

MD: I did some musique concrète in Argentina for some short art films, opera, theater, using some effects and very simple manipulation of sounds. My first real compositions weren't done until I came to New York. A friend of mine, a Hungarian cellist named Kertesz, had a good recording studio in Buenos Aires. Somehow I was able to do some very simple things with tape in his studio. Playing tape backwards, filtering, and so on. Also in Buenos Aires, Francisco Kröpfl was doing some experimenting at the Faculty of Architecture. They had facilities for acoustical design, equipment to measure sounds, filters, other devices, and an old-fashioned reverberation room used by architects to experiment with spaces. I visited that studio, which had some very good equipment such as European tone generators and a Swiss filter that was very fine.

BG: What was it like to live in Buenos Aires as a young musician?

MD: Buenos Aires was a fabulous city for new music. Very intellectually sophisticated. The connection between Paris and Buenos Aires goes back a long time. We did concerts of new music. A group of us founded a society, including Alcides Lanza and myself, which performed our own music and whatever we could play from the repertoire. I also belonged to the Society for New Music directed by Juan Carlos Paz, a leader in the European avant-garde. He was very close to the French scene.

The politics, not so much the politics of the government, but politics of the musical community made it difficult for me to want to stay in Argentina. I came from nowhere, from a small farm town, moving to Buenos Aires, and when I was 18, my string quartet won a major competition given by the Wagnerian Association. The premiere was very well played, but there was a tremendous negative reaction. This happened for a few reasons. In part, it was because I was a product of German and thus non-Argentinian teachers, and during that year the Germans were looked upon with hesitation. I am sure that it was very difficult for them to get jobs at the Conservatory. Most of them made their money teaching privately. Other reasons were because I was not well known, and I wouldn't be surprised if it was also because I was Jewish. Since the people I worked with were not South American, I became viewed as one of them in a certain way.

BG: How did you come to work at the Columbia-Princeton Center for Electronic Music?

MD: Setting up a studio in South America was very expensive, bureaucratic and cumbersome. So anyone who wanted to work had to flee to Europe. People had to leave to go to places where there were substantial studios. Since I had already been in the United States, I chose to return there in 1960.

I had landed in America by being a Tanglewood Fellow. In 1957, someone played a piece of mine at Tanglewood, a piano quintet, and Aaron Copland heard it and invited me there as a Fellow in 1958. At that time I was a twelve-tone composer, like Milton Babbitt. Copland knew that I was not particularly interested in his music, but that didn't in any way lessen his interest. He thought that I was a talented guy and that's all that he cared about. Sitting with Copland, I expressed my interest in going to Europe to work in electronic music. He said that there was someone on the Tanglewood faculty to talk to. It was Milton Babbitt. The faculty then included Babbitt, Copland and Lukas Foss. I went to talk to Milton. He listened to one of my pieces and he was very sympatico. I talked to him about my interests. He said: "Well, we are on the verge of getting the money to get a studio in Columbia."

I then went back to Argentina but I really needed to return to New York. Milton said: "Apply for the Guggenheim. Aaron and I will write on your behalf and you will get it." I applied and got my Guggenheim in 1960 and came back to New York.

BG: What were the early days like at the Columbia-Princeton Center?

MD: For my first visit to the studio on 125th Street, in New York, Milton Babbitt invited me to see the RCA Synthesizer. It was on a Sunday. I waited in the outside doorway for Milton to come down. An older man arrived and also waited by the door, obviously also waiting to see the studio. It turned out to be Josef Tal, an Israeli composer, soon to become founder of the Israel Center for Electronic Music. Milton gave Tal a demonstration and Tal and I became very friendly.

Columbia was like a dream. Vladimir Ussachevsky was wonderful to me. At the time, only Ussachevsky, Otto Luening, and Bülent Arel were there. There was nothing organized educationally. Arel was fluent in French from where he grew up in Turkey. Neither of us knew English. I translated my English from Spanish and we made the same grammatical mistakes. We got really friendly and he became my teacher. I worked as an assistant to Bülent, watched what he did and learned by trial and error. By the third year, I created a syllabus and I was teaching. I became a de facto member of the studio and wasn't doing too badly.

I was very close to Edgard Varèse, Stefan Wolpe, Elliott Carter, and Aaron Copland. I was a young kid, but I arrived in New York at a good time, and after two years, just by the fact that I was there, they were very friendly with me. My feeling was that the non-electronic composers like Wolpe and Roger Sessions liked my stuff better than did the electronic composers. I was Stefan Wolpe's guide when he visited Argentina later on. He adopted me like a son. We had a close relationship when he came to New York to teach at Julliard. Every Tuesday night we used to have dinner. It was a tremendous opportunity to talk with a towering intellectual.

BG: Can you discuss your early musical works?

MD: My first real electronic music piece was created at Columbia-Princeton. The first big concert there was to take place in May 1961, so I had just a few months to create a piece. The setting was the McMillan Theater, which was outfitted with a fantastic eight-channel mixer and nineteen loudspeakers on the ceiling and on the sides. We could rotate the sounds around the room.

Since Milton Babbitt knew a little bit about my music before I arrived, and since I came as a visiting scholar and I was working in the studio and already had a piece in the first concert, it was easier for me than for some others to have my works performed publicly. A year later, flutist Harvey Sollberger played the first Synchronism piece. By 1962, I had become an established composer. When the New York Times wrote about avant-garde music, they included a picture of me. Even if they hated it, they reported it. I was played much more then than now. Things seemed to happen for me. It helped that I was close to performers by natural osmosis, and my career developed. I am not exactly someone who promotes my own music. I am too proud to ask anybody for anything and I just don't. Things just happened. I was lucky.

BG: Can you comment on your advocacy for South American composers?

MD: While I was at Columbia-Princeton, I remained aware of the situation of composers in Latin America. If it was difficult in Argentina, it was ten times more difficult elsewhere, although Chile had a decent studio facility. I became well known in Latin America from my electronic music, especially my Synchronisms pieces, and due to my travels to Brazil and elsewhere in the region. I became a ferocious advocate of Latin American composers who applied to come to the Center. For many years, with great support from Vladimir Ussachevsky, I did my best to open up the studio to people from Chile, Venezuela, and other countries. The fact that they came to Columbia-Princeton was because they knew that a South American composer was there. I did my best at securing access for them. At that time, we had many visiting people. Technicians were assigned to work with them.

Hector Kintanar from Mexico came and was trained. I helped him write a piece for piano and tape in the late 1960s. He then went back home and established a studio. Another Mexican composer, Manuel Enriquez, was in New York City to attend Julliard. He came to the studio and we tried to facilitate things for him. As a result of all the involvement by Latin American composers, even Vladimir Ussachevsky traveled extensively in that region. Other students came and went back home to establish studios.

BG: What was the Instituto Torcuato di Tella?

MD: In 1963-1964, when Alberto Ginastera opened the Instituto Torcuato Di Tella, we spoke of establishing a studio there. They had an engineer. Some information was exchanged so that they could buy Ampex tape machines and some other good equipment, comparable to what we had at Columbia-Princeton. Ginastera wanted me to inaugurate the studio by working with the faculty. The timing was right since I also wanted my son to be born in Argentina, and so I was able to go to teach there. My students were Alcides Lanza, Antonio Tauriello, and a few other composers.

BG: How did your interest in combining tape and acoustical instruments begin?

MD: The principal reason was that I immediately realized that sounds in electronic music behave in a completely new way. There is no physical constraint, no bow, no air to blow. I learned that the dynamic of the sound was really fantastically new, with a whole new idea of space and time. I immediately thought that those behaviors of sound were so good that I wanted to make them a part of instrumental music.

I wanted to translate those aspects of musical behaviors into the scores. There are certain things that you cannot do with a performer because of limitations of speed and technique. When I studied vocal music, vocal music became part of instrumental music. Then when I studied electronic music, it too became another possibility. I see this as an implementation of issues of *musica humana*, music of people, and *musica mundana*, music of the spheres, music of nature. Composing music is by its nature like a biologist working in the laboratory, working with cells and wanting to experiment. I like that scientific metaphor. Composing, for me, was like working in a laboratory.

Also, I think that it is a natural tendency that when you discover something new and fresh you want to mainstream it, to incorporate it into the total memory that you have. You do not want your discovery to be something that becomes *ghetto-ized*, but instead becomes part of the existing vocabulary.

There was another reason that greatly stimulated me. At that first concert at Columbia, there was something ungainly about presenting music on a stage with ugly looking boxes and with so many connotations implied by the concert setting but from which nothing really happened. In a way, I really thought that politically, I could help the cause of electronic music by introducing a human being playing. The audience can connect with a flutist or violin player. I thought that seeing a real instrumentalist playing could disarm the hostility that someone might have for electronic music.

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The Online Repository for Electro-acoustic Music Analysis (OREMA) project is a community-based repository and forum for electro-acoustic music analysis. It is a platform where analysts can upload and share their analyses of electro-acoustic compositions and participate in online discussions of analytical methodologies and strategies with other practitioners. The project website (www.orema.dmu.ac.uk), which went live in March 2011, was split into two phases. Initially it was a closed beta in which only core participants could contribute content. Now, registration is open to everyone allowing contributions from anyone who has an interest in electro-acoustic music analysis.

The OREMA project is part of a three year funded project titled *New Multimedia Tools for Electro-acoustic Music Analysis* (funded by the Arts and Humanities Research Council), which is coordinated by Professors Simon Emmerson and Leigh Landy of De Montfort University, Leicester.

What is the OREMA Project?

At this time the OREMA project is a content management system (CMS) website that gives users the ability to upload content and information on the subject of electro-acoustic music analysis. The information held on the website is split into three distinct content types: analyses, analytical tools, and comments/ discussion threads. Although these areas are interrelated, they function in slightly different ways. First, the analysis section of the website is a place where users can submit their analyses of any electro-acoustic work. This can include a written description with embedded images and uploaded files. Only the authors and moderators (for administration related issues) can delete or modify an analysis once it has been uploaded, meaning that an author can make changes to an analysis once it has been published on the site. Second, the analytical toolbox is a collection of methodologies and strategies for electro-acoustic music analysis. These pages function similarly to Wikipedia articles in that any user can alter the content if they consider the information to be inaccurate or false. This framework ensures that a consensus is gained through peer review and collaboration. Finally, there are areas for discussion throughout the site allowing users the option to comment on analyses and analytical tools within the comments section at the bottom of every page. There is also a forum where users can post topics to debate ideas relating to electro-acoustic music analysis. All the content on the website is user generated and protected under a Creative Commons licence that allows other users and non-users the option to share and alter content, provided that credit is given to the author(s) and that it is used for non-commercial purposes. In other words, users and non-users can employ an existing analysis as a template to construct their own analysis.

Scope of the Project

It is important to acknowledge that the term *electro-acoustic music* has a variety of differing connotations within this specific field of research, ones that perhaps might differ from the meaning held within the OREMA project. To clarify, and to borrow a definition from Leigh Landy, the OREMA project accepts analyses of "any music in which electricity has had some involvement in sound registration and/or production other than that of simple microphone recording or amplification" (Landy 1999). This, therefore, can encompass more works than traditional acousmatic music, such as live electronic improvisation, sound installations, and noise music. So far the majority of analyzed works have been acousmatic. However, the aim is to begin to incorporate analyses that investigate other forms of electro-acoustic music.

One question that is often asked is what is an acceptable analysis for the OREMA project? Marc Battier wrote that the analysis of electro-acoustic music generally falls into two camps in relation to semiology: “the esthesic camp, in which analysis is built upon perception, and the poietic camp, for which analysis focuses on the context and processes involved in the making of a piece” (Battier 2003: 249). The majority of the contributed analyses currently hosted on the website fall into the former (esthesic) camp, as many of them are based on an aural analysis tradition. Still, there is no archetype for the kind of analysis that is accepted within the project. It just so happens that it is easier for users to submit aural analyses, as these do not require secondary research or access to the creation materials collated by the composer in the compositional process. Furthermore, there is no prejudice with regard to the type of analysis one can submit to the project. There are a variety of examples currently hosted on the website ranging from graphic transcriptions, typological analyses, spectrogram segmentation using spectro-morpholical terms (Blackburn 2006), and even a Schenkerian analysis (Batchelor 1997) of an electro-acoustic work.

Another point of confusion might occur with respect to the analytical toolbox. The word *tool* in this instance does not refer to a machine or a piece of software used as a medium for analysis (such as the Acousmographe). It rather describes an applicable concept that can be employed in the analysis of a particular music genre, in this case electro-acoustic music. The analytical toolbox is therefore a guide to prospective analysts who want to get a broader understanding of the prevalent publications and methodologies in this field of research. Again, there is a current bias towards analytical methodologies specifically for acousmatic music, as there are significantly more publications on this subject than on live electronic performance analysis, for example.

The intended constituency for the OREMA project is wide and varied. It ranges from students to lecturers, neophytes to specialists. This is because a single analysis might have several uses beyond its initial purpose. The following are examples of uses for an analysis, some of which have been taken from Evelyne Gayou’s article *Analysing and Transcribing Electro-acoustic Music: the experience of the Portraits polychromes of GRM* (the article specifically focuses on graphic transcription of electro-acoustic works):

- A guide to interpretation;
- A pedagogical tool;
- A score for diffusion;
- A means to understand specific compositional processes (Gayou 2006).

As previously noted, these are very specific to acousmatic music. Our hope is that as users begin to submit analyses for other categories of electro-acoustic music, different uses will become apparent.

Aims, Objectives, and Ethos

The overall aim of the project is to assess whether a community-based forum and repository, alongside a clear taxonomy for music analysis, would provide people from different backgrounds a means to understanding electro-acoustic music. This overall aim can be broken down into three specific aims:

- To create and maintain a community-based forum and repository for electro-acoustic music analysis;
- To assemble a taxonomy of terms;
- To create a toolbox of analytical methodologies.

The objectives of the OREMA project are less apparent since they are concerned with how to maintain interest in the site, which should flow from the aims of the project. The objectives are:

- To encourage activity from members so that there is an active and engaged community;
- To ensure sufficient added-value for users;
- To maintain and improve quality of use for participants.

It should also be noted that one of the original objectives for the beta version of the website, which ran on a platform different from the current one, was to assess the suitability of the platform it should operate on. This was ultimately a decision made to ensure the best end-user experience.

Although there are no limitations to the methods an analyst might use to analyze a work, there exists a credo or ideology within the OREMA project. Firstly, and perhaps most importantly, there is no one "true" analysis of a single work. On this subject Jean-Jacques Nattiez remarks that:

> "[…] rarely will a musicologist allow outright that an analysis other than his or her own is acceptable. In fact, when a musicologist takes the trouble to suggest a new analysis of a work, it is because that musicologist believes that he or she has discovered the truth" (Nattiez 1990: 168).

The OREMA project subscribes to his thesis that there is "never only one valid musical analysis of any given work" (Nattiez 1990). One of the main functions of the OREMA project is that it allows different perspectives on a particular work. When we analyze a work we break it down into constituent elements, but these constituents offer too many possibilities for one single analysis. Ultimately, one must sacrifice some elements of a work in order for the analysis to be comprehensible to others and to ensure sufficient depth of study. One would have to create an extremely complex schema in order to communicate every single element and its relation to all other elements within a given piece. Consequently an analysis is viewed within the OREMA project as an interpretation of a work; the outcome of this interpretation is the medium of communicating the results to others. Secondly, the OREMA project does not advocate a specific methodology for the analysis of an electro-acoustic work. The analytical toolbox is there for reference, not as a list of the acceptable analytical models for analysis. The project aims to encourage new methods of analysis, especially for electro-acoustic works that are not exclusively fixed-media. Thirdly, all the information is free to all users and non-users. Although non-users are unable to contribute to the content hosted on the site they can view its contents freely. There is also no cost associated in becoming a member of the OREMA project, nor will there ever be. Finally, all users have the same rights regardless of their occupation or status. There is no hierarchy to determine who is fit to undertake an analysis of a particular work.

Closed Beta Period

The initial platform for the OREMA project website was *MediaWiki*, an open source wiki platform used by *Wikipedia*. Invitations were sent out prior to the release date to gauge interest and to assemble a group of core participants who would use the website and provide feedback on what was needed. These invitations were sent out to UK universities asking for postgraduate students who might be interested in electro-acoustic analysis. Professors and lecturers were also welcomed to participate. A total of twenty-two participants volunteered to be part of the closed beta of the OREMA project website, not all of whom were part of the initial core participant group on the March release date.

To ensure interest, and to give the group central focus, certain compositions were suggested for analysis every two months. These suggestions weren't intended to narrow the field of potential compositions (participants were always welcome to analyze a work of their choice), but rather to encourage activity and maintain momentum within the project. The compositions chosen within the first few months were as follows:

- *Dripsody* by Hugh Le Caine;
- *Étude aux chemins de fer* by Pierre Schaeffer;
- *Presque rien No.1C* by Luc Ferrari,
- *Meattrapezoid* by Merzbow.

