DLA doctoral dissertation thesis

Bálint Bolcsó

Designing an Interactive Music System with an Acoustic Sound Source

Supervisor: Andrea Szigetvári

Franz Liszt Academy of Music

Doctoral School No. 28.
for the History of Art and Culture
Budapest

2014

I. The Premises of the Research

Traditional luthiers had a clearly defined job: to design instruments suitable for a musical system that was part of the common practice. During the 20th century, this unified system was replaced by personal sound and musical worlds imagined by individual composers, not necessarily accessible any more with traditional tools. The digital paradigm made it possible for composers to develop new tools specifically for navigating in these individual worlds. Control and sound generation, traditionally coupled in musical instruments, became independent. Both components, as well as the mapping between them, were suddenly malleable, subject to design and redesign as part of the composition process.

Research of computer based musical instruments and interactive music systems dates back to the 1950s, just like any other musical use of computers. The advent of personal computers and MIDI in the 1980s opened the door to anyone to create digital instruments. This freedom recently became tangible with the ubiquity of laptops and other mobile devices, with broadband internet accelerating the exchange of ideas, software and publications. Flexibility of software in general and easily accessible creative tools, together with intuitive input

devices proved to be an ideal playground for composers to experiment in an interactive environment.

II. Sources

Active research of this field skyrocketed in the last 15 years due to technological advancements. Researchers and musicians like Max Mathews, Tod Machover, Robert Rowe, Joel Chadabe and Michel Waisvisz laid the foundation of this work during the decades before. I mostly refer to their ideas in a developed form through more recent writings by other authors. One of the sources I used most extensively was Sergi Jordà's 2005 dissertation,[1] which, together with the 2006 book by Eduardo R. Miranda and Marcelo M. Wanderley,[2] thoroughly summarize the achievements in the field up to their respective publish dates. As for more recent activity, the proceedings of the *International Conference on New Interfaces for Musical Expression* (NIME), as well as *Organised Sound* and some other journals were of great use. Hungarian language literature in this field is virtually non-existent. I used some related writings by Béla Bartók and György Ligeti, the latter translated by Márton Kerékfy.

---

[1] Sergi Jordà: *Digital Lutherie: Crafting Musical Computers for New Musics' Performance and Improvisation*. PhD dissertation, Universitat Pompeu Fabra, 2005. (Manuscript).

[2] Eduardo Reck Miranda and Marcelo M. Wanderley: *New Digital Musical Instruments: Control and Interaction Beyond the Keyboard*. (Middleton: A-R Editions, 2006)

While there are many articles about specific components of interactive music systems (new interfaces, mapping strategies, sound production), those are mostly dominated by either technical, ergonomical or psychological considerations. Compositionally oriented holistic approaches are rather rare, and this is even more the case when it comes to the musical uses of newer, widely available technologies.

III. Methods

In my thesis I discuss two of the three basic components constituting digital music systems: control and mapping. Among the various possibilities of sound production I focus on those that avoid the loudspeaker in favor of purely acoustic means, effectively reducing the scope of research to one special branch of computer based lutherie.

As a strating point, I briefly review the transformation of the notions 'musical instrument' and 'composer' witnessed during the last decades and how these affected the practice of lutherie. I examine the implications of digital and computer technology, including the relocation of instrument control from the vicinity of sound generation. In order to illustrate this process, originating earlier in music history, I borrow Bartók's scale of instruments and extend it with newer systems discussed in the thesis. Looking at the heritage of acoustic instruments, their pecularities worth retaining, recreating or reinterpreting in the

digital context are reviewed. Lutherie now becoming an organic part of the composer's skillset, compositional aspects as well as types and occurences of improvisation are considered. I then go into designing a control interface in conceptual and technical detail, again approaching the issue from the acoustic instruments' viewpoint. I introduce the notions '*composed control element*' and '*control space with clear dimensionality*' when referring to today's quickly and easily configurable basic controllers, along with some examples for each dimensionality. After briefly discussing what a 'meta-instrument' could be, the first part concludes with a couple of case studies portraying some 'common' and special forms of interactive music systems, some of which are not even (entirely) digital, but nevertheless share many of the same features.

Those acoustic examples lead us to the second part of the thesis where a meta-instrument based on a remote controlled pipe organ (my own project titled *HUMAchiNe.org*) is presented in detail. I begin by describing the organ's pecularities compared to other traditional instruments. The project is then placed into context by reviewing experimental organ literature and organ building, where both aspects are centered around the ideas of Ligeti. I present the goals of my projects, followed by an enumeration of steps I made in the course of planning and realisation. I then describe each unit of the meta-instrument along with all technical details and their musical implications.

Finally, after explaining the structure of the piece and other compositional considerations, some possible directions for future work are outlined.

IV. Conclusions

Traditional instruments remain a natural point of reference for new digital music systems, despite all the differences in their workings. This can be equally seen in expectations of the musician towards the playing experience as well as in those of the audience towards the audiovisual character of the concert. This way, aspects like the haptic relationship with the instrument, the player's gestures, difficulty and virtuosity all remain relevant when making music with new tools.

All of the special music making situations examined in the first part (live coding, robotic instruments, realtime score, Soundpainting) exhibit at least some features of interactive music systems, despite involving human participation and acoustic sound production in varying amounts. Soundpainting, for example, shares many of its principles with live coding, with the rules for some signs resembling *composed control element*s and other analogies from the digital world, while operating with gesture control and mostly acoustic sound sources.

The remote controlled acoustic instrument, serving as a focal point of the thesis, can similarly be regarded as a 'mixed' system, combining the liberty provided by computer control

with the physical immediacy of the acoustic sound source. This twofoldedness is mirrored in the compositional process: the first step, like with any acoustic instrument, is to explore all the regular and extended playing techniques and the sound palette available through them. To exploit those possibilities, however, the composer can turn to technology for help. Composed control elements based on *control spaces with clear dimensionality* can facilitate the creation of control surfaces with freely definable gestures. The special characteristics of this workflow, not present in completely digital systems, are discussed through the experiences of a concrete project in the second part of the thesis.

Mixed interactive music systems, comprising digital, acoustic and human elements remain an exciting and not yet widely explored field of study and experimentation for researchers and composers alike.

V. Documentation of activities related to the topic of the dissertation:

As a member of multiple groups playing free improvised music, I regularly play live concerts with computer based instruments, which I continuously develop. In recent years, playing with musicians like Jonas Kocher, Christian Kobi and Zsolt Sőrés as well as groups like rubik.erno.quintet and trio:beeper provided to me the most interesting musical situations.

As a composer, I explored different types of interactive music systems in the following pieces:

HUMAchiNe (2006)
clarinet controlled with realtime score, electronics (first performance: 2006, Vienna)

lautlos (2009)
Sprechgesang, live electronics (first performance: 12 June 2009, Karlsruhe, ZKM; Julia Mihály – soprano)

Oktogon (2010)
8 channel composition or interactive sound installation (first performance: 28 May 2010, Cologne, College of Music)

HUMAchiNe IV (2011)
clarinet, bass clarinet, live electronics (first performance: 23 March 2011, Budapest, Háló Community Centre; Horia Dumitrache – clarinets)

Enigma Remix (2014)
Sprechgesang and cimbalom; speaker, clarinet and cello controlled with realtime score; controller (first performance: 16 February 2014, FUGA Budapest Center of Architecture; Eszter Zemlényi – soprano, Erzsébet Gódor – cimbalom, Lóránt Bocskor Salló – speaker, Csaba Klenyán – clarinet, Tamás Zétényi – cello)

HUMAchiNe.org (2014)
computer controlled pipe organ (first performance: 17 October 2014, Budapest, Palace of Arts)