Gestural Control in Music and Engineering

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Introduction

The 1:30 h panel session on Gestural Control in Music and Engineering was chaired by Kia Ng with four panellists: Marcelo Wanderley, Shin Maruyama, Philip Zerweck, and Thomas Jürgensohn. Due to the inherent multi-disciplinary nature of gestural control in both domains (music and engineering), an effort had to be made in order to focus the discussion.

Basic terminology issues are one of the initial concerns in such type of discussion; terms such as *gesture*, *interaction*, *mapping* and even *control* may have several (sometimes conflicting) meanings in the different fields of music and engineering. Moreover, the lack of domain-specific resources — especially in music — help creating difficulties in establishing a common framework for discussions[6]. Again, due to the multi- and inter-disciplinary nature of this research, publications have to be located from a wide range of journals and conferences. Clearly, it needs input from many related fields, for example:

Music: Composition, Musicological Analysis, Synthesis and others
Design, HCI, Ergonomic Studies
Experimental Psychology, Human Factors
Human Motor Control
Electronic Engineering, Computer Science, and many others.

Contextualisation

In order to carry out a focus discussion, it was proposed and agreed that the session does not raise any issues on definitions due to the time constraint, and *gesture* is put in context for clarification. For example, a distinction between the several meanings of gesture presented below was made explicit during the panel:

Musical gesture (non physical)
Instrumental gesture (physical)
Conductor gesture
Expressive gesture
Empty-handed gesture
Co-verbal or natural gesture, among others.

Mapping

The role of mapping is vital in the design of new instruments (Hunt *et al.* 2000). Mapping, or the relationship between gestural variables – usually obtained through the use of different sensors – and sound synthesis variables in a digital musical instrument, changes the way the instrument responds to performer actions. The concept of a digital musical instrument does only make full sense when all three factors – input device or gestural controller, mapping, and synthesis algorithm – are defined.

In fact, the choice of mapping strategies used to relate gestural variables and the available synthesis variables will define the interaction possibilities offered by the instrument. For instance, in Rovan *et al.* (1997) a digital musical instrument simulating a clarinet has been implemented using an off-the-shelf MIDI controller (Yamaha WX7) and additive synthesis. The idea in that research was to explore the role of the choice of mapping strategy in the behaviour of the simulated instrument. It was found that complex mappings (interdependent control variables with non-linear response) simulating the behaviour of the original acoustic instrument were essential for expert performers, whilst simpler mappings (independent variables with linear response) were more appealing to beginners. Similar idea has also been explored in Ng (2001) for interactive dance performance, applying "multi-layer" mapping with varying abstraction, starting from simple direct mapping and building toward complex mapping with increasing abstraction. These results suggest the role of mapping in pedagogical situations using digital musical instruments, since in this case, contrary to what happens with acoustic instruments, the mapping layer can be adjusted to the user needs.

Therefore, not only the design of new controllers and the development of alternate synthesis algorithms is needed for gestural control of music, but an understanding of the role of mapping is essential for the definition of an instrument using computer sound synthesis.

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[6] One exception is the electronic publication "Trends in Gestural Control of Music" (Wanderley and Battier 2000), a book in the format of a cdrom extensively covering the current research of gestural control in the music context.

Following that, questions such as "Is it possible to model this trans-domain mapping?" and "What would be an effective model?" should received serious studies.

Interaction

Processing time latency was discussed, as human performers' interaction was believed to be almost instantaneous. A conductor reported that somehow the orchestra player would pick up the emotional content which could be 'transmitted' and understood without latency. Clearly this is not possible with a gesture tracking system, since there must be time for data acquisition, follow by processing and reaction time. After much discussions, it was concluded that for a system to simulate human orchestra, it would require a behaviour modelling module which learn the intension of a conductor (similar to rehearsal time) and able to build parallel hypothesises to predict the motion of the conductor during the performance with clues and hints, from both the motion of the conduction and the music scores, in order to minimise latency.

Maruyama reported his study to describe interactive properties between a professional orchestral conductor and concertmaster by using a videotaped data of rehearsal sessions, focusing on the relative timings with their gesture at the opening section of Beethoven's Fifth Symphony. The main results suggest that there may be a coherent and stable time margin between a conductor's directive action and a concertmaster's bowing action even with different conductor's gestures. It was proposed that the conductor's 'reciprocal' aspects with orchestra players must be considered more than the formal changes in conductor's gestures to describe the dynamic activities of the orchestral conductor. The mutual changes in gesture and motion of both the conductor and orchestra player indicates the emergence of 'interpersonal kinematics' beyond the conducting forms or styles.

To save time, Ng and Wanderley did not give their short presentations at the panel session, since they have delivered their lectures (Ng 2001, Wanderley 2001) at an earlier session.

Continuation and Future Development

This is an increasingly active domain, which require interdisciplinary collaborative research. To continue this discussion and to provide information distribution and sharing, Ng and Wanderley invite everyone interested in this area to visit the Working Group on Interactive Systems and Instrument Design in Music (ISIDM). ISIDM is a working group within the International Computer Music Association (ICMA) in collaboration with Electronic Music Foundation (EMF), to provide speedy access to discussion and distribution of information in the field of interactive music and new instrument design, to enhance and extend possibilities for human creativity in music and the arts.

Further information on the ISIDM working group can be found online at
http://www.notam.uio.no/icma/interactivesystems/wg.html or
http://www.kcng.org/wg

The ISIDM mailing list, http://www.jiscmail.ac.uk/lists/isidm.html, is hosted by the National Academic Mailing List Service, JISCmail, UK.

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