There were a number of considerations in the choices made for the proposed compositions. The main consideration was the length of the composition. None of the works presented above are longer than five minutes. This is not to say that there is a limitation on the length of a piece, but rather it was an acknowledgement that many of the contributors had other commitments and might not be able to devote a lot of time during the initial beta version of the project. Another reason these compositions were chosen was that they were all very different. *Dripsody* and *Étude* *aux chemins de fer* are both early examples of *musique concrète* that employ different techniques in their composition. *Presque rien No.1C* was introduced as an example of a piece of 'anecdotal' music, one that would perhaps require different strategies than the previous two works. The most recent work to be introduced to the core participants was a noise piece by Merzbow called *Meattrapezoid*, a work that can be considered vastly different from the three previously mentioned. As of this moment in time no one has attempted to analyze the latter piece. Finally, all these compositions have been released on CD; some of them are even available on music streaming services such as *Spotify*. It should be mentioned that participants are recommended to use the highest quality recording of a piece; however, not all the participants had copies of the music and hence it was often more convenient to download the piece (usually at mp3 quality), rather than buy an entire CD of the work.

As time went on it became apparent that the MediaWiki platform was unsuitable for the purpose of this particular project. Although it offered considerable flexibility, it came at a cost. The primary concern was that it was too difficult to use. Participants were required to add data to many different pages in order to publish just one analysis. It was also hard to find information. Users were often confused, not only in the publication of an analysis, but also when searching for other analyses. The maintenance of the site was also a concern, as there were no simple methods of adding information or publishing news. Measures were taken to try to improve the usability of the website by adding third-party extensions, but these only resolved smaller administration and end-user related problems. The platform was fundamentally incompatible with the requirements of the project and it was agreed that a change of platform was necessary. The new version of the OREMA website was released in December 2011.

Current Version of the OREMA Project

The platform that was chosen for the new OREMA website was *Drupal*, an open source content management system. Whereas MediaWiki was a wiki-based platform, Drupal is a content management system. The main difference between these two platforms is the method by which they handle content. A wiki allows users to create pages, which can then be linked through the use of hyperlinks. There are some rudimentary tables that allow users to organise content, but these still need to be programmed individually by the user. A content management system works by defining content types, which are then filed in the same area of the website. Moderators are then able to group certain content within a content type by arguments. In short this means that end-users only need to submit an analysis with one standard input page. Once finished they simply click *publish* and the system, set up by the administration, takes that data and sorts it automatically. Furthermore, if a change needs to be made to the format of a content type, the administration only needs to change the parameters of that particular type, rather than tracing back through all the content on the website to ensure consistency.

The majority of the information that had to be collated in the MediaWiki version of the OREMA website was transferred to the new Drupal platform. Unfortunately, not all the information could be replicated on the new site. Discussions that had taken place in the forums of the previous website could not be transferred to the new one as a consequence of the system change.

Initial Findings

There were a number of interesting findings during the beta stage of the project, especially in relation to how the community functioned as a group. The first analysis that was introduced to the group in March was *Dripsody*. To try to gain interest, and to demonstrate a way one might conduct an analysis of this kind of work, the author submitted a detailed sound-by-sound graphical representation of the piece (Gatt 2011a). This sparked an interest in the forums, specifically from one user who requested that an overview of the piece be made, as the representation uploaded was too descriptive and did not give a sense of the overall structure. Before the author had time to create an overview, the user uploaded an analysis of *Dripsody*, which happened to be a structural analysis of the overall form (Hill 2011). Rather than create an additional overview, the author decided to keep the original analysis the same, as the two analyses complemented each other, offering different perspectives on the pieces from the micro to macro levels.

There were a number of assumptions made before the project began. Since the call for core participants was specifically aimed at postgraduate students, one presumed that the participants would have an understanding of Denis Smalley's term *spectromorphology* (Smalley 1997), for example. It transpired, however, that some of the participants had never heard of such terminology, as their research focused on computer-aided analysis rather than traditional aural analysis. This lead to a few participants creating analyses that borrowed terms from other disciplines. An example of this was another analysis of *Dripsody* in which the researcher chose to use the repeating drips to form a metre for the piece. By segmenting the piece in such a way, the user found that the drips came to a crescendo within two percent of what is termed the *golden mean* (Constantinou 2011a). This is an observation that neither of the other *Dripsody* analyses addressed.

The second recommended composition for analysis, *Étude aux chemins de fer*, yielded very different results in the choices made by the analysts. Again, to try to encourage interest in the piece, the author created an initial analysis using Schaeffer's typo-morphological framework (Schaeffer 1966) to sort the sounds present in the piece into categories (Gatt 2011b). The author also tried to add further information regarding the sounds morphology, still using Schaeffer's schema, whilst developing a self-defined methodology to describe the interactions between the sounds (a methodology which will be substituted with Stéphane Roy's *grille fonctionnelle* (Roy 2003) in the near future). This analysis spurred another researcher to create a structural analysis of the piece (Constantinou 2011b), again to complement the typo-morphological analysis. Rather than just providing one overall structure, the analyst offered two different segmentations of the piece, which both revealed symmetry in its form.

Closing Statements

There are a number of criticisms of electro-acoustic music analysis, specifically regarding the need to listen to a piece a number of times in order to detail elements of a work. Smalley wrote "we must be cautious about putting too much faith in written representations because writing freezes the experience of the temporal flux" (Smalley 1997: 108). Conversely, Stéphane Roy makes a clear distinction between an analyst and an auditor:

> "The perception of the analyst differs from reception of the auditor because of the reduction they exert on a given sound. After listening to a given sound many times the analyst is able to perceive details which will pass unperceived at the time of contextualized listening practiced by a listener." (Roy 2003)

There will always be a trade-off between the listening experience of a concert and the repeated listening required when analysing a work. However, by doing an in-depth analysis we are able to uncover aspects of a piece that would be missed in a single listening. The aim of an in-depth analysis is to gain an understanding of how a piece works.

> "An analysis in effect states itself in the form of a discourse - spoken or written - and it is consequently the product of an action; it leaves a trace and gives rise to readings, interpretation, and criticism." (Nattiez 1990)

The physical outcome of an analysis, regardless of whether it is a written explanation or a graphical representation, is a way of sharing these findings with other people. François Bayle said "music is not a solitary act. It is born when it is played in public" (Bayle 1997: 14). It is the contention of the author that the same is true for analyses. By sharing our analyses with others we are expanding our understanding of a particular composition and genre. Although an analysis might be overly detailed in relation to the actual listening experience, it does offer a different perspective that even specialists of the field might benefit from. The uses of such analyses can also extend to teaching and in aiding new listeners.

The OREMA project is still in its infancy, and requires more support, not only from the UK, but also from other countries. It is no longer a closed beta and people are encouraged to become members. The project will continue to run so long as there is sufficient interest and submitted content.

References

Batchelor, Peter. 1997. *Peter Batchelor's Valley Flow analysis* [online] December 12, 2011. http://www.orema.dmu.ac.uk/?q=content/peter-batchelors-valley-flow-analysis

Battier, Marc. 2003. *A Constructivist approach to the analysis of electronic music and audio art – between instruments and faktura*. Organised Sound, 8(3), pp. 249-255.

Bayle, François. Desanots, Sandra and Roads, Curtis. 1997. *Acousmatic Morphology: An Interview with Francois Bayle*. Computer Music Journal, 21(3), pp. 11-19.

Blackburn, Manuella. 2006. *Manuella Blackburn's Valley Flow analysis* [online] December 12, 2011. http://www.orema.dmu.ac.uk/?q=content/manuella-blackburns-valley-flow-analysis

Constantinou, Stace. 2011a. *Stace Constantinou's Dripsody analysis* [online] December 12, 2011. http://www.orema.dmu.ac.uk/?q=content/stace-constantinous-dripsody-analysis

Constantinou, Stace. 2011b. *Stace Constantinou's Étude Aux Chemins De Fer analysis* [online] December 12, 2011. http://www.orema.dmu.ac.uk/?q=content/stace-constantinous-%C3%A9tude-aux-chemins-de-fer-analysis

Gatt, Michael. 2011a. *Michael Gatt's Dripsody analysis* [online]. December 12, 2011. http://www.orema.dmu.ac.uk/?q=content/michael-gatts-dripsody-analysis

Gatt, Michael. 2011b. *Michael Gatt's Étude Aux Chemins De Fer analysis* [online] December 12, 2011. http://www.orema.dmu.ac.uk/?q=content/michael-gatt%E2%80%99s-%C3%A9tude-aux-chemins-de-fer-analysis

Gayou, Évelyne. 2006. *Analysing and Transcribing Electroacoustic Music: the experience of the Portraits polychromes of GRM*. Organised Sound, 11(2), pp. 125-129.

Hill, Andrew. 2011. *Andrew Hill's Dripsody analysis* [online] December 12, 2011. http://www.orema.dmu.ac.uk/?q=content/andrew-hills-dripsody-analysis

Landy, Leigh. 1999. *Reviewing the musicology of electroacoustic music: a plea for greater triangulation*. Organised Sound, 4 (1), pp. 61-70.

Nattiez, Jean-Jacques. 1990. *Music and Discourse – Toward a Semiology of Music*. New Jersey: Princeton University Press.

Roy, Stéphane. 2003. *L'analyse des musiques électroacoustiques: Modèles et propositions*. France: L'Harmattan.

Schaeffer, Pierre. 1966. *Traté des Objets Musicaux*. Paris: Éditions du Seuil.

Smalley, Denis . 1997. *Spectromorphology: explaining sound-shapes*. Organised Sound, 2(2), pp. 107-126.

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Introduction

This paper introduces two technologies designed by the young start-up *Ultrasonic Audio Technologies*. The company was established in 2011, with the purpose of introducing to the market outputs from an ongoing research project conducted at the Institute for Sonic Arts Research (IRZU) in Ljubljana, Slovenia[1]. The commercial technologies being developed at *Ultrasonic Audio Technologies* cover a wide range of disciplines within the "sound and music computing" domain and include mobile music computing, human computer interaction, tactile feedback, computer vision, music information retrieval, and nonlinear acoustics. The two products – *Syntact*™ and *Acouspade*™ – which will be described in detail in the following sections, share several technical features, while their application potentials and target markets are considerably different. Both products are based on the usage of airborne ultrasound, which has also influenced the selection of the company name.

SYNTACT™

Syntact™ is a new, "hands-free" musical interface/controller, utilizing a non-contact tactile feedback technology based on ultrasound. Through high-energy ultrasound, a midair force field is created. This force field can then be sensed through tactile feedback. The interface allows musicians to feel the actual sound (its temporal and harmonic texture) while a computer vision system is interpreting their hand gestures, allowing them to virtually mold and shape the sound – i.e. change its acoustic appearance – directly with their hands. The method of generating tactile feedback in multi-media applications by using airborne ultrasound was first proposed by Hoshi et al. (Hoshi 2009) Hoshi's group created a tactile display for adding haptic sensation to holographic images.

Non-Contact Tactile Feedback

Stage Layout

Syntact™ consists of 121 ultrasound transducers arranged on a concave surface, as shown in Figure 1. The piezoelectric transducers operate at the resonant frequency of 40kHz. The input audio signal modulates the amplitude of the 40kHz sinus carrier, which is used to drive the transducers. As the high-frequency content is filtered out by our ears as well as by the tactile sensors of our skin, the effective output is perceived as (roughly) equal to the input audio signal.

The acoustic energy projected through all 121 transducers is condensed in the focal point of the instrument 25 cm above the transducers, in the center of the virtual sphere, which defines the concavity of the surface. This point is equidistant to all of the transducers and therefore, all 121 acoustic signals exhibit identical phasing pattern. As a consequence, all sonic energy produced is summed at this point, enhancing the acoustic pressure to the maximum. In this way, a strong pressure field is established that can be sensed by the skin through tactile feedback. This pressure field resembles the frequency structure and temporal/rhythmic characteristics of the audible sound that is directly mapped onto the tactile domain.

In (Hoshi 2009), a phase shift method was implemented in order to condense the acoustic energy at a selected spatial point. An 18x18 transducer array was arranged on a flat surface, where each transducer was driven by a separate audio signal. By phase shifting individual signals (requiring 18x18 separate audio channels) it is possible to freely define the focal point location inside a three-dimensional space in front of the array. This method, however, requires substantially more hardware resources

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[1] www.irzu.org

than the method used in Syntact™. By the means of concave arrangement of transducers in Syntact™, a fixed focal point is created while all transducers can be interconnected and driven by a single audio channel.

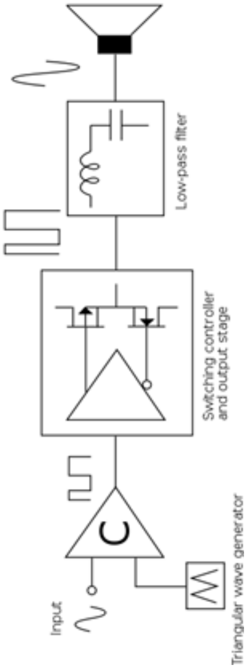

Figure 1. Class-D amplifier basic scheme

Modulation and Amplification

The modulation of the audio signal with the high carrier frequency is realized with an analog multiplier. The modulated signal is then sent to a lightweight and highly efficient D-class switching amplifier, as shown in Figure 1 (image courtesy of Wikipedia). The amplifier transforms the modulated signal into a Pulse Width Modulated (PWM) square wave at 400kHz; the low-frequency portion of this signal's spectrum represents the desired output. After the switching stage, a passive low-pass filter removes the unwanted high-frequency components, smoothing the pulses and recovering the desired low-frequency signal. In the case of Syntact™, however, this corresponds to the amplitude modulated 40kHz signal. At maximum power, the spherical transducer array draws a current of 2 amperes at 30 volts. More details on D-class amplifiers can be found in (Gaalaas 2006).

Computer Vision and Mapping Strategies

The general idea behind Syntact™ is to enable playful interactions with sound. Therefore, one of the crucial components of the instrument is its feed-forward/motion sensing module. Since 2010, the input section concept in Syntact™ has undergone several modifications and iterations. One of the more successful implementations based on acoustic feedback is still being used in performances by the author.[2] The feed-forward solution, in which three ultrasonic receivers placed around the emitter array analyze the amount of acoustic energy being reflected by the musician's hand in different positions, is described in detail in (Ciglar 2010). The final realization, however, uses a computer vision system in order to track and analyze motion, location, and shape of the hand.

Considering the intrinsic specificities of Syntact™ it was hardly straightforward to devise a concept of organizing and interpreting the real-time image descriptors, and finding an ideal solution is perhaps still subject to further research and improvements. One can find several very successful examples which already have attempted to deal with the problem of interpreting hand gestures within the context of digital musical instrument input design, as can be seen in (Oliver 2010). In case of Syntact™, however, the tactile signal is confined to a somewhat small spatial area, making it the one and only place to position your hand or one's fingertips (since they are most susceptible to tactile sensation) during performance. At the moment, the implemented computer vision system is able to extract several different low-level descriptors connected to the spatial and temporal dynamics of the musicians' hand. It also enables the establishment of inter-dependence relationships amongst different descriptors, providing a spatially conditioned gating system for input data that can be further be mapped to the audio event generation engine.

Although the computer vision system implemented in Syntacts™ is able to generate several independent data dimensions representing real-time input directives, the most

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[2] www.ciglar.mur.at

difficult task was the conceptualization of the data-to-sound mapping section. With regard to its hands-free feedback feature, Syntact™ can be seen as a new musical instrument/controller. Therefore, it was also important to match this aspect of novelty in its feed-forward section.

During testing and development, it became evident that having only raw image descriptor data to work with would require considerable effort from the user to create interesting and varied real-time music compositions. Hence, one of the design goals was to offer a mapping solution, which would be attractive for a wide range of users while still allowing access to low level image descriptor data for the experienced musicians to create individual mappings. The default image of the interface is now based on a pre-defined, relatively sophisticated mapping concept, which allows easy and playful generation of meaningful and diverse musical structures and patterns. The generation of sound is based on standard MIDI files provided by the user. Additionally, multi-track MIDI files can either be pre-composed by the user and any other existing MIDI tracks can be used. With different hand gestures, the musician can then trigger different instruments or instrument groups, which generate output according to pitch and time information contained in the MIDI files that are "played" (silently) in the background. The MIDI files therefore only define the possibility of a note occurring at a certain time, which is further conditioned by a combination of image descriptors. While the possible onset times are quantized according to a selected grid of smallest time units (e.g. sixteenth notes), the pitch can also be reorganized in real-time through different gestures and with regard to an automatic analysis of harmonic progressions in the selected MIDI composition. The result is a musical structure where the pitch is "always correct" and all the musical events are "always in time." The hand gestures define the dynamic variations, temporal density of events and some basic harmonic alterations in the pre-selected/pre-composed piece. Further details on the algorithms and video examples can be found at www.ultrasonic-audio.com.

