

Gestural Control at IRCAM

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Abstract

This report presents an overview of IRCAM activities related to gestural control in music over the last five years. We comment on the different activities, from music creation and courses, to developments in hardware and applied research.

1 Introduction - Historical Perspective

Since its inception in the 1970s, IRCAM has been interested in merging instruments with electronic music means on the stage. This led to many developments so that control of digital sound synthesis and processing could be another interpretative dimension (Sequential Drum, Mathews and Bennett 1978).

In the eighties, a man-machine interface project was carried out (Battier 1986) that has given light to developments such as the MIDI flute (Pousset 1992) and the PACOM (Starkier and Prevot 1986) that have both been extensively used in compositions and musical productions at the institute and abroad.

For instance, a sonar type sensor was built in 1993 (Dubost 1993) and was used initially by X. Chabot (Chabot 1993). Among other researchers/composers, A. Tanaka has taken part in related projects, such as a children's workshop at IRCAM (1995).

Interest in historical perspectives has led to a curatorship with the newly renovated Musée de la Musique in Paris to design the XXth century's collection of electronic instruments (Battier 1993) and an ongoing collaboration with Electronic Music Foundation (EMF)¹.

2 Current Activities

This report focuses on the period from 1996 to the present. During these five years, various activities have been

carried out related to gestural control at IRCAM. They are summarized below.

2.1 Publications

Three publications have been edited by IRCAM researchers concerning gestural control of music:

- *Interfaces Homme-Machine et Création Musicale*, Hermes Science Publications - 1999, edited by Hugues Vinet and François Delalande (GRM) is the revised proceedings of the workshop held at IRCAM in December 1998. Invited speakers have made a detailed review of several fields related to human-computer interaction in music, such as graphical interfaces, musical controllers, and interactive systems (Vinet and Delalande 1999).

- *Aesthetics of Live Electronic Music*, Contemporary Music Review 18:3, 1999, edited by Marc Battier. To further discuss the questions linked to the live performance of electronic music, M. Battier has edited in 1999 an issue of Contemporary Music Review, which is accompanied by an audio CD. Gestural control issues were addressed by a number of contributors: J. Appleton, J. Chadabe, J. Eaton, J-C Risset, M. Stroppa, M. Subotnick, M. Waisvisz, amongst others (Battier 1999).



Figure 1. Left: Interfaces Homme-Machine et Création Musicale, Hermès Science Publishing, 1999. Right: Trends in Gestural Control of Music, IRCAM, 2000.

- *Trends in Gestural Control of Music*, IRCAM - Centre Pompidou - 2000, edited by Marcelo M. Wanderley and Marc Battier, is an Electronic Publication (CDROM) containing various articles and tutorials on gestural control of music. Specifically, it consists of: a) a round table with leading instrument builders and performers, b) twenty-four

¹ <http://www.emf.org>

* Current address: Faculty of Music, McGill University, Montréal, Canada.

articles, tutorials and case studies on gestural control of music written by key contributors to the field, c) an extensive bibliography (around 500 entries), and d) a detailed list of resources. It includes several videos and sound examples illustrating the articles, which are especially formatted for screen reading and printing (Wanderley and Battier 2000).

3 Research and Development

Many projects focusing on or related to gestural control have been developed in the Research Department, headed by H. Vinet. Main topics relate to:

3.1 Alternate Controllers

X. Rodet, A. Terrier, and P. Pierrot collaborated on the development of JERRY, a four dimensions mouse, which is a normal computer mouse equipped with two pressure sensors, allowing the simultaneous control of 4 continuous parameters (Rodet, Terrier and Pierrot 1997, patented).

B. Rován developed a data glove based on FSR (force sensing resistors) sensors on the tips of each finger. This glove was used in clarinet and saxophone performances giving extra control variables for real-time synthesis/processing control.



Figure 3. Butch Rován and the tactile glove he developed at IRCAM in 1997. Photo by Myr Muratet.

3.2 Haptic devices

During a sabbatical leave in 1997 - 1998, V. Hayward (McGill University) worked in collaboration with B. Rován, and this led to the development of a tactile feedback system to be used in conjunction with open-air computer music performance devices (Rován and Hayward 2000). The *VR/TX system* is proposed as a solution for adding tactile feedback to open-air controllers.

3.3 Real-Time Additive Synthesis Control - ESCHER

The development of a real-time synthesis system with applications to gestural control based on jMax has been carried out from the latter part of 1997 by Rován, Schnell, Dubnov and Wanderley. The system was proposed to provide a flexible environment for sound synthesis and a basis for experimentation in human-computer interaction in music (Rován *et al.* 1997) (Wanderley, Schnell and Rován 1998). It is built as independent modules that may be

replaced according to the synthesis method used, and to the type (level) of interaction desired.

3.4 Real-time control of Physical Models

Research by C. Vergez and X. Rodet focuses on the control of a physical model of a trumpet in real-time (Rodet and Vergez 1996) (Vergez 2000). The control interface was developed using a MIDI wind controller for the information concerning mouth's pressure and piston position. The resulting interaction between the player and the model closely simulates the one experienced by a performer and his instrument. A new controller based on a real trumpet is being developed (Vergez and Rodet 2001).

3.5 Inversion of Physical Models

Recent work engaged in the Analysis-Synthesis Team concerns the development of tools to estimate time varying control parameters of a physical model associated to a target sound. Two approaches are currently being studied: *inversion techniