Research Proposal
"Instrument Transformations in Live-Electronics"

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1 Introduction

Artists using electronics to musically transform the sound of other instruments in a performance face unique challenges. The variety of algorithms and methods to do so is overwhelming and the technical complexity can easily become disproportionate to the artistic outcome. A lack of nomenclature and classification, a problem common to electronic music, hinders communication between humans and humans, and between humans and instruments. Many approaches seem to be constantly reinvented, either by starting from scratch or by copying simple strategies that have been proven to "work".
The research proposed here is driven by these shortcomings and discusses the role of custom-built instruments. It attempts to come up with a classification system for sound transforming practices using electronics, that can facilitate discussion and exchange as well as guide in the creation of new music and instruments. While such a system, if it can be found, has to remain non-exhaustive given the open nature of music creation, it can serve as exemplification for similar attempts in other genres and aesthetics. Applicability to own musical practice is an important factor here, and is considered as main motivation compared to universal validity.

2 Context

My work is focussed on electronic concert instruments transforming the sound and playing of other instruments in an ensemble setting. The aesthetical field is classical music (1950s - today), written for ensemble instruments and a live-electronic part that is of transforming nature. This part shall be notated or at least sufficiently well described to allow for repeatable and comparable performances by individuals other than the composer and instrument builder. This important distinction respects the artist performing the live-electronics as being an independent musical contributer. This research is not primarily concerned with the creation or best use of physical interfaces or sensor technology for the control of music technology. For most of the proposed work, the microphone shall be considered the input device, a lowest common denominator and a universal acoustical sensor.

3 Research Questions

While it seems normal that some instruments are built and used for certain musical styles only, the peculiarity of live-electronic instruments being often matched to an individual performer or a single piece of music is a unique feature. Often composed out of multiple signal processing processing blocks, the modular layout of these blocks determines to a large extent the complexity, and one could argue expressivity or usability, in the performance of music. Since the entire nature of the instrument changes with its modular structure, the main reason for a custom design and the tight coupling between the instrument and the composition at hand demands investigation.

- Why are live-electronic instruments usually custom built? What role does modularity have in this context? What are alternative approaches?

Step 1: Literature and score survey of existing pieces: How different are several pieces of the same composer in this regard?
Step 2: Conduct a thought experiment: Design a general purpose instrument that is usable in several compositions and can be learned and played by multiple performers. Pay as little attention to technical feasibility as possible. Document all conceptual problems encountered.

- Can a classification of sound transforming instruments be found, that is based on the sonic outcome of a transformation, the musical result defining the role of the instrument?

Step 3: Collect algorithms from own musical practice and try to organize them according to musical role. Locate and identify properties unique to the multi-player situation of acoustical and electronic instruments.
Step 4: Analyse existing instrument classification systems and document their shortcomings with regard to live-electronics. Attempt possible modifications to existing systems if applicable, or discuss a layout for a different classification.

- How can such a classification be employed as guide in composition, instrument building and performance, in relation to more generally usable instruments?

Step 5: Commission three compositions using the same live-electronic instrument. This instrument should be an implementation of a representative number of algorithms, sorted and described by a classification system deducted previously. Evaluate rehearsal and performance (using qualitative measures, comparing the composers intentions with her/his assessment after the performance, document the rehearsal and question the performer) with regard to performability and expressivity.

4 Literature

Important work describing design criteria of computers as musical instruments has been done by Sergi Jordá Puig in his PhD thesis [Pui05], applicable to sound generation, synthesis and the real-time control of high-level compositional parameters in mostly improvised music.
The term *composed instrument* is introduced by Schnell and Battier in [SB02] mentioning basic stream processing modules applicable to live-electronic sound transformation, though this idea is not developed further. A superb discussion of sound manipulation methods is given by Trevor Wishart in [Wis94] for non-real-time applications, exemplifying the mediation of signal processing

algorithms for practical sound composition work. It presents a good structure for the use of many transformation techniques.
Important aspects of live-electronics are discussed by Simon Emmerson in [Emm07] with consideration of the audience's perception in live performance as well as the presentation of an aesthetical differentiation system.
While the complex interrelation of music and technology is a field of study on its own, with contributions ranging from sociological studies by Paul Théberge [The97] to stimulating discussions by Paulo Chagas [Cha02], most of my work should remain focussed on the performance situation. The practical work of two individual studios with regard to concert work is documented in Hans-Peter Haller [Hal95] and Morawska-Büngeler [MB88] respectively, covering individual composers and their works. A wealth of similar accounts exists.

4.1 Suggested Reading

The widely accepted system for the classification of musical instruments seems to be the system presented by Hornbostel and Sachs [vHS14] considering the physical excitation as the normative structure. Kurt Reinhard proposed a system based on the sonic possibilities of instruments [Rei60], which gets extended and adapted by Tellev Kvifte in [Kvi88] for electronic instruments with keyboard interfaces. Laurie Spiegel presents a system for interactive musical generation systems in[Spi92] that demands examination as well.
Pierre Schaeffer's typo-morphologies [Sch66] should be investigated with respect to the sound transformation classification. Here it will be interesting to determine how independent a sound source and its transformation can be. This point so characteristic to musique concrete shall be related to most approaches in live-electronics, where the visual reference of an acoustic instrument on the stage seems to contradict Schaeffer's reduced listening approach.
Miller Puckette's book [Puc07] gives a great overview on sound synthesis and processing techniques and will serve as additional valuable resource in the development of transformation algorithms and instruments.
A wealth of information on live-electronic composition and performance practice concerned with individual pieces or composers is available, for example about Luciano Berio in [GMS03] and Luigi Nono in [Spa83]. Different roles of the people driving the alliance of music and technology shall be considered along the way, as perhaps best done by Georgina Born in [Bor95].

References

[Bor95] Georgina Born. *Rationalizing Culture: IRCAM, Boulez, and the Institutionalzation of the Musical Avant-Garde*. University of California Press, 1995.

[Cha02] Paulo Chagas. Spiel und Dialog. Das Komponieren mit Apparaten. In Elena Ungeheuer, editor, *Elektroakustische Musik. Handbuch der Musik im 20. Jahrhundert 5*, pages 182–196. Laaber Verlag, 2002.

[Emm07] Simon Emmerson. *Living Electronic Music*. Ashgate, 2007.

[GMS03] Francesco Giomi, Damiano Meacci, and Kilian Schwoon. Live Electronics in Luciano Berio's Music. *Computer Music Journal*, 27(2):30–46, 2003.

[Hal95] Hans-Peter Haller. *Das Experimentalstudio der Heinrich Strobel Stiftung 1971-1989, Band 1 und 2*. SWR Schriftenreihe zur Rundfunkgeschichte 6, 1995.

[Kvi88] Tellev Kvifte. *Instruments and the Electronic Age*. Taragot Sounds, Oslo, 2nd edition, 1988.

[MB88] Marietta Morawska-Büngeler. *Schwingende Elektronen. Eine Dokumentation über das Studio für Elektronische Musik des Westdeutschen Rundfunks in Köln, 1951-1986*. Musikverlag P.J. Tonger, Köln, 1988.

[Puc07] Miller Puckette. *The Theory and Technique of Electronic Music*. 2007.

[Pui05] Sergi Jordà Puig. *Digital Lutherie, Crafting musical computers for new musics' performance and improvisation*. PhD thesis, Departament de Tecnologia, Universitat Pompeu Fabra, 2005.

[Rei60] Kurt Reinhard. Beitrag zu einer neuen Systematik der Musikinstrumente. *Die Musikforschung*, 8:160–164, 1960.

[SB02] Norbert Schnell and Marc Battier. Introducing Composed Instruments, Technical and Musicological Implications. *NIME Conference, Dublin, Ireland*, 2002.

[Sch66] Pierre Schaeffer. *Traité des Objets Musicaux*. Editions du Seuil, Paris, 1966.

[Spa83] Friedrich Spangemacher. *Luigi Nono: die elektronische Musik*. Bosse, 1983.

[Spi92] Laurie Spiegel. Performing with active instruments - an alternative to a standard taxonomy for electronic and computer instruments. *Computer Music Journal*, 16(3):5–6, 1992.

[The97] Paul Theberge. *Any Sound You Can Imagine - Making Music / Consuming Technology*. Wesleyan University Press, 1997.

[vHS14] Erich von Hornbostel and Curt Sachs. Systematik der Musikinstrumente. *Zeitschrift für Ethnologie*, 4,5, 1914. http://www.oberlin.edu/faculty/rknight/Organology/H-S-1914-German.pdf accessed August 2011.

[Wis94] Trevor Wishart. *Audible Design*. Orpheus the Pantomime Ltd., 1994.