Figure 2. Syntact™ front-end - concavely shaped transducer array

ACOUSPADE™

ACOUstic SPAce DElimiter™ is a highly directional speaker based on nonlinear interaction of ultrasound and air. Acouspade™ is focused on audible sound, and projects it to a desired spatial location. It is implemented with the same base technologies (transducers, amplifier, and modulator) as Syntact™, with an important difference: the transducers in Acouspade™ are arranged on a flat, rather than curved, surface, as shown in Figure 3. As a result of the sound wave propagation through air, an interesting side effect can be observed. The amplitude-modulated ultrasonic signal is self-demodulated so that the projected sound is rendered audible. The phenomenon of self-demodulation of modulated ultrasound, called the *parametric array effect*, and the consequential directionality of audible sound is described in detail in (Croft 2001).

The most typical application of directional loudspeakers is in-store advertising. Focused sound can be very useful in situations where several different products or visual information sources need to coexist, require audio feedback, and are arranged in close proximity, for example, articles in stores or shopping malls. With directional loudspeakers, the sound can be projected to a desired location, hence reducing unnecessary noise at neighboring locations, or where other sounds already occupy the acoustic space.

Figure 3. Acouspade™ – directional speaker

Features

Unlike similar products on the market – those that generate high frequency sounds with metalized foil membranes – Acouspade™ uses an array of piezoelectric transducers. Acoustic measurements have shown that Acouspade™ can achieve extremely high linear frequency response, which results in clear audible frequencies as low as 100Hz. Compared to similar products, the piezoelectric transducers exhibit much less distortion and can achieve very high dB levels. Another important feature is the built-in MP3 player (accessible via a micro SD card slot) as well as an onboard motion sensing system. Acouspade™ is thus the first directional sound system that does not require the connection of any additional sound source for its operation, while still enabling the connection of external audio devices. The motion detection sensor is built into the loudspeaker and is connected to the MP3 player, allowing the triggering of the audio file from its beginning when the presence of a person is detected. In case of longer sound files advertising a particular product, for example, it proved to be very convenient if a person is able to listen to it from the start as soon as she/he approaches the product. Furthermore, the sensor also shuts down the amplifier if no motion is detected (i.e. when no one is there to listen to the audio content), thus saving energy and extending the lifetime of loudspeakers and amplifier. If required, however, the sensor may also be disabled in which case the MP3 player automatically starts looping its content.

References

Hoshi T., Iwamoto T. and Shinoda H.: Non-contact Tactile Sensation Synthesized by Ultrasound Transducers. In: *Proceedings of the Third Joint Eurohaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems* Salt Lake City, UT, USA, 2009.

Ciglar M. “An ultrasound based instrument generating audible and tactile sound.” In: *Proceedings of New Interfaces for Musical Expression* - Sydney, Australia 2010.

Gaalaas E. “Class D Audio Amplifiers: What, Why, and How.” In: *Analog Dialogue* 40-06, June (2006).

Oliver, J. ”The MANO Controller: A Video Based Hand Tracking System” In: *Proceedings of the International Computer Music Conference*, New York, USA, 2010.

Croft J.J. and Norris J.O. “HSS-Theory, History, and the Advancement of Parametric Loudspeakers A TECHNOLOGY OVERVIEW” - © 2001 - 2003 American Technology Corporation

Music and the Micrometer: Granulation in Truax's Basilica

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Techniques of Granular Synthesis

A Return to Performance

Many approaches to the use of technology in music have been established during the twentieth century, and some, such as the use of computer programs for music notation, have gained widespread popularity. However, other areas of electronic and technological expansion into music are still in the early stages of development, and many lack widespread acceptance from the music community at large. As Barry Truax noted in 1990:

> "Despite the many changes which the introduction of the computer into the compositional process has brought about, it is remarkable how frequently the compositional models implemented in both software and hardware retain the concepts and techniques of instrumental music." (Truax, 1990)

Synthesis with particles is an example of a computer music technique that abandons the traditional concepts associated with instrumental music, such as individual notes and specific metric structures.

The fundamental type of particle synthesis is *granular synthesis*, which at its most basic level is a technique that produces complex sounds by isolating small acoustic events, called *grains*, and, quite simply, layering them. Grains are typically ten to thirty milliseconds (ms) in duration and usually less than fifty ms, and they are the building blocks that composers use to create the basic sound units for their musical works (Truax 2004). Curtis Roads believes that the versatility of granular synthesis is one of the more interesting features of the process. Indeed, grains can be taken from sampled sound, frequency modulation synthesis (FM), or PCM waveforms of various types (e.g. sine, square, or pulse) (Roads 1991). A large number of grains are needed to create a usable sound, however, and these groups of grains form larger units also referred to as *clouds*, each of which can last seconds or minutes. A cloud formation consists of a group of grains that can be controlled by a number of parameters. These parameters include start time and duration of the cloud as a whole, duration of the individual grains, grain density, waveform of the grains, frequency band or spectrum occupied by the cloud, and spatial dispersal of the grains in the cloud. In addition, the amplitude envelope of the cloud can be controlled by the attack time, decay time, and loudness pattern. (Dodge 1997)

While the primary developments in granular synthesis occurred in the late 1980s and early 1990s, in 1963 Iannis Xenakis prophetically wrote:

> "All sound is an integration of grains, of elementary sonic particles, of sonic quanta… All sound, even all continuous sonic variation, is conceived as an assemblage of a large number of elementary grains adequately disposed in time…" (Xenakis 1971)

The concept of granular synthesis was originally pioneered in the 1970s by Xenakis and later by Curtis Roads. Today, granular synthesis is one of the broadest categories in the family of sound particle techniques. This method creates a large number of compositional possibilities through the manipulation of the particle source and the projection of particles in time. (Roads 1997)

At first, few composers explored this technique due to the large amount of computation that was required by the computers of the time. However, in 1986, Barry Truax designed a method of exploring granular synthesis in a real-time environment by means of the PODX system at Simon Fraser

University.[3] According to Truax's own description, the PODX system:

> "…is a collection of compositional programs that exploit the interactive potential of the DMX-1000. Each program implements a model of interactive composition that allows the user to design sounds and/or structures with immediate aural feedback…" (Truax 1985)

The DMX-1000, a micro-programmable signal processor by *Digital Music Systems*, is designed for control by a *Digital Equipment Corporation* PDP-11 or LSI-11 computer. The software package designed for this system, *Music-1000*, resembles the earlier *Music-11* software, a variation of the *Music-N* series of sound-generating computer programs. The late Max Mathews originally developed this series in 1957 at Bell Telephone Laboratories. Truax foresaw great potential in the PODX system for the development of new synthesis techniques. In 1985, before his real-time granular breakthrough on this same system, he stated:

> "The microprogrammability of the DMX-1000 ensures that any number of synthesis algorithms, presently known or about to appear in the future, can be introduced and refined within the basic structure of the system." (Truax 1985)

The technique of granulation is a process of taking an original sound and dividing it into tiny grains. These grains, each of which is given an amplitude envelope, are then reproduced in high densities of several hundred or even several thousands of grains per second. While a grain listened to in isolation may seem trivial, when layered with other grains a rich and complex texture emerges. Another common technique utilized in granulation is "time stretching." By means of this technique the composer can take a grain and prolong its duration by any factor without a resultant change in pitch.[4]

In order to organize the large number of grains necessary to create a usable sound event, software that enables the composer to specify structure on a higher level is required. Due to the enormous number of grains, the composer cannot specify the exact position of each grain, but can provide general rules for the generation and organization of grains. There are two main methods for organizing the temporal distribution of the grains: synchronous and asynchronous. In synchronous mode, grains are dispersed at reasonably uniform intervals of time, producing a sound with a specific pitch. When played asynchronously, the time between the grains is randomized, producing a cloud of sound (Dodge 1997).

A cloud is the basic structural element of granular synthesis just as a phrase can be regarded as the fundamental unit of traditional musical structure. Unfortunately, this comparison is not exact, thus contributing to the difficulty often faced by casual music listeners when trying to grasp small and large scale musical structures in electro-acoustic music. Curtis Roads defines nine time scales of music in his book *Microsound* (Roads 2004). These time scales range from "infinite" to "infinitesimal" and describe the entire range of possibilities for time in musical structure (see Table 1 towards the end of the article for further details).

The grains that form the basis of granular synthesis fall near the middle of this continuum. They are still perceptible by the human ear, yet when perceived in isolation, they are inconsequential to the musical structure. Despite this fact, Roads points out that "nothing" can be truly isolated:

> "Time scales are interlinked, so that to operate on one level is to simultaneously affect other levels. For example, a transformation of grain duration on a micro-scale imposes an overall timbre change in a cloud." (Roads 1997)

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[3] www.sfu.ca/sonic-studio/handbook/Gran.html

[4] www.sfu.ca/sonic-studio/handbook/Gran.html

Barry Truax and Compositional Aesthetics

Barry Truax is a Canadian composer presently on the School of Communication faculty at Simon Fraser University in Burnaby, British Columbia. He earned a Bachelor of Science degree in mathematics and physics at Queens University, and a Master of Music degree at the University of British Columbia. He also studied with Gottfried Michael Koenig and Otto Laske at Utrecht University. He joined R. Murray Schafer's *World Soundscape Project* in 1973, and has accomplished extensive work under the auspices of that organization. The original mission of Schafer's World Soundscape Project was to draw wider attention to the sounds of the environment and the phenomenon of ever-increasing noise pollution. (Iwatake 1994)

Soundscape composition is a type of electro-acoustic music that uses environmental sounds in a recognizable form. This process should be distinguished from the practice of *musique concrète*, which also uses recorded sounds. In musique concrète, techniques can be used to *transform* the original sounds in a manner that obscures their origin. By contrast, in soundscape compositions, the sounds are designed to interact with a listener's knowledge and awareness of the soundscape from which they were derived. Hildegard Westerkamp described soundscape composition in the following manner:

> "… the essence of soundscape composition is the artistic, sonic transmission of meanings about place, time, environment and listening perception."[5]

In early examples of soundscape composition, the sounds were taken out of context and used with minimal modulation in order to direct the listener's attention to the sounds origin. This "neutral" use of the material represents one end of the soundscape continuum and can be thought of as "found composition." At the other end of the spectrum, however, the transformation of environmental sound is used to invoke strong associations for the listener by delving into the sound. According to Truax, this type of soundscape composition seeks "… to reveal a deeper level of signification inherent within the sound and to invoke the listener's semantic associations without obliterating the sound's recognizability" (Truax 2004). Westercamp further stated that:

> "…the soundscape composer can draw our ears more deeply into the contours of sound, its colours and textures and into its details, and thereby enrich our perceptions of and change our attitudes towards our daily sound environment."[6]

Composer Truax is also further concerned with the social and contextual aspects of music, and is particularly concerned that these issues do not disturb most musicians, especially in computer music. Regarding this problem he wrote:

> "In an age where all of the arts, and contemporary music perhaps most of all, are becoming marginalized in society, I seriously doubt that we can afford to train thousands of young composers with the belief that 'abstract' is best." (Truax 1994)

Truax also believes that society also sometimes turns a blind eye to context, acting as if it were possible and desirable to create a non-contextual work of art. In fact, no form of communication, even music, can be entirely divorced from its context.

One can observe that Barry Truax seeks to include the original context as an equal partner in his compositions without letting it interfere with the musicality of the composition itself. He acknowledges, however, that when working with an outside influence it is easy to let the subject take control, leaving little room for musical interest. He extensively described the problems

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[5] www.sfu.ca/~westerka/writings%20pages/soundscapecomp.html

[6] www.sfu.ca/~westerka/writings%20pages/soundscapecomp.html

created by this challenge in the article "The Inner and Outer Complexity of Music:"

> "The problem with such music is that the external complexity is not sufficiently matched and integrated with its internal complexity. Such an imbalance is equally unsatisfying as the reduced dimensionality of abstract music…" (Truax 1994)

A listener should still be able to appreciate the musical composition without being "educated" about the external references as the music could, otherwise, suffer compositional longevity. According to Truax, the ideal way to solve this conundrum is to have a steady ebb and flow between the musical level and the contextual level.

> "The basic model of acoustic communication is grounded in the understanding that information and meaning arise through listening from both the inner structure and patterns of sound itself and also the listener's knowledge of context… Further, sound is not merely information exchange, but is capable of creating relationships between listeners and their environment in a dynamic process of embodied cognition." (Truax 2012)

When looking at these ideas within the world of electronic music, it is imperative to note that the performance environment for electronic music – performance via a multiple loudspeaker setup – has a profound effect on the spatial context. According to Truax this medium will "… allow unlimited potential to perform music in any environment whatsoever, outdoors or indoors, thereby linking the space within the music to the external environment." (Truax 1994) It is also important to realize that electro-acoustic music is considered somewhat of a "parallel culture." The "classical music" community has done very little to embrace or support the development and acceptance of this form of musical expression.

Since electronic music is still a very small community, it is not difficult for a composer to become complacent, because s/he so often composes for colleagues who comprehend his/her musical language. This understanding may lead to value assessments that are based on a similarity of compositional aesthetic rather than artistic merit (Truax 1999). The aesthetic based judgment criteria have encouraged composers to pursue the theoretical and computer-assisted basis behind the music and accept sounds that are only feeble replications of those found in the real world (Truax 1999). This reasoning validates the soundscape composition approach, which allows a composer to produce music that is far more complex and interesting than is currently normal in electronic music. In Truax's essay "Letter to a Twenty-Five-Year Old Electro-acoustic Composer" he gives several suggestions for creating worthwhile music, including looking for a balance, finding your passions and expressing them through music, being humble, and refraining from jumping onto the latest trend:

> "… become informed to the best of your ability, but be prepared to go the final steps on your own with only your own intuition as a guide… Do not be misled by the merely rational aspect of technology to think that electro-acoustic music is just an esoteric mind game for producing abstract music…" (Truax 1999)

Compositional Examples

Since his 1986 breakthrough, Barry Truax has written a number of other compositional works that have focused on and utilized granular synthesis techniques. This method of composition has opened various new ways of thinking, broadening the definition of composition by challenging many historically entrenched values. In the composer's own words:

> "Composing with real-time granular sound has not only opened up a new sonic world, but has also challenged some very fundamental ideas about what composition is. Whereas instrumental music models assume the note as the smallest compositional unit, granular

> synthesis works at the micro level of the grain." (Truax 1994)

Truax also points out that in granular synthesis, the structure of the music and the sound itself are highly inter-related, and that traditional distinctions, such as score and ensemble, are obsolete. Additionally, Truax notes:

> "Deterministic and linear thinking are clearly inappropriate, if not impossible; the composer is constantly being challenged by new concepts of sound and its organization, and if for no other reason than that, the technique may resist widespread commercialization." (Traux 1994)

Studying Truax's works provides an opportunity to see his interest and practice of contextual and social awareness in musical composition. Some of the recordings collected for the World Soundscape Project have served as sound sources for his compositions. Truax's *Riverrun* (1986) is perhaps the first work to be entirely realized using real-time granular synthesis techniques. In this work Truax explored what he has called "The fundamental paradox of granular synthesis…" The composer continued to describe this paradox as follows:

> "… that the enormously rich and powerful textures it produces result from its being based on the most 'trivial' grains of sound – suggested a metaphoric relation to the river whose power is based on the accumulation of countless 'powerless' droplets of water." (Truax 1988)

In Truax's first works using real-time granulation of a sampled sound, *Wings of Nike* (1987) and *Tongues of Angels* (1988), very short, fixed length samples of recorded material were used. In *Wings of Nike*, the base samples were vocalizations of phonemes by both men and women. In *Tongues of Angels*, recordings of live instruments were utilized. With these recordings (assuming that the grain duration was not too short) the source material determined the pitch and timbre of the granulated sound. However, the resulting pitch and textural structures were not straightforward. According to Truax:

> "…the overlay of up to 20 simultaneous versions of such sound per stereo pair of tracks, each with its own variations, produces a 'magnification' of the original sound, as well as introducing the possibility of gradual or rapid movement through its micro-level characteristics." (Truax 1988)

The first Truax composition to use granular synthesis-based time-stretching was *Beauty and the Beast* (1989), a mixed-media performance piece. Similar techniques were also used in *Song of Songs* (1992). In continuing to explore this method, Truax wrote three works in the early 1990's that used time-shifted environmental sound as the main technique of composition: *Pacific* (1990), *Dominion* (1991), and *Basilica* (1992).

Pacific is divided into four movements, each containing sounds derived from the Canadian West Coast. These materials included waves, boat horns blared for the New Year, harbor ambience, and the Dragon Dance in a Vancouver Chinatown celebration. Several of these sounds suggest a New Year celebration. Truax described the significance of this theme in his article, "The Inner and Outer Complexity of Music:"

> "The symbolism of the New Year involving death and rebirth imagery was the reason for these references, and as well these events provided the sonic materials for the movements in question." (Truax 1994)

The materials used in *Dominion* were drawn from other Canadian so-called *soundmarks*, such as cannons, bells, foghorns, and other similar sounds (Truax 1994). These sounds shared a common temporal reference to noon in four different regions of Canada. (Truax 1994)

The last work of this set, *Basilica,* explores the sound of three bells in the Basilica in Quebec City, sound material that Truax first used in some sections of *Dominion*. In *Basilica* these recorded bells are heard at the original pitch level, an octave lower, and a twelfth higher. Each of these basic sounds is stretched in time for up to twenty or more times the original duration. This extension of the central sounds allows the inner harmonics of the bells themselves to be heard. Truax described this experience as freeing the listener and allowing him to appreciate the music at a new level of awareness:

> "As the temporal shape of a sound becomes elongated, whether by a small percentage or a very large amount, one's attention shifts towards the spectral components of the sound, either discrete frequency components, harmonics or inharmonics, or resonant regions and broadband textures. I often refer to this process as listening 'inside' the sound…"[7]

In *Basilica*, specifically, the time-stretching technique achieves a magnification of associations. When hearing "inside" the sound, it seems to the listener as if s/he is entering the enormous mass of the church itself. The timbre of the bell remains largely intact; however, its formants sound strikingly like those of a choir. Indeed, at the approximate two-thirds mark of the composition, the melody of a chant is suggested by a repetitive sequence of momentary bell spectra in which each of the elements is prolonged and transposed down an octave. (Truax 1994)

The granular transformations in *Basilica* are constructive in nature rather than deconstructive. Meaning and depth are added to the source sounds without compromising the characteristics that signify the bell timbre. Truax has described this work in terms of bell resonances and their associations:

> "The complex bell resonances in Basilica resemble organ clusters slowly dying away in a reverberant cathedral. However, in terms of the soundscape composition, the added duration also allows the sound to reverberate in the listener's memory, providing time for long-term memories and associations to surface."[8]

This multifaceted relation between sound and structure exemplifies the increasingly intertwined nature of these musical descriptors in granular synthesis. Indeed, one cannot be adequately explained without reference to the other.

Conclusion

Granular synthesis is a technique that was developed into a popular musical tool and method during the late 1980s and early 1990s. It pulls away from the instrumentally-driven and score-driven models and allows the composer to create complex, rich, and unique sounds. The use of granular synthesis in soundscape composition enhances the context and meaning of a work, linking the sounds to the environment as well social contexts. Barry Truax has been at the forefront of the development of real-time granular synthesis and the establishment of the soundscapes genre. He integrates sound context into his composition as an equal partner to the more traditional musical elements, adding interest and expressive power to his works. *Basilica* is a representative example of his output in the early 1990's that showcases the time-stretch approach to granular synthesis. Barry Truax has contributed much to the field of electronic music since the early 1980s, and he will undoubtedly be remembered for his 1986 innovation of real-time granular synthesis and his beautiful works that show the enormous potential of this synthesis technique. His extensive output of writings and compositions regarding granular synthesis continue to influence the direction that field is taking today.

References

Barry Truax, "Composing with Real-Time Granular Sound," *Perspectives of New Music* 28 (1990): 120.

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[7] www.sfu.ca/~truax/mviva.html

[8] www.sfu.ca/sonic-studio/handbook/Gsample

Barry Truax, “Granular Synthesis,” *Handbook for Acoustic Ecology*, <http://www2.sfu.ca/sonic-studio/handbook/Gran.html> (1999), accessed 3 October 2004.

Curtis Roads, “Asynchronous Granular Synthesis,” in *Representations of Musical Signals*, ed. Curtis Roads et al. (Cambridge, MA: MIT Press, 1991), 143.

Iannis Xenakis, *Formalized Music: Thought and Mathematics in Composition* (Bloomington, IN: Indiana University Press, 1971), 43.

Curtis Roads and John Alexander, “Granular Synthesis,” *Keyboard* 23 (June 1997): 43.

Barry Truax, “The PODX System: Interactive Compositional Software for the DMX-1000,” *Computer Music Journal* 9 (1985): 29.

Dodge and Jerse, *Computer Music*, 262.

Curtis Roads, *Microsound* (Cambridge, MA: MIT Press, 2004), 3-4.

Toru Iwatake, “Interview with Barry Truax,” *Computer Music Journal* 18 (1994): 17-19.

Barry Truax, “Soundscape Composition,” *Compositional Techniques* <http://www.sfu.ca/~truax/scomp.html>, accessed 14 September 2004.

Barry Truax, “The Inner and Outer Complexity of Music,” *Perspectives of New Music* 32 (1994): 177.

Barry Truax, “Sound, Listening and Place: The Aesthetic Dilemma,” *Organised Sound*: *An International Journal of Music Technology* 17, no. 3 (2012), <http://www.sfu.ca/~truax/OS8.html>, accessed 12 March 2015.

Barry Truax, “Letter to a Twenty-Five-Year Old Electro-acoustic Composer,” *Organised Sound: An International Journal of Music Technology* 4, no. 3 (1999): 148.

Barry Truax, “Discovering Inner Complexity: Time Shifting and Transposition with a Real-time Granulation Technique,” *Computer Music Journal* 18 (1994): 45.

Barry Truax, “Real-Time Granular Synthesis with a Digital Signal Processor,” *Computer Music Journal* 12 (1988): 25.

Name	Description
Infinite	A unit of time ideal for mathematically calculated durations such as infinite sine waves.
Supra	A time scale longer than most individual compositions and can be defined in months or even centuries.
Macro	A time scale that measures the overarching musical architecture of a piece. It is usually defined in minutes or hours.
Meso	The division of the form into phrases.
Sound object	The most common basic unit of musical structure, such as a note or sound event. This time scale ranges from a fraction of a second through several seconds.
Micro	A time scale that includes sound particles or grains. This time scale is measured in milliseconds (ms) and extends to the threshold of auditory perception.
Sample	The smallest unit of a digital audio system and is measured in millionths of a second (microseconds).
Subsample	This unit contains fluctuations on a very brief time scale that is too minuscule to be properly perceived. This time scale is measured in nanoseconds (billionths of a second).
Infinitesimal	A unit of time ideal for mathematically calculated durations, such as extremely brief delta functions.

Table 1. Description of terms

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Abstract

Music technology is a popular term in society's current lexicon. It is used in industry, media, and academia as though it is a clear idea with a known definition. However, much like the classification of what qualifies as *music*, pinpointing a standard notion of what qualifies as *music technology* is a potentially contentious topic, without suitable published definitions. This article starts by considering the colloquial idea of what music technology is, and then branches out to reconsider the term in relation to *music, technology,* and the philosophy of both. This exploration leads to the presentation of the author's current working definition for the term *music technology*.

Introduction

Music technology is a difficult term to define. It lacks an entry in the sources where one would expect to find definitions or descriptions for such a ubiquitous and seemingly specific term.[9] Yet, this term is commonly used within academic music institutions, written about in popular music and music research journals, referenced in trusted newspapers, and a web search will return somewhere around 1 million results mentioning "music technology"[10]. When browsing these results, it becomes clear that the colloquial definition for the term could be *music that is mediated through the use of electronics or computers*. Academic institutions that have music technology departments or degrees in music technology typically describe these studies in accordance with this definition. For example, the learning and research that occurs within New York University's Music Technology program is described as "sound engineering, computer music, audio-visual production and post-production, mastering, scoring for film and multimedia, audio for games, software development, and multimedia production".[11] In this case, the description particularly pertains to the teaching and research of the production and creation of music. In looking closer at these departments though, it becomes clear that much more research is happening under this term than what was just described. For example, the Music and Audio Research Laboratory (MARL)[12] within New York University's Music Technology program also has special interest research groups in computer music and interactive systems, immersive audio, music cognition, music experience design, music informatics, and music theory, as well as the previously mentioned recording and production.

It is not too difficult to explore why fields such as music experience design, music theory, and music cognition might fall under this term. Clearly, the use of electricity-based "technology" is critical towards the collection of and understanding of research data in these fields. But what is really meant by the term music technology? Is it just a term intended to be a catchall for music research that started

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[9] The Encyclopedia Britannica Online lacks an entry. Additionally The Oxford Music Online site, which is the source every performing musician is taught to reference for basic music terminology, and contains the complete set of articles from the ever expanding Oxford Companion to Music series, The Oxford History of Western Music, and The Oxford Dictionary of Music also seems to be missing this entry.

[10] Conducted through Google's search engine on 01/28/2013 using "music technology".

[11] http://steinhardt.nyu.edu/music/technology

[12] http://steinhardt.nyu.edu/marl/

occurring near the end of the 21st century? Are there examples of music technology prior to the Second Industrial Revolution and the electrification of the world? Clearly, yes; instrument design, concert hall design, acoustics, and applications of math towards the better understanding of music can, and should all be considered as music technologies (Webster 2002). Yet, these topics are rarely associated with the term in the modern era.

The goal of this paper is to explore the ideas around and specifics of the term music technology by further considering the current popular definitions, the scholarly writings on the subject, and related fields in the philosophy of technology. This leads to the presentation of a working definition for the term music technology.

Music and Technology

As a term, music technology seems to currently lack a convincing description. A recent definition from *An Introduction to Music Technology* by Dan Hosken makes the opening claim that "Music technology is a broad term encompassing everything from microphones to saxophones" (Hosken 2010, 26). The opening statement of that book acknowledges, through this little rhyme, that mechanical-based technology is as important in music technology as electricity-based technology (although this is still too narrow of a definition on both sides). However, this book then immediately limits the topic to a far more narrow definition of *music-making which uses electricity*. For the purposes of an introductory book about "modern" music technology, this change allows the book to cover the intended information, in-depth, without needing an encyclopedia's worth of editions. This is similar to the current demarcation that the community-sourced Wikipedia page on the term provides, adding "especially the use of electronic devices or computer software" ("Music Technology" 2013).

In order to avoid this problem altogether, most scholars refrain from the use of the term. In his introductory book *Electronic and Experimental Music: Technology, Music, and Culture*, Thom Holmes alludes to this issue in a section on *The Debate over Terminology*, in which he acknowledges the subtle distinctions between terms used within the evolution of electronic music technology (Holmes 2008). This section grapples with the broad terms traditionally associated with music technology including *electronic music, electro-acoustic music, computer music,* and *recording arts*, as well as traditional stylistic terms such as *electronica, acousmatic, organized sound,* and *musique concrète*. However, his use of the qualifier "electronic" before "music technology" demonstrates his clear awareness that music technology, as a term, encompasses more than has typically been associated with it during the end of the 20th and start of the 21st centuries. Likewise, Joel Chadabe's *Electric Sound: The Past and Promise of Electronic Music* refrains from the use of music technology, and rarely uses the term *technology* except in the opening paragraphs of his preface (Chadabe 1996, 1). Here, Chadabe uses the idea of developments in *instrument technology* to refute a seemingly "anti-technology diatribe" (ibid.) espoused by John Philip Sousa against the potential dangers of "machinery" on the expressive beauty of music. Clearly, within the last century, Western society has come to consider technology as involving electricity. This relationship has been furthered through the historical terms identified above, which have become tightly associated with music technology. The use of electronics and computers for the production of electro-acoustic music is the cornerstone of many music technology programs and has assisted in this unnecessary relationship.

As has been mentioned and eluded to thus far, music technology encompasses much more than the production of electro-acoustic music, or the recording arts. These are, of course, immensely important areas of research and practice within today's domain of music technology, and music in general. However, by reconsidering what music technology is, the research activities of music technology departments and the practice of music composition stand to benefit.

Music

First, it is important to establish what is meant by *music* and *technology.* This is particularly important, as the question of "what is music?" is a highly subjective, and oftentimes personal definition. If music refers only to the functionally tonal music of the 17th through 19th centuries, then the discussion of knowledge systems towards music as technologies is severely restricted. Furthermore, this conservative definition omits a wonderful diversity of music, including most of the electro-acoustic music from the 20th century. Many have railed against the "cacophonous" changes in music; in 1958 one man published a list of qualifications for music that included the idea that "every tone, vocal or instrumental, should be as pure, as pleasing, and as lovely as possible" (Earhart 1958). The Christian Church also offered views throughout the development of music about the dangers of "cacophony" and complexity within music, stating that the combination of tones beyond "the natural laws" of the world should be considered dangerous and could not be called music (this, at various points, has been in reference to anything other than an octave, intervals beyond major 3rd's, or harmonies outside of western functional tonal harmony) (Isacoff 2001). These "natural laws", which were used as evidence by those claiming them as the basis for various organizations of music, also contain so many exceptions, and inconsistencies so as to counter any "law-like" property. Schoenberg emphasizes this point in his *Theory of Harmony*, in which he uses this argument as a way of explaining why "functional harmony" is not, and should not be considered as a natural requirement of music (Schoenberg 1978).

Whereas, if instead, music is allowed to "reflect the world around us" (Chadabe 2002, 559) through the influence of principles and technologies that define and reshape humanity's relationship to the world, then it becomes easier to consider the great number of musical contributions that have occurred before and after the above time period. Instead, the music of the above time period can be better understood as a reflection of the values and ethics at play in Occidental culture. For example, the Romantic ideals of the late 18th and 19th centuries of an "individual-genius" creator of art, and the desire to record, protect, and preserve his output, led to the "work of art" mentality and a canon that now dominates the world of Classical music (Born 2005; Goehr 1992).

Music can therefore be viewed as a reflection of society's values, ideals, and relationship to nature. This recognition makes it unrealistic to adopt a strict set of rules that define what music might or "should" be. For these reasons, this paper finds itself in line with the standpoints of Varèse and Cage that music is the "organization of sound" (Varèse and Wen-chung 1966; Cage 2010), regardless of whether this organization occurs through more traditional compositional means, or is the result of a listener choosing and creating music through the organization of sound events they perceive.

Technology

Considering the idea of technology by itself also helps this problem of definition. Encyclopedia Britannica defines technology as;

> ...the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment. ("Technology" 2013)

In this definition, "scientific knowledge" clearly means

> …any system of knowledge that is concerned with the physical world and its phenomena and that entails unbiased observations and systematic experimentation. ("Science" 2012)

Technology, by many accounts, is as old as humankind (Buchanan 2013; Basalla 1988). It is one of the things that differentiate humans from other species on Earth. Humans have the ability to study their world or the problems they perceive, to imagine ways of achieving a desired change, and to apply these ideas through the fabrication of systems or tools. The establishment and development of technologies allow for more efficient work towards survival, such as in the case of hunting weapons, systems for organized agricultural practices, or means of communication during battles (Changizi 2011b). It may also allow for the greater collecting of knowledge and distribution of ideas, such as the modern alphabet and printing press. Perhaps more important to consider, though, is the influence technology has on the defining characteristics of society, for example, two Stone Age era technologies, considered by many as prerequisites to civilized man: the wheel, estimated at roughly 5,000 years old, and fire, estimated at roughly 1.5 million years old (Basalla 1988).

As many are quick to address when discussing the ideas, specifics, or philosophy of technology, the word itself stems from the ancient Greek words of *techne*, and *logos* (Di Scipio 1998b; Tabachnick 2004). Techne is understood as meaning *art* or *craft*. Logos is traced as meaning *word, speech,* or even *to reason.* Compared to the modern idea of technology referring to electronic or mechanical artifacts, the understanding of these root words points towards a definition that considers the application of knowledge (logos) to making or poiesis (techne). Technologies are tools and systems for making, fixing, or addressing perceived needs within the world. These tools and systems are formed through the application of knowledge, as obtained through experience and observation. Tools are thus the "primary means by which humans control and manipulate" their world ("Tool" 2013).

Are Language and/or Music 'Technologies'?

This leaves open the questions of whether music and even language should be considered as technologies (Changizi 2011b; Changizi 2011a)? Both are clearly organized sets of knowledge that are used for making; specifically, they serve as tools of communication and knowing. Language and music are both communication skills that we must learn, as an ability to fully use these tools is not present at the time of birth, although, it would appear our brains are wired to support this development (Rizzolatti and Craighero 2004). Likewise, these tools are developed and changed over time in relation to the needs of society and the views of humanity towards itself and nature. This in itself suggests the constant reorganization of information as a way of changing the world.

Consider a related technology, the alphabet. It is clear that the Western alphabet is a technological development (McLuhan 1962; Cole 1974). The alphabet is a system for breaking up language into a symbolic representation of the shortest and most versatile sound elements. The alphabet, as a symbolic representation, was then used to record the thoughts and knowledge of people. It allowed humans to record information so that it could be shared over larger distances, or survive the mortal timescale of individuals.

Another tool related to language that could be considered technology, is the practice of *inquiry*. Inquiry is one of the ways that humans assess and discover knowledge about the world and society. It is also therefore a tool, which can be used to identify the qualities of the world that the user perceives as needing technological tools to change. Whereas the alphabet is, or can be used as, a way of directly constructing physical artifacts in the form of written language, inquiry's artifact is that of reason, knowledge, and thought. Even though it produces no physical artifacts, John Dewey considered inquiry technological as it is "the means of effective control of an environment that is not what we wish it to be" (Hickman 1990). Inquiry allows humans the ability to change their relationship to the world.

Similar to inquiry*,* music, or the organization of sound, can serve as a way for humans to reconsider their relationship to the world or the relationships of humans within the world. The established means of symbolically representing music are also analogous to the alphabets' relationship to language. Music facilitates a way of reconsidering relationships and contains systems for the organization and physical documentation of musical ideas. In addition, it can also serve as a means of communication. This is true in the case of music for important ceremonies, special occasions, and within memories; it becomes a way of continually reestablishing a connection with others in our society (Turino 2008) and as a means "for creating, enhancing, sustaining and changing subjective, cognitive, bodily and self-conceptual states" (DeNora 1999, 49). Humans can find many of these same principles at work in the use of language. It is clear that there are tools, systems, and therefore technologies that are a result of and support both music and language.

However, it is more difficult to determine whether language and music are themselves technologies. These are important questions, but require more space for a full discussion than is appropriate for the scope of this paper. Nevertheless, the presentation of these ideas is necessary in assisting and expanding the ideas of technology, music, and music technology.

Effects of Music and Technology

Just as society's relationship with and development of music is a reflection of its relationship to the world, society's relationship to and development of technology is a reflection of the qualities of life that require new or different solutions. However, it is also important to recognize the reverse of these relationships. Music, as identified above in the works of Turino and DeNora, serves as a tool to change the relationships of individuals and society with their world, for both the better, as exemplified in the work of the above, and as a means of control. Music has the ability, through evolutionary adaptations to "promote behavioral changes" (Panksepp and Bernatzky 2002), again for better and worse. The recognition of this knowledge has allowed its applied use as a technology of control to "drive your brand… [and] sales" by companies such as Muzak (Westerkamp 2011).

Just as technology is born out of the desire to change or address human necessities, it influences humanity; the same is true of music as well, and of each other. Many have pointed out the inevitable influence of technology on society and art. Marshall McLuhan, in his seminal text *Understanding Media: The Extensions of Man*, presents the mediums (or technologies) of communication that have dominated humanity at various times (McLuhan 1966). McLuhan draws connections between the advent of the "written word" and "the visual preference of western civilized society", the "typographic extension of man" and "nationalism, industrialism, mass markets, and universal literacy and education", the "car" and the "scale of our cities", and "weapons" and "control". His central claim is that "the medium is the message… [and that] …it is what shapes and controls the scale and form of human association and action" (ibid. 9). McLuhan is not alone in these endeavors, as contemporary philosophers of technology have also published observations on how technology transforms experience (Ihde 1978), and how "ambient intelligence and persuasive technologies start to interfere openly with our behavior, interacting with people in sophisticated ways and subtly persuading them to change their behavior" (Verbeek 2011).

Returning to "Music Technology"

Many artists of the idealized and romantic world hold a "standard notion of technology [that] conveys the belief that artistic ideas are independent of any specific technological substratum" (Di Scipio 1998b). A common teaching in the creation of art is to let the beauty, ideas, form, and concepts drive the creative process towards a final product instead of allowing the technological means to dictate or suggest the outcome. Many artists follow this idea by mastering the skills of their craft to a point where a gestalt-like practice can take over between them, their instrument, the style, and musical language. However, for those who wish to push the use of technology, develop new technologies to address perceived problems, and inquire into new means of expression, they must address the considerations and influences that technology will suggest. The idealized, 20th century, version of the musical genius being invited to an electronic music center where a team of sound engineers would try to fulfill his artistic vision (Di Scipio 1998b) is no longer realistic. Similarly, it is not conducive to the creation of the art of "our time". It has been observed that the technology of today has brought on a glut of information, both in terms of raw data, and in attempts to understand the potentials of the technology itself (*The Economist* 2010). This is data and information that needs to be organized in order for it to be useful. This situation, and the possible route out of it, is described very well by McLuhan from a debate he had with Norman Mailer:

> "…when [humans] are presented with too much information [they] result to pattern recognition. The contemporary artist is always seeking new pattern recognition,

> which is his task. His great need. The absolute indispensability of the artist is that he alone, in the encounter with the present, can give the pattern recognition. He alone has the century recognition to tell us what our century is made of. He alone is more important than the scientist. The scientists are going to wake up to this shortly and arrive en masse to the artist's studio in order to discover the form of the material they are dealing with." ("Norman Mailer and Marshall McLuhan Debating" 1968)

The influence of technology on music has been present throughout the history of music. Di Scipio has written a number of articles emphasizing the role of technology in modern music creation and the need for analysts of this music to know these technologies if they expect to produce a truly informed analysis of the work (Di Scipio 1998b; Di Scipio 2013; Di Scipio 2000; Di Scipio 1998a). Likewise, Dillon points out that "technology mediates our relationships with [all] creative activities" (Dillon 2007). These are modern examples, but technological advancements have driven music in major ways throughout the ages, and musicians, theorists, philosophers, and scientists have worked together to implement ideas as new technologies in order to change the world around them. These new technologies have equally influenced artists and society along the way.

Definition

The previous discussions have led to the following working definition for *music* technology:

> *Music technology is the systematic application of knowledge to evolve the means of creation and/or relationships of individuals to any act of musicking*[13].

This definition allows for recognition of the many systems, tools, and advancements that have defined music throughout the cultures of the world. More importantly, though, this definition steps away from the all too simple idea that music technology refers only to artifacts that use electricity for the creation of music. Instead, the above definition allows for the comparison of related technologies that have shaped or been shaped by music throughout human history.

Conclusion

The primary goal of this paper was to address the question of "What is music technology?". By first considering the current colloquial ideas and informal definitions of music technology, this paper located the limited definition that has been applied to this idea in recent decades. Through an examination of the principles behind technology and music, this term was repositioned. The goal of this was not to stir controversy, but rather to inquire about the role of the music technologist in relation to the world. By just touching the surface of the fields dealing with the philosophy of technology and ethics of technology, it becomes clear that the responsibility of the music technologist is larger than that of just facilitating electricity-based artifacts for the manufacturing of music. It also becomes clear that music technology, as a field of inquiry, should expand beyond the current research occurring in music cognition, immersive audio, interactive systems, and music informatics, to consider the influence of previous music technologies on these subjects, the ethical responsibilities of work within these subjects, and the ability of these subjects to facilitate the investigation and reconsideration of music relationships within society and music relationships to nature. Music, as it is today, is the result of technological advancements. Language, music, and technology are part of society, and many consider them to be as old as civilization and humankind. Musicking has become a distinguishing characteristic of humans. Music technology therefore is the study of these systems of knowledge towards music, and society, as well as the consideration of how technology and music will affect each other and society in the future.

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[13] "Musicking" as is identified in the work of (Small 1998).

References

Basalla, G. 1988. *The Evolution of Technology*. Cambridge, UK: Cambridge University Press.

Born, G. 2005. "On Musical Mediation: Ontology, Technology and Creativity." *Twentieth-Century Music* 2 (01): 7.

Buchanan, R. A. 2013. ""History of Technology." *Encyclopædia Britannica Online.* Encyclopædia Britannica Inc. http://academic.eb.com/EBchecked/topic/1350805/history-of-technology.

Cage, J. 2010. *Silence: Lectures and Writings*. Wesleyan University Press.

Chadabe, J. 1996. *Electric Sound: The Past and Promise of Electronic Music*. Pearson.

Chadabe, J. 2002. "Music and Life." *Leonardo* 35 (5): 559–60. http://www.mitpressjournals.org/doi/abs/10.1162/002409402320774376.

Changizi, M. A. 2011a. *Harnessed: How Language and Music Mimicked Nature and Transformed Ape to Man*. BenBella Books.

Changizi, M. A. 2011b. "Is Language a Technology?" *Huffington Post*, August 21. http://www.huffingtonpost.com/mark-changizi-phd/language-and-evolution_b_930075.html.

Cole, H. 1974. *Sounds and Signs: Aspects of Musical Notation. -*. Oxford University Press, Incorporated.

DeNora, T. 1999. "Music as a Technology of the Self." *Poetics* 27 (1): 31–56. \

Di Scipio, A. 1998a. "Compositional Models in Xenakis's Electro-acoustic Music." *Perspectives of New Music* 36 (2): 201–43. http://www.jstor.org/stable/10.2307/833529.

Di Scipio, A. 1998b. "Questions Concerning Music Technology." *Angelaki: Journal of the Theoretical Humanities* 3 (2): 31–40. http://www.tandfonline.com/doi/pdf/10.1080/09697259808571982.

Di Scipio, A. 2000. "An Analysis of Jean-Claude Risset's Contours." *Journal of New Music Research* 29 (1): 1–21. http://www.tandfonline.com/doi/abs/10.1076/0929-8215(200003)29%3A01%3B1-P%3BFT001.

Di Scipio, A. 2013. "The Place and Meaning of Computing in a Sound Relationship of Man, Machines, and Environment." In *Keynote Address - International Computer Music Conference (ICMC 2013)*. Perth, Australia.

Dillon, S. 2007. *Music, Meaning and Transformation*. Newcastle, UK: Cambridge Scholars Publishing. http://eprints.qut.edu.au/24153/.

Earhart, W. 1958. "What Is Music For?" *Music Educators Journal* 44 (6): 23–26.

Goehr, L. 1992. *The Imaginary Museum of Musical Works : An Essay in the Philosophy of Music: An Essay in the Philosophy of Music*. Clarendon Press.

Hickman, L. A. 1990. *John Dewey's Pragmatic Technology*. Bloomington, IN: Indiana University Press.

Holmes, T. 2008. *Electronic and Experimental Music: Technology, Music, and Culture*. Routledge.

Hosken, D. 2010. *An Introduction to Music Technology*. *Routledge*. 2nd Editio. Routledge.

Ihde, D. 1978. *Technics and Praxis*. Springer Science & Business Media.

Isacoff, S. 2001. *Temperament: The Idea That Solved Music's Greatest Riddle*. Alfred A. Knopf.

McLuhan, M. 1962. *The Gutenberg Galexy*. *Toronto: University of Toronto*. Toronto, Canada: University of Toronto Press. https://brainmass.com/file/4662/The+Gutenberg+Galaxy.doc.

McLuhan, M. 1966. *Understanding Media: The Extensions of Man*. Scarborough, Ont. : New American Library.

McLuhan, M., and N. Mailer. "Norman Mailer and Marshall McLuhan Debating 1968." 1968. Canada: Canadian Broadcasting Company. http://www.youtube.com/watch?v=PtzxWR-j1xY.

"Music Technology." 2013. *Wikipedia*. Accessed November 2. http://en.wikipedia.org/wiki/Music_technology.

Panksepp, J, and G. Bernatzky. 2002. "Emotional Sounds and the Brain: The Neuro-Affective Foundations of Musical Appreciation." *Behavioural Processes* 60 (2): 133–55. http://www.ncbi.nlm.nih.gov/pubmed/12426066.

Rizzolatti, G., and L. Craighero. 2004. "The Mirror-Neuron System." *Annual Review of Neuroscience* 27 (January): 169–92.

Schoenberg, A. 1978. *Theory of Harmony*. Edited by Roy E. Cater. University of California Press.

"Science." 2012. *Encyclopaedia Britannica. Encyclopaedia Britannica Online Academic Edition.* Encyclopædia Britannica Inc. http://www.britannica.com/topic/science.

Small, C. 1998. *Musicking: The Meanings of Performing and Listening (Music Culture)*. Wesleyan.

Tabachnick, D. E. 2004. "Techne, Technology and Tragedy." *Techné: Research in Philosophy and Technology* 7 (3). http://scholar.lib.vt.edu/ejournals/SPT/v7n3/tabachnick.html.

"Technology." 2013. *Encyclopædia Britannica Online.* Encyclopædia Britannica Inc.

The Economist. 2010. "Data, Data Everywhere," February. http://www.economist.com/node/15557443.

"Tool." 2013. *Encyclopædia Britannica Online.* Encyclopædia Britannica Inc. http://www.britannica.com/technology/tool.

Turino, T. 2008. *Music as Social Life: The Politics of Participation*. University of Chicago Press.

Varèse, E., and C. Wen-chung. 1966. "The Liberation of Sound." *Perspectives of New Music* 5 (1): 11–19. http://www.jstor.org/stable/10.2307/832385.

Verbeek, P. P. 2011. *Moralizing Technology: Understanding and Designing the Morality of Things*. University of Chicago Press.

Webster, P. 2002. "Historical Perspectives on Technology and Music." *Music Educators Journal* 89 (1): 38–43. http://eric.ed.gov/?id=EJ676765.

Westerkamp, H. 2011. "Exploring Balance & Focus in Acoustic Ecology." *Soundscape: The Journal of Acoustic Ecology* 11 (1): 7–13.

Events

Cinesonika 2: Celebrating the Soundtrack
The Second International Film and Video Festival of Sound Design
Simon Fraser University Surrey, Vancouver, B.C.
February 17-19, 2012

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Film and video are audiovisual arts, yet their study has historically been skewed in favor of the visual. This predilection is inscribed even in the etymology of the word "video," and the principle has also been enshrined in cinema criticism. However, the last two decades have seen the emergence of scholarship that contemplates the interaction of sound and image in moving media, considering sound and image as equally important and capable of reciprocal influence. This evolution in the field owes much to the work of the composer and musicologist Michel Chion, who has proposed in several influential books, including *Audio-Vision: Sound and Image in the Cinema (*1990), that film needs to be understood as an art where sound influences visual experience and vice versa.

Chion's work was invoked several times by presenters at Cinesonika 2 and, in general, the spirit of his scholarship seemed to hover over the proceedings. This invocation of the spirit of Chion's work was a logical step, since this year's renewal of the international film and video festival was intended to celebrate the filmic soundtrack. In the words of Michael Filimowicz, the festival's founder and director: "Usually in cinema festivals there is a fixation on movie stars, or captivating imagery, or the literary qualities of screenplays. Sound tends to be relatively unvalorized in moving-image making. The intent of the Cinesonika festival is to give attention to innovative work in the creation of film and video soundtracks, and to give due credit to the importance of audio in audiovisual media." In keeping with this stated goal, many of the scholars presenting work at Saturday's conference proffered new interpretive perspectives on filmic footage characterized by the analysis of reciprocal audio/visual interactions. Likewise, many of the films in Sunday's film festival explored the potential relations of sound to the moving image in novel and exciting ways, featuring eclectic scoring, extraordinary soundtracks, and idiosyncratic sound design.

One of Cinesonika's most enjoyable aspects was the way the conference schedule embraced theory and practice, bringing together sound designers and Foley artists with scholars who approached film from a more academic perspective. Presenters at Saturday's conference came from a wide variety of different disciplinary backgrounds and dealt with topics ranging from the theory-driven to the technology-intensive.

Andreas Floros and Nikolas Grigoriou of Ionian University in Greece discussed recent technical advances in real-time spatial audio restoration and enhancement. Foley artist Vanessa Ament analyzed sound design in *Bram Stoker's Dracula*, referencing the sound in that film as work that exemplifies an aesthetic of "sound excess." Kurt Daugherty of Loyola Marymount University presented a paper on 5.1 surround location sound recording. Sheldon Schiffer, Associate Professor at Georgia State University, examined the production of body-derived Foley sound and the effect that such enhancements have on listeners' experience, addressing specific examples such as amplified sounds of heavy breathing and punches landing. Conference director Michael Filimowicz enumerated five hermeneutic modalities of sound design in his presentation, considering examples of sound from Jan Svankmeyer's *Alice,* Stanley Kubrick's *2001: A Space Odyssey*, Akira Kurosawa's *Red Beard*, and Krzysztov Kieslowski's *Decalogue 2*.

During Saturday's sessions, a number of art historians and film studies scholars considered limit cases in moving image media where the relation of sound to image diverges widely from conventional expectations. Lawrence Andrews, Chair of Film and Digital Media at University of California Santa Cruz, presented a paper titled "Rendering the invisible in the movement from sonic to animated spaces," drawing examples from his own work in progress, the animated film *OwnerBuilt.* Aysha Iqbal Viswamohan of the Indian Institute of Technology, Madras described the evolving conventions of background music in some recently produced Bollywood musicals. Shaun Inouye and Babak Tabarree, Master's candidates in film studies at the University of British Columbia, addressed uses of silence and evocations of acousmetric presences in films by Harmony Korine and Abbas Kiarostami. Godfre Leung of Western Michigan University analyzed medium-specific modes of listening in different editions of *Thursday Afternoon*, one of Brian Eno's so-called "video paintings" from the 1980s. Luke Fidler of Northwestern University addressed the use of the soundtrack in Aleksandr Sokurov's *Moscow Elegy,* which mourns Andrei Tarkovsky and documents the director's last days. The author of this review spoke about failed lip sync effects in works of video art form the 1970s by Steina Vasulka, Bruce Nauman, Richard Serra, and Nancy Holt, concluding that the artists in question used this medium-specific effect to criticize, celebrate, or simply document the postmodern debasement of auditory presence.

Innovative treatments of the audio/visual relationship also characterized the 42 films from 12 countries that were screened Sunday in the Cinesonika film festival at the Westminster Savings Credit Union — Simon Fraser University Surrey Theatre. Films were grouped into six categories: narrative feature, visual music, documentary, sonic narrative, cinepoetry, and animation. Rubaiyat Hossain's *Meherjaan* and Sheldon Schiffer's *Transmigration*, a lushly realized depiction of fugue state in the Brazilian rain forest, represented the narrative feature category.

Several directors, including Schiffer, were present to introduce their films in person. Michael Drews and Jordan Munson discussed directorial decisions that shaped their *Noir*, a purist take on the eponymous genre that preserved a sense of nameless dread while jettisoning most elements of conventional narrative. Paul Glennon presented *VOYAGE*, a vividly scored short made using an iPhone and designed for individual Internet consumption. Claudia X. Valdes and William Fowler Collins introduced a screening of_*The Sixth Magnitude,* which paired abstract motion graphics with an ambient track from Collins' album *Perdition Hill Radio*.

The festival films were too numerous to summarize here in their entirety, but certain common themes could be discerned among them. One of these was the appearance of multiple analog utopias, nostalgia-infused futurisms drenched in the paranoia of the Cold War and replete with identifiably midcentury sights and sounds. Paul Donoghue's *Phasing Waves*, an abstract short recorded live in the experimental TV Studio New York using '80s technology, fell into this category. So did *Magnetic Resonance Medley*, a quasi-autobiographical variation on the mad-scientist plot by poet and filmmaker H. Michael Sanders. Piotr Tolmachov's *Collapsing Radioforce Mantras* paired rare Soviet sci-fi footage with a memorable techno-electric score built from tape-recorded samples made during his brother's military service in the USSR during the 1980s.

Cinesonika 2 was noteworthy for the opportunities it presented for relaxed and informal interactions among participants. Good cheer and stimulating conversation were in plentiful supply at the conference lunches and dinners, as well as during the question and answer sessions that followed each event. The beautiful city of Vancouver and its suburb of Surrey proved a welcoming and cosmopolitan site for the proceedings. Michael Filimowicz and his team of resourceful student volunteers from Simon Fraser University went well beyond the call of duty in welcoming conference participants to the locality, solving logistical problems, facilitating audiovisual tech support, and making sure that all ran smoothly over the course of the weekend's events. The conference succeeded in forging connections among film studies specialists, art historians, sound designers, musicians, and filmmakers. And the conference papers, many of which will be published in an upcoming issue of *The Soundtrack*, set an important precedent for the contemporary study of sound as it relates to moving image media.

Good news, then, for the fields of sound and image studies that the festival will be returning for a third iteration next year. It will be expanding as well as moving to a European location for the first time. Cinesonika 3 will be hosted at the School of Creative Arts, University of Ulster, Derry/Londonderry, Northern Ireland in February 2013.

EMS12: Meaning and Meaningfulness in Electro-acoustic Music

11-15 June, Stockholm, Sweden

Review by Hubert Howe
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The Electro-acoustic Music Studies Network (EMSN) is an international initiative which aims to encourage better understanding of electro-acoustic music in terms of its genesis, evolution, and current manifestations. The organization, which has been active since 2003, was started by Marc Battier (University of Paris, Sorbonne) and Leigh Landy (MTI Research Centre, De Montfort University, UK), and later added Daniel Teruggi (INA-GRM)[14]. The main activity of the group is to sponsor conferences, usually devoted to a particular theme; all this activity, including the proceedings of all conferences, is documented on the web site. Papers may be given in either English or French, and membership is truly international, including people from Asia, Australia, Europe, and the Americas. The first conference was held in 2003, and they have been held annually since 2005, making "EMS12" not the twelfth conference, but the 2012 conference.

Concerts are not the main activity of EMSN gatherings. Although they do take place, they are not the focus of the meetings, and are organized by the presenters almost as an afterthought. Membership includes some leading composers of electro-acoustic music, and many others who are devoted to raising the level of understanding of the art, as well as those who simply wish to explore the music in greater depth, in other words, the electro-acoustic music intelligentsia. These meetings always take place in early June.

EMS12 took place in Stockholm, Sweden, and was organized by William Brunson of the Royal College of Music (KHM) and Mats Lindström of Elektronmusikstudion. Its stated subject of "meaning and meaningfulness in electro-acoustic music" is what attracted my attention in the first place. Sweden has a long history of involvement with electro-acoustic music, as was clearly in evidence in the presentations at the conference itself. Many of the papers presented at EMS12 were reports of detailed research projects, while others, like my own, were more speculative. The first day of the conference was devoted to a roundtable discussion, a keynote address Swedish composer Lars-Gunnar Bodin, and a concert to finish the day. Tuesday through Thursday featured full days of papers, with concerts in the evenings, and Friday had only morning sessions. There were plenty of opportunities to renew old friendships and make new ones.

Lars-Gunnar Bodin's address was full of his reminiscences of his long involvement with electro-acoustic music and some of the trials and tribulations he went through in the early days. But he was sometimes hard to follow, because he simply wasn't comfortable speaking in English, and read his presentation in a mostly monotone style, which may have caused some to tune out. There were few people with his depth of experience at the conference.

An interesting thing that I found in listening to many of the presentations was that some on what seemed to be inconsequential or minor topics turned out to be quite interesting, while others that had promised insightful conclusions turned out to have less. The topic of "meaning" brought out all kinds of responses, including the topics of aesthetics, semiotics, perception, and detailed categorizations of the emotions that music arouses. One of the truly unexpected things I found was that there were several papers on the music of Luc Ferrari, one of which discussed the meaning of some aspects of his oeuvre. At least in those papers, specific works

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[14] http://www.ems-network.org

were discussed. Many of the papers did not focus on the details of individual works but instead gave more general impressions about the whole experience of electro-acoustic music, which did not always seem to have relevance to any specific piece. It is not surprising that there were such diverse viewpoints expressed by different practitioners.

Probably the most well-organized and best presentation at the conference was by Leigh Landy and Simon Emmerson. They gave a joint presentation so "crisp" that a sentence begun by one of them could be completed by the other. They addressed the general problem of sorting electro-acoustic music (often abbreviated "EA music") into genres, noting that many ideas soon become hybridized with others. They used a variety of new tools, including computer aided music analysis techniques. Some of the genres they identify include acousmatic, electronica, and glitch, but these categories aren't always discernible from the sounds alone. It is amazing that such a seemingly simple problem can have so many non-obvious ramifications.

A related presentation was by Pierre Couprie, who is developing the software used by Emmerson and Landy to analyze EA music. He explained why analyzing this music is different from instrumental music and mentioned "the blurred border between sounds and music." His analytical tools can even be adapted for "different types of audience: specialists, musicians, teachers, children, etc."

Kerry Hagan of the University of Limerick in Ireland addressed the question of meaning in electro-acoustic music by discussing her way of interpreting several different but well-known works, each of which required a different approach. Her paper yielded many important insights, and she also remarked on how the question of meaning in electro-acoustic and acoustic music can be quite different.

Another interesting and unusual paper was by Peter Rothbart of Ithaca College, who discussed ethnic qualities in electro-acoustic music. While EA music is usually discussed in terms of its technical, technological, or geographic qualities, he pointed out that there are remarkable similarities between the works of certain composers and the ethnic music of their cultural background. He also pointed out how many works are united by the equipment that was used in their creation. His examples were amazingly convincing.

Many of the papers discussed ongoing research projects. One of these was by Monty Adkins of the University of Huddersfield in England. He discussed the *Audiomobiles* of Roberto Gerhard, written in the late 1950s. These were some of the first electro-acoustic music works created in England by a composer who was well known from his many instrumental works. He discussed Gerhard's sound sources and methodology. These works are little known outside the UK, but from his discussion they certainly seem worthy of broader exposure.

Another research project of sorts was by PerMagnus Lindborg of Nanyang Technological University in Singapore, the "soundscape emotion" study. Field recordings were made of everyday sonic environments, and selected excerpts were played for individual subjects who had also taken a personality index test. The main conclusion was that personality and mood influence how music is perceived. While this outcome may not seem remarkable, the study is continuing.

Gary Kendall, until recently of Queen's University Belfast (UK), presented "a model of mental layers in the process of listening." While this has been an active research area of his for a while, this paper was not a report of specific results. He has broken down the process by which listener comes to terms with a piece of music into five distinct layers, which he names sensations, gist, locus, contexts, and domains. The only musical example he gave in this lecture was a 20-second excerpt from Stockhausen's *Telemusik,* which consists only of "an interrupted high-frequency cluster during which almost nothing happens." It was remarkable that such an excerpt could give rise to such detailed speculations about the acquisition of meaning.

Other presentations were just as detailed, but less convincing. Pascal Terrien, of the Université Catholique de l'Ouest and the Conservatoire National Supérieur de Musique et de Danse de Paris, gave a detailed description of the process by which a listener tries to make sense of an electro-acoustic piece he hears for the first time. He had detailed descriptions of elements that the listener would supposedly recognize the first, second, third, etc. times that he or she hears a new work, including a detailed classification of the emotions. While backed up by a study of fifty listeners, including amateur musicians and non-musicians, I am not convinced of his conclusion. Most people who listen to and take electro-acoustic music seriously listen to their favorite pieces many more times before forming their interpretations anyway.

James Harley, the author of a comprehensive and authoritative book on the music of Xenakis, with whom he studied, discussed instrumental sources in that composer's music from 1967 to 1970, showing how he recycled and reshaped some of the same materials into different works. Among other things, he revealed how hard-working and inventive Xenakis was, and how the ideas he developed at this time helped shape all his future EA works.

Another paper, by Frédérick Duhautpas of the Université Montpellier III (France) and others, discussed "The Question of Meaning in the Electro-acoustic Music of Iannis Xenakis" with specific reference to *La Légende d'Eer.* They argued partly that the presence of extra-musical sounds forces a redefinition of the way we approach listening to this music.

Many papers were devoted to pedagogical aspects of electro-acoustic music, including subject matter, curriculum, and for whom the study is directed. Robert Nomandeau of the Université de Montréal discussed the program there, but others were more general. Nasia Therapontos of De Monfort University (UK) discussed how musical meaning should be addressed in such curricula. William Brunson made a good case for electro-acoustic music as narrative. James Andean of the Sibelius Academy in Finland showed how, while the subjects taught in EA music (its tools, techniques, and traditions) seem simple enough, each of them is "thoroughly problematic."

One of the most interesting of these papers was by Lin-Ni Liao of the Université Paris-Sorbonne. She discussed the "cross cultural dilemma" between the Western intellectual tradition of music and the Far Eastern "quest of spiritual harmony." EA music is now practiced widely in the countries of Asia, but many people there are unconscious of the cultural conflicts. She demonstrated these conflicts with specific examples from music by Asian composers.

Just as Ms. Liao had hinted, there were several papers by Asian composers that reflected, at least from my perspective, cultural issues that were not as objective as they may seem. Chih-Fang Huang of Yuan Ze University (Taiwan) and others reported on a study of "Peking Opera Music Automated Composition Based on Rhythm Meaning Retrieval." Their intention was to perform automated composition that would be similar to actual Peking Opera music. Yuriko Hase Kojima of Shobi University (Japan) reflected on the "meaning" of water sounds in tape music and noted how listeners "sometimes get lost within the boundaries between music and raw sound materials." Mikako Mizuno of Nagoya City University (Japan) discussed the reception of the Pierre Schaeffer's music in Japan from 1952 onwards by composers, musicologists, and theorists. Ruibo Zhang (also known by his nickname Mungo) of Shenyang Conservatory of Music (China), noted that EA music is still in its infancy in China, and attacked the cultural problem head on in his paper entitled "The Influences of International Conferences ... to Chinese Academic Research Regarding Electro-acoustic Music."

Several papers were devoted especially to improvisation in electro-acoustic music. Per Anders Nilsson, an improvising composer, discussed "the meaning of the instrument," and Simonetta Sargenti, and composer and violinist, discussed gesture in interactive composition. Pierre Alexandre Tremblay discussed "mixing the immiscible," in which he argued that "mastered improvisation" was a means to "bridge the historical dichotomy between ... the 'aesthetics of perfection' and 'the aesthetics of imperfection'."

It was amazing to me that so many interesting papers were concerned with the music of as inconsequential composer as Luc Ferrari, whose recent passing may have stimulated these speculations. Tatjana Böhme-Mehner of the Hochschule für Musik "Carl Maria von Weber" discussed "meaning and meaningfulness" in his anecdotal music. She pointed out that such music challenges traditional assumptions and gives rise to interesting concepts of the nature of internal and external meanings in music. Daniel Warner of Hampshire College in Massachusetts argued that Ferrari's *Presque Rien No. 1* was a "seminal musical composition." He discussed "not only what the musical composition may mean, but ... what it means to musically signify in the fullness of subjectivity." Martin Rumori, of the University of Music and Performing Arts, Graz (Austria), delved straight into the problems of using musical anecdotes themselves. Other papers mentioned Ferrari as well.

Two papers discussed the music of individual composers whose work is now not widely known. Gergely Loch of the Liszt Academy of Music (Hungary) discussed *Twelve Stations,* a six and a half hour-long composition by the Hungarian composer Ákos Rózmann (1939-2005), who was active in Sweden between 1971 and 2005. This work relates to the Buddhist concept of moving from samsara to nirvana, or from hell to heaven. Kai Lassfolk and Mikko Ojanen of the University of Helsinki (Finland) discussed the work of Erkki Kurenneieme (b. 1941), who "was a central figure in Finnish experimental and avant-garde scene in the 1960s and early 1970s." He produced a large amount of electro-acoustic material that was used by him and other composers in the creation of some works, but which was also available as raw, unprocessed material. This prompted speculations on "the definition and meaning of the work-concept in electro-acoustic music."

As mentioned above, the concerts were not the main focus of the conference, but they did include some noteworthy moments. There was a short concert at the Royal College of Music on the opening night that included an interesting piece by Lars-Gunnar Bodin, as well as some student works. To me, the most interesting concert was at a space known as Audiorama, installed in a former torpedo factory. It is a small "black box" theater surrounding the small audience (there were only about 50 seats) with 21 speakers and programmable lights to provide both an audio and a visual experience. The final concert was at the Fylkingen society, the organization devoted to promoting new music of all types in Sweden. The works played demonstrated some of the society's long history. The concluding work featured a section in which the composer dipped her hands in what looked like flour or corn starch and rubbed various objects to produce noises of various kinds.

There were many other presentations at the EMS12 conference, but I did not hear them all, and the ones I have discussed made the greatest impressions on me. The papers were certainly thought-provoking, and both raised and answered many interesting questions. One of the final issues that I am left with is the conundrum of what exactly is and is not included under the definition of "electro-acoustic music" in the first place. Some of the speakers seemed to have very definite ideas such as, for example, that "sound-based" music is included but "note-based" music is excluded. Others seemed to argue that electro-acoustic music always involves references to extra-musical sounds and connotations. My own presentation, "Reality and Unreality in the Interpretation of Electro-acoustic Music," argued that we may need to give up the extra-musical connotations in order to understand the music, and that even the same sounds at different times will have different meanings. Nevertheless, if music is based on environmental sounds, those connotations will always be present on at least some level. This organization and its conferences will provide an excellent forum for discussing these issues in the future.

International Conference on Auditory Display 2012

Reviewed by Mason Bretan
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The 2012 International Conference on Auditory Display (ICAD) was held June 18th through June 21, 2012 in Atlanta, Georgia at Georgia Tech's historic Academy of Medicine. The event marked the 20th anniversary of ICAD, and lent itself to some fascinating discussions exploring both the scientific and artistic practices of sound as a communicative display. Unlike many conferences that appeal to either the scientific or the artistic, ICAD provides a setting for individuals of both mindsets, thus giving attendees a unique opportunity for informed discourse involving multiple perspectives. The conference was highlighted by installations from the Sonification Contest and an evening musical performance with Sonic Generator, Atlanta's contemporary music ensemble.

Elizabeth Mynatt (Professor of Interactive Computing and Executive Director of Georgia Tech's Institute for People and Technology) and Jonathan Berger (Denning Provostial Professor in Music, The Center for Computer Research in Music and Acoustics (CCRMA), Stanford University) gave compelling keynotes on the first and second days of the conference, respectively. In the keynote, entitled "Reflections of a Girl Audio Geek", Mynatt described her relationship with sound. She recounted her experiences involving auditory research, the community dedicated to understanding sound, and the community of people who use hearing as the dominant sense to experience the world. She detailed the lessons learned from these experiences and how they informed everything from her research in designing auditory displays and interfaces to understanding the fundamental qualities of humans such as conveying and experiencing emotion. Jonathan Berger spoke on the effects of auditory surprise and of expectation realization and violation. He suggested though surprise is such a critical component of effective auditory display and elicits such a significant emotive response, it is a technique in composition and sonification that is best used sparingly.

The presentations encompassed several interesting topics including themes from spatial audio, sonification, and auditory interfaces. Despite what may be considered somewhat of a niche field, the presenters demonstrated the growing implications of the research, as experiments related to auditory display have become more pervasive to include a wide array of practical and artistic applications. Some of the most intriguing papers came from a paper session led by Myounghoon Jeon on the theme of sound and movement. Several presenters described methods of sonifying movements for analysis (for example, sonifying pressure changes while swimming). Nina Schaffert and Klaus Mattes took this a step further and presented a system which allowed for real-time acoustic feedback while rowing to induce an adaptive training scheme (implementing their system with Germany's Olympic rowing team to positive results). Some presentations involving more artistic themed installations included, "Tweetscapes", a real-time sonification of Twitter data, and a brain sonification (of fMRI data) system that utilizes 3D sound.

One of the highlights of the conference was the evening concert with Sonic Generator, the contemporary music ensemble-in-residence at Georgia Tech. The concert featured music by Jonathan Berger, Steve Reich, Charles Dodge, Visda Goudarzi, and Katharina Vogt. The concert theme kept in line with the ideals and focus of ICAD, showcasing music that transformed various types of data into sonic form. Often what makes listening to an algorithmic composition or sonification an interesting and engrossing experience is listening for any unique components of the music that may arise as a result of the algorithm or the input data. Concertgoers were treated to four very different takes on algorithmic music. Berger's piece, *Doubles,* uses seventeenth century ornamentation techniques to reference songs and sounds representative of peace, freedom, and resistance. *Viola Elegy* by Dodge more literally makes use of the word algorithm and draws upon fractals for its creative inspiration. Perhaps the most entertaining and impressive piece of the night was a riveting rendition of Reich's famous minimalist composition, *Piano Phase,* on two marimbas.

Each year composers, sound artists, and researchers are invited to create sonifications for the ICAD sonification competition. Participants are given a dataset or theme to sonify. This year the competition adopted the theme: Listening to the World Listening, "as it challenges us to explore what we can learn about listening through the analysis and sonification of social media data about listening." Entrants were invited to use any API that could help in obtaining social media listening data such as Twitter, MusicBrainz, or The Echo Nest. This year's winner, Andrea Vigani (Como Conservatory, Italy), used Social Genius' web service, *Twitter Music Trends*, to collect a dataset of music related tweets. Vigani developed a software instrument in which the sound was generated by the combination of information collected from the tweets (for example, Artists names and Twitter Ids) and the process in which this data was converted to machine code. Various forms of sound synthesis and speech synthesis software were used to create a sonification that allowed listeners to understand which musical artists were currently trending.

Ultimately ICAD 2012 was a success in that it provided attendees an opportunity to appreciate, converse, and listen to the latest developments in sonification and auditory display. Although the substantial amount of fascinating discourse that occurred is encouraging to the field, it is important to realize that there is still much to explore and develop with respect to auditory display and sonification. The friendly and dedicated nature of ICAD encourages discussion concerning the potential of particular presentations and research. For instance, during the presentation regarding the analysis of swimming and motion, the President of ICAD, Bruce Walker, pondered whether the next step in the research is to use such a sonic analysis to teach or aid swimmers in becoming better or more proficient. It is exciting to anticipate what innovations in sound research and composition may be presented next year as a result of what was discussed at ICAD 2012.

John Sampen and Mark Bunce Concert

Reviewed by John C. Griffin
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On March 30, 2012, I attended a recital at Western Michigan University in Kalamazoo featuring saxophonist John Sampen and Mark Bunce on electronics. Both artists are on the faculty of Bowling Green State University. Sampen is a specialist in new music and has commissioned many pieces during his career, including works by Babbitt, Lutosławski, and Stockhausen. He is the recipient of NEA and Meet the Composer grants as well as the first classical performer to solo on the Yamaha WX7 Wind Controller. Bunce is a composer and the Director of Recording Services at the university.

The theme of the concert was “Mysterious Morning: Spiritual Music of Asia and the Americas.” Nearly all the compositions included electronics and visual projection, both of which were put to effective use. In order to give the impression that they were present in the concert space, each piece was introduced by a sound recording of the composer discussing the composition or the creative process. With the exception of the final work on the program, the whole recital was played without interruption, thus creating a continuous flow of ideas.

Before the live concert began, a recording of *Four 5*, an electro-acoustic work by John Cage commissioned by Sampen was played through onstage speakers to set the mood for the upcoming recital. For his first piece on the program, Sampen chose Marilyn Shrude’s *Trope* for saxophone and electronics, which he began playing as he walked on stage. At the start, the stage was in near-darkness, but more light was added as the piece progressed. This performance featured a screen animation of a constantly moving line that curved and ran in multiple directions, an effective combination of music and image.

Fuminori Tanada’s *Mysterious Morning III* incorporated several virtuosic extended techniques for the saxophone, such as multiphonics and key clicks, that demonstrated the performer’s prowess on the instrument. Toru Takemitsu’s *Distance*, while also including many extended techniques, was a more serene piece and had a less strident overall timbre than Tanada’s work. It featured interactive electronics, along with beautiful images of Japanese rock gardens.

A highlight of the program was Mark Bunce’s *Schrödinger’s Cat*, an exploration of the origins of the universe. The piece featured electronics and video projection of outer space (along with subliminal cat imagery!). The electronic sounds were beautiful and sophisticated, perfectly integrated with those of the saxophone. Listening to his composition, the listener certainly did get a feeling for the vastness of the cosmos.

Another highlight was William Bolcom’s *A Short Lecture on the Saxophone*, composed for Sampen in 1979, a fun and slightly irreverent look at the saxophone’s place in musical history.

It required the performer not only to play original music and famous musical excerpts, but also to recite a satirical speech written by Bolcom. While this piece did not incorporate any electronics, there were projected images that served as visual aids to accompany the "lecture."

The recital concluded with a work by Morton Subotnick, originally composed in 1988. The instrumentation initially included a Yamaha WX7 Wind Controller and interactive computer. In the 1990s the technology needed to perform the piece became obsolete, but recently a new version was created using the Max/MSP programming language, allowing Sampen to play this work again after a hiatus of several years. The electronic sounds used in the composition seemed "old-fashioned" but were entertaining nonetheless and well worth preserving. It is fortunate indeed that this work is now receiving a second life. Out of respect for the composer's wishes, this was the only piece on the program that did not feature any background screen projection.

Overall, Mr. Sampen's recital demonstrated remarkable virtuosity and tremendous respect for new music. It was a unique, well-integrated blend of live musical performance, electronics, visual images, spoken words, and lighting design. It is a pleasure to applaud this musician who champions the production and performance of new works, both acoustic and electronic, and serves to move art music into the twenty-first century.

Publications

Kyma and the SumOfSines Disco Club

by Jeffrey Stolet

273 pages, lulu.com, 2012, $40.

Reviewed by Brett Wartchow
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Kyma and the SumOfSines Disco Club (*KSOSDC*) by Jeffrey Stolet, University of Oregon, provides a substantive resource for a growing and increasingly diverse Kyma user base. An exhaustive technical reference enhanced by an approachable narrative-style presentation, the book occupies a unique space in the Kyma world. Stolet's self-described "Kyma novel" is the first instructional text published since the release of Kyma's official operator's manual, *Kyma X Revealed* (2004), authored by Carla Scaletti, the system's co-creator. Stolet reinforces fundamental concepts introduced in *Revealed*, but only as necessary to establish context for his book's underlying purpose: to present Kyma as an expressive language for generating, molding, and performing digital audio data as expressive media. The book is also autobiographical narrative of seeking the fabled SOS Disco Club among the streets and alleys of Xi'an, China.

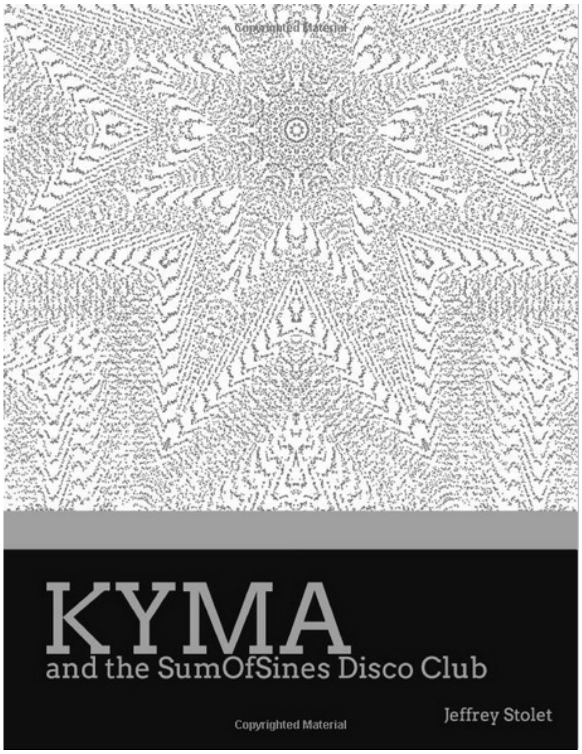

Figure 1. Kyma and the SumOfSines Disco Club book cover

Not including the Introduction and Index, the book is organized in 17 sections that address every aspect of the Kyma system. The brief opening, "What is Kyma", establishes a conceptual baseline for upcoming topics, namely understanding Kyma as a data-driven language. The following section, "How to Connect a Kyma System", guides readers though the process of integrating Kyma into a studio work space. While much of this information is already available online, its inclusion here as a print reference is welcomed.

The next section, "Sound and Sound Objects", defines Kyma's graphical user interface, while "Sound Files" and "Where to get Kyma Sounds and Sound Objects" instruct readers how to navigate the system's software and archival scheme. Information in these sections is presented cogently and succinctly. Readers new to the system, even those without experience in computer music or object-oriented software, should have no problem learning the principles of Kyma's Sound objects, the system's "fundamental building blocks." Graphic depictions are clearly explained, definitions and key-commands are highlighted in bold, and footnotes offer elucidation without interrupting the narrative pace.

"Sound Editor" explains the signal flow and parameter fields, the heart of Kyma's sound design environment. Here, the author expands on previous topics by illustrating how Kyma's Sound objects can be algorithmically networked and customized. As before, fundamental definitions and concepts are outlined before interrelationships are revealed. Nothing is left out, but the presentation is never ponderous, as graphic examples remain plentiful and diagrams clearly illustrate abstract ideas.

"CapyTalk" expounds on themes already addressed and offers a detailed overview of Kyma's powerful real-time event language. More than a mere crash course in real-time control, this section describes how to integrate the flow of MIDI data and connects readers with a repertoire of CapyTalk expressions that, with dedicated study and practice, can yield fluency. As the author pairs this information with suggested aesthetic considerations and philosophical viewpoints, readers become equipped with a conceptual base for understanding Kyma as a language for interacting with and expressing data: "Grow to understand the poetics of the algorithm." The ensuing section, "Virtual Control Surface — Virtual Control Surface Editor" describes Kyma's set of customizable interface objects (potentiometers, faders, buttons, and toggles) used for real-time sound control. "Seeing and Realizing Sound" introduces Kyma's oscilloscope and spectrum analyzer displays that enable users to view the output of any Kyma Sound.

As the title indicates, "Fifty Essential Sound Objects" articulates the technical verities of 50 Kyma Sound objects. The section is divided among seven categories: Generators, Mixing and Spatialization, Spectral Modifiers, Non-Spectral Modifiers, Control, Live Performance, and Other. Functionally akin to the *U.S. Army Survival Manual*, this richly detailed reference offers information and insights that every user at every level will find repeatedly insightful. Beyond providing standard overviews, special attention is devoted to describing how effective ranges of numerical values can be included in Sound objects' parameter fields, what methods are "effective, interesting, or efficient manners in realizing numerical values to control these Sound objects", and how these objects can be algorithmically networked within the signal flow.

The "Sample Editor" section instructs how to use Kyma's dedicated audio editing environment, and introduces readers to necessary concepts for the ensuing section, "Sample file types, their editors, and the Sounds that use them". Here, explanations of non-audio file types and their associated sounds are presented with Kyma's high-powered suite of utilities and editors. While each of these tools is explained clearly and completely, the author's in-depth description of both Kyma's spectral analysis/resynthesis structure, as well as that of the Time Alignment Utility (TAU), is especially instructive. Readers will especially benefit from a presentation that makes the highly complex operations of these utilities immediately apparent and rewarding to use. Having been presented with all the materials to successfully navigate and utilize the full extent of Kyma's Sound objects, the "Sound Object Dictionary" serves as a quick reference to every Sound available in Kyma's Sound object library (at the point of the book's 2011 publication date).

"Timeline" informs readers how to make full use of Kyma's scheduling, mixing, and spatialization environment. Important information regarding the similarities and differences between the Kyma Timeline and other DAW sequencers is discussed here. While the expected overview of interface tools, timecode, etc. is a general focus, information is presented in a way that encourages engagement with the Timeline as an expressive instrument in its own right.

The sections “Menu Items” and “Convenient Utilities” are self-explanatory and detail the aspects of Kyma yet to be addressed. “Miscellaneous Topics and Random Bits of Information” includes the author’s final offering of useful hints and wisdom. Despite it being the last section, this section merits thorough study, as it presents some of the book’s most interesting “under the hood” perspectives on Kyma functionality.

Clear, often humorous, and always insightful, *KSOSDC* succeeds in revealing Kyma’s underlying reality as a language for interacting with data as expressive media. The text’s systematic narrative instructs readers via accretion, and sections such as “Fifty Essential Sound Objects” and “Sound Object Dictionary” serve as a quickly navigable desktop reference. Beyond this, *KSOSDC* achieves another goal. Like classic composition texts, such as Fux’s *Gradus*, *KSOSDC* empowers readers with not only information, but also attitudes and perspectives for personalizing them. By interpolating technical information with instruction on applying learned concepts, Stolet lays a framework for thinking about Kyma in particular, and data-driven composition and sound design in general. Fundamental topics systematically synthesize into more powerful ideas that that in turn reveal an aim to inspire learning, exploration, and imagination beyond the page.

Kyma users of all stripes shouldn’t hesitate to pick this book up. And with respect to the search for the SOS Disco Club, you’ll need to read it to believe it.

JUCE tutorial: Second Squeeze

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Introduction

JUCE is a C++ library for building cross-platform audio applications and plugins. Although it comes with a plethora of well-written demos and example code, they are mostly presented in a "DIY" manner for intermediate users and, consequently, there is a dearth of educational materials for beginners. This tutorial is intended to contribute in filling that gap. In our previous JUCE tutorial *Intro to JUCE: First Serving*, we discussed how to create a simple cross-platform sine-wave generator from the ground up. In this second JUCE tutorial iteration, we introduce a step-by-step guide to quickly code a real-time Root Mean Square (RMS) analyzer with simple visualization and Graphical User Interface (GUI) components. Before we start squeezing out some code, let's briefly review what JUCE is and how we can begin a JUCE application using the *Introjucer*.

Review

Developing audio applications can be a nontrivial task for experienced developers. Many issues, including having appropriate libraries, threading capabilities, simple user-interface implementations, and audio I/O complexities are made "easy" when using JUCE. JUCE is, in a nutshell, a C++ library for building cross-platform audio applications and plugins. JUCE has been extensively developed and extended by Jules Storer since 2003. It is has found much popularity and is currently widely used for audio software application development. Developers from both non-commercial and commercial communities (e.g. *Tracktion*, *PPMulator*, *Codex Digital, Ueberschall*, *ICT7*, and many more) use JUCE to render their cross-platform software products. JUCE is supported on a variety of operating systems including Windows (Windows XP, Vista, 7, and 8), Mac OS X (10.5 and later), iOS (versions 3 and later), Linux kernel series (2.6 and later), and Android hardware using NDK-v5 and later. JUCE is compatible with the following compilers: GCC versions 4.0+, LLVM - LLVM Clang, Microsoft Visual Studio - Visual C++ 2005+, and MinGW. And now onto coding …

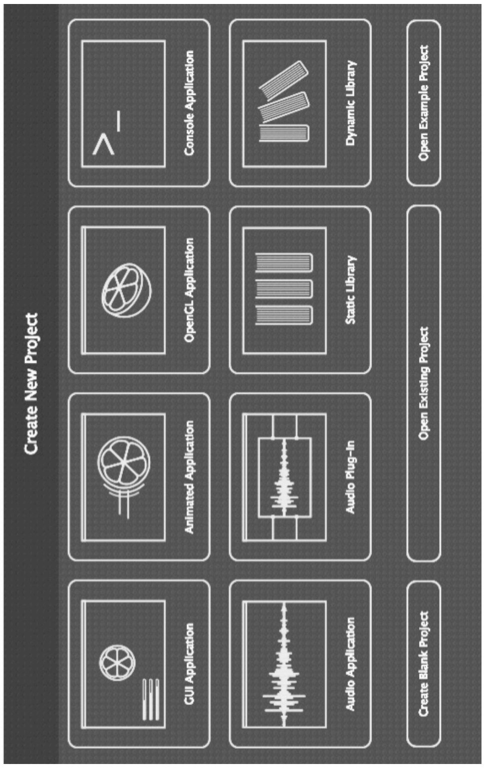

Figure 1. Starting *Introjucer*

Creating a Project

If the reader has not yet installed the JUCE library, please refer to the previous tutorial *Intro to JUCE: First Serving* in Journal SEAMUS Volume 24, No.1-2 from 2012. In this tutorial we will begin by creating a new project using the *Introjucer*. If you start *Introjucer* and create a new project, you will be presented with a handful of options for your project as shown in Figure 1. Selecting "Audio Application," will then prompt the user to (1) create a name for the new JUCE project and (2) select a directory where the project is to be saved. This process is shown in Figure 2. Once the new project name and the project directory are set, press the "Create" button.

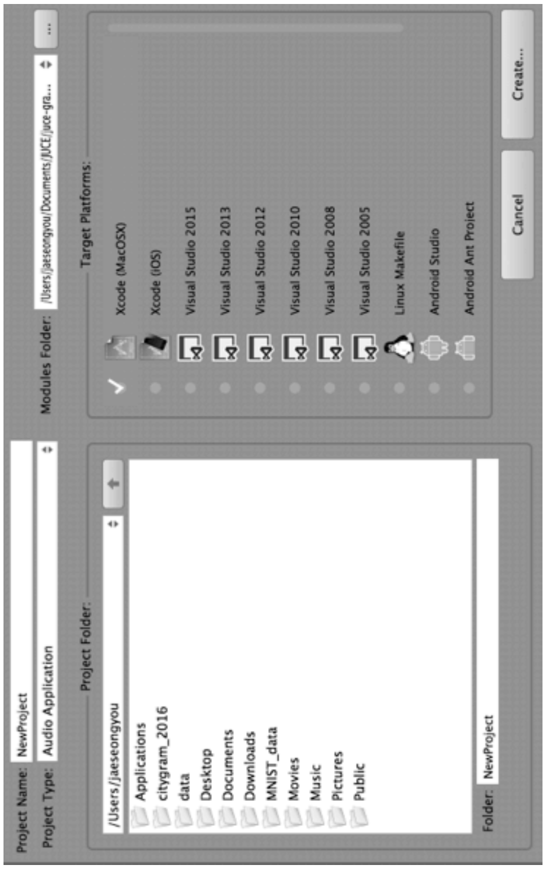
Project Name: NewProject
Project Type: Audio Application
Modules Folder: /Users/jaeseongyou/Documents/JUCE/juce-gra...
Project Folder: /Users/jaeseongyou
Folder: NewProject

Figure 2. Creating a new project

Now that your projected has been created, its settings can be customized, as shown in Figure 3. Let's move to the 'Files' tab. In the 'Source' directory under the project directory, two source code files can be found:

`Main.cpp`
`MainComponent.cpp`.

These files are populated with boilerplate code that is thoroughly commented and self-explanatory. `MainComponent.cpp` is where you can manipulate the main application window. We will first add a new header file called `LiveScrollingAudioDisplay.h` by right-clicking the source folder under the 'Files' tab as shown in Figure 4. To this header file, we will copy and paste the content from the header file of the identical name, a JUCE demo example. It is located under the directory:

`../JUCEOSC/examples/demo/source/demos/`.

By default, this header file provides *audio callback* functionality and waveform drawing functionality. The audio callback is called whenever the audio buffer is filled by the CODEC (e.g. with a buffer size of 512, the audio callback gets called every 512 samples). In this header file, we will place all the additional functions needed for RMS computation, and interact with them from `MainComponent.cpp`. Before you open the project in your IDE, make sure you save the project so that the changes are reflected in the code structure. We are now ready to compile our project. If you compile the project, you will see a black window with your chosen project name. Then your project is successfully compiled.

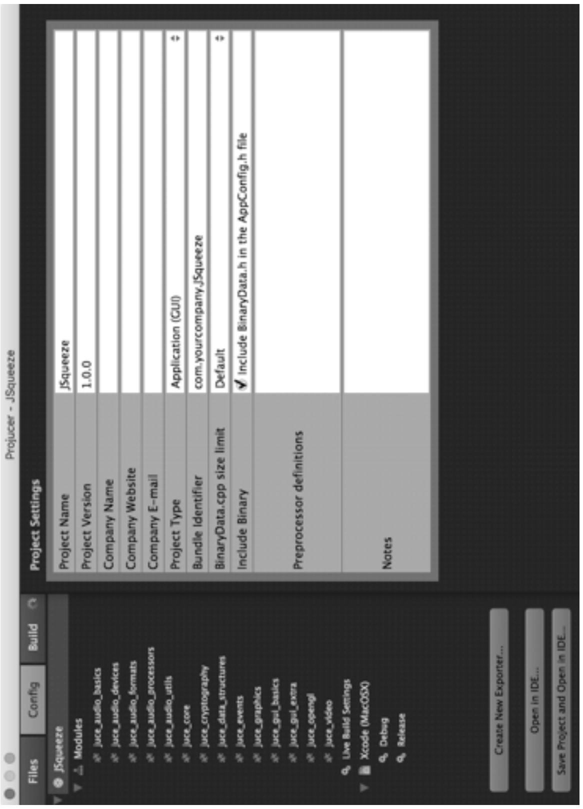
Project Name: JSqueeze
Project Version: 1.0.0
Company Name:
Company Website:
Company E-mail:
Project Type: Application (GUI)
Bundle Identifier: com.yourcompany.JSqueeze
BinaryData.cpp size limit: Default
Include Binary: ✓ Include BinaryData.h in the AppConfig.h file
Preprocessor definitions:
Notes:

Figure 3. Setting up project configurations

Creating the RMS Analyzer

Root-Mean Square (RMS) is a widely used time-domain feature that can be used to represent the energy envelope of a signal in a given analysis window. It is defined as the square root of the average of the squared values of the signal, as shown in equation (1). It succinctly captures the energy level of the audio.

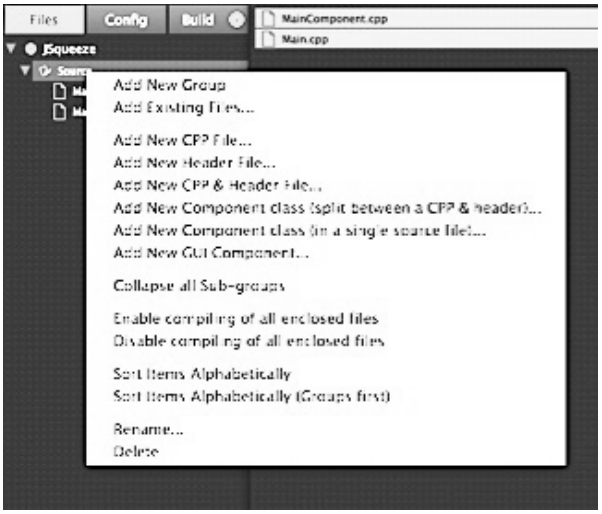

Figure 4. Adding a header file

Our RMS analyzer will have two GUI components: a real-time waveform visualizer and a text editor. The waveform visualizer should reflect the audio captured through the input microphone, and the current RMS value will repeatedly be refreshed in the text editor.

$$RMS = \sqrt{\frac{1}{N}\sum_{n=0}^{N-1} x^2[n]} \qquad (1)$$

Reading in Audio

To compute the RMS from the incoming audio stream, we have to be able to read audio values from the microphone (e.g. the internal microphone on an Apple Macbook). Let's go to `LiveScrollingAudioDisplay.h` to see how the class inherits from three different parent classes:

```
Component
AudioIODeviceCallback
Timer
```

This means that the class is a GUI component, which functions as an audio callback for the current device. In addition, it has a timer functionality to control the callback for waveform drawing (this is different from audio callback). Audio captured by the device audio CODEC in:

```
audioDeviceIOCallback()
```

This audio callback function reads input channel data and pushes the PCM samples to a float table called `samples` that serves an audio buffer. In Section *Computing RMS*, we will use the values of this table to compute the current RMS value.

```
// Constructor
MainContentComponent()
{
// set the app window
setOpaque(true)
setSize(500, 240)

// create/initialize a device manger
deviceManager =
new AudioDeviceManager();

deviceManager->
initialize(2,2,0,true,String::empty,0);

// initialize a liveAudioScroller
// add it to the device manager
addAndMakeVisible(liveAudioScroller);
deviceManager->
addAudioCallback(&liveAudioScroller)
```

Code Example 1. Creating handles and plots

In order to make use of the class called `LiveScrollingAudioDisplay`, we have to first create an instance. Let's add an instance of the class called `liveAudioScroller` as a private member of `MainComponent.cpp`. As we aim to access the audio device and manage the data stream from its input device, we need to instantiate an `AudioDeviceManger` object in `MainComponent.cpp`. We are going to name it `deviceManger`. According to the JUCE API, the class "keeps tracks of a currently-selected audio device, through which it continuously streams data from an audio callback ..."[15] Although we have created and initialized `deviceManager`, it has yet to be linked to the `liveAudioScroller` as its audio callback. By calling a JUCE-provided function called `addAndMakeVisible()`, we (1) instantiate a `liveAudioScroller`, (2) add it to the parent window, and finally (3) make it visible. Now

---

[15] http://www.juce.com/doc/classAudioDeviceManager#details

that `liveAudioScroller` is instantiated, it can be passed to `deviceManager` as an audio callback. Please refer to Code Example 1.

```
for (int i = 0; i <
numElementsInArray(rms); i++){
   int rmsWindowBegin=i*rmsHopSize;
   float squaredSum = 0.0f;
   float rmsValue = 0.0f;
   float sampleValue = 0.0f;

   for (int j = 0; j <
      rmsWindowSize; j++){
      int rmsPointer = rmsWindowBegin + j;

      if(rmsPointer >=
         numElementsInArray(samples))
        sampleValue = 0.0f;
      else
        sampleValue = samples[rmsPointer]/20;

      squareSum += pow(sampleValue,2);
   }
   rmsValue = sqrt(squaredSum/rmsWIndowSize);
   rms[i] = rmsValue;
}
```

Code Example 2. Computing RMS

Drawing Waveform

Let's go back to the header file `LiveScrollingAudioDisplay.h`. In addition to the audio callback, the header file provides a variety of other functionalities required for real-time waveform visualization. For drawing the waveform, we use the demo file that is provided with JUCE with minimal modifications. The waveform is refreshed at a fixed interval specified in the constructor; `startTimerHz()` denotes how many times refreshing occurs per second (note that we can use this callback functionality due to the fact that `LiveScrollingAudioDisplay` inherits from `Timer`). The `paint()` function is called whenever redrawing occurs and fills the Graphic object with color black, and draws a light green waveform that scrolls from right to left using the values from the float table `samples`.

Computing RMS

As briefly mentioned above, we can compute the RMS value from the float values of the `samples` table. Since we need a place to put the RMS values once we compute them, we declare another float table `rms` as a private variable. Normally, low-level acoustic descriptors are computed over a window of a fixed size with a window hop size that is also fixed. To execute this sliding window mechanism, we need to add two relevant integer variables: window size and hop size. They are named `rmsWindowSize` and `rmsHopSize` respectively, in our example. Let's arbitrarily set them as 32 and 16 samples each. Now that we have all the variables needed, all we need is a place for the actual computation of the RMS values. A private function called `computeRMS()` will do this nicely and cleanly. Given the window of a fixed size, all the sample values within the window are each squared. The squared values are averaged and square-rooted before pushed to the `rms` table, whose size was determined with the hop size and the size of the `samples` table as shown in Code Example 2. To compute the average value of `rms` we will define another private float variable, `rmsCurrent`. As to how that averaging process takes place, please refer to Code Example 3 below. Finally, we will need to call `computeRMS()` in `timerCallback()` so that `rms` and `rmsCurrent` can be updated in the loop.

```
% update rmsCurrent
rmsCurrent = 0;
for (int i = 0; i <
numElementsInArray(rms); i++){
  rmsCurrent += rms[i];
}
rmsCurrent = rmsCurrent /
numElementsInArray(rms);
```

Code Example 3. Averaging `rms`

Printing RMS Value

Now that the algorithm is nicely computing RMS values in the callback, the next task is to print out the current RMS value to a text editor. To this end, we need a GUI component of a text editor, which is provided in JUCE. This JUCE-provided GUI component class' text editor can be instantiated from a class called `TextEditor`. In `MainComponent.cpp`, we declare a pointer to `TextEditor` under the name of `textEditor` as a private member that is instantiated in the constructor. One problem is that the text editor needs to update the RMS value when it is computed inside `liveAudioScroller`. For this to happen, we need to pass `textEditor` to `liveAudioScroller` somehow. To this end, we go back to header file `LiveScrollingAudioDisplay.h` and declare a `TextEditor` pointer called `textEditor` as a public variable. We then add a setter function for it as shown in Code Example 4. At this point we instantiate a text editor in `MainComponent.cpp` and connect it `liveAudioScroller`, as shown in Code Example 5. With this treatment, the text editor in `MainComponent.cpp` can be controlled inside `LiveScrollingAudioDisplay.h`. All we need to do now is to print `rmsCurrent` in the loop of `timerCallback()`. Code Example 6 illustrates how this is done.

```
TextEditor* textEditor;

void setTextEditor (TextEditor*
textEditorIn)
{
  textEditor = textEditorIn;
}
```

Code Example 4. Declaring a setter for `textEditor`

```
// Initiate and set the text editor
textEditor = new TextEditor();
addAndMakeVisible(textEditor);
liveAudioScroller.setTextEditor(textEditor)
```

Code Example 5. Initiating `textEditor`

```
// update text
if (textEditor != nullptr){
  textEditor->
   setText(std::to_string(rmsCurrent));
}
```

Code Example 6. Printing `rmsCurrent`

Fine-tune

Function-wise, the project is basically done. However, we can also further fine-tune it a little bit. First let’s change the color (from black to silver) of our app window in the `paint()` function. This way, we can better visualize where the waveform is active. It would also be great if all the GUI components can be automatically resized whenever the parent window is resized; Code Example 7 illustrates how we can get the values of the parent window bounds, and adjust the size of the waveform and the text editor accordingly.

```
// Within resized()
Rectangle<int>
localBounds(getLocalBounds());
liveAudioScroller.setBounds(localBounds
.removeFromTop(80).reduced(8))
liveAudioScroller.textEditor->
setBounds(localBounds.removeFromTop(150
).reduced(20))
```

Code Example 7. Controlling `resizing()`

0.006631

Figure 5. Compiled Project

Conclusion

This basically concludes our second serving of JUCE. We are now ready to pour, or rather, compile our RMS analyzer project. Check if the project window contains the real-time scrolling waveform as well as the text box where the current RMS value is constantly reprinted. The project should look similar to Figure 8. In our second serving of JUCE, we have presented a step-by-step introduction on how to build a cross-platform RMS analyzer application. Using JUCE one can develop a professional audio application that runs on a variety of standard platforms, without having to worry about platform customization or optimization, which can be tedious, difficult, and oftentimes uninteresting. Since JUCE provides a high degree of stability and expandability, one can extend this basic RMS analyzer application to a freestanding feature extraction/visualization library.

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About SEAMUS

Founded in 1984, The Society for Electro-Acoustic Music in the United States (SEAMUS) is a non-profit national organization of composers, performers, and teachers of electro-acoustic music representing every part of the country and virtually every musical style. Electro-Acoustic music is a term used to describe those musics, which are dependent on electronic technology for their creation and/or performance. Many members of SEAMUS, like Jon Appleton, the guiding light in the conception of the Synclavier, are recognized world leaders in their fields. All are dedicated to the use of the most advanced technology as the tools of their trade.

SEAMUS seeks to provide a broad forum for those involved or interested in electronic music. Through its journal, newsletter, national meetings, and its national archive at the University of Texas, SEAMUS seeks to increase communication among the diverse constituency of the relatively new music medium.

The Society's objectives include:
To encourage the composition and performance of electro-acoustic music
To develop a network for technical information and support
To promote concerts and radio broadcasts of electro-acoustic music both in the US and abroad
To create an exchange of information through newsletters and other means of communication
To establish and maintain a national archive and information center for electro-acoustic music
To attract a wide diversity of members and supporters
To advocate licensing and copyright concerns

SEAMUS strives to address not only relevant technology but also the non-technical issues pertinent to the electro- acoustic music community. In a field usually dominated by technical concerns, it is refreshing to hear paper sessions devoted to aesthetics, collaboration, education and of the ethical and social issues facing electro-acoustic musicians. The provocative sessions provide fuel for lively discussions during the national meetings.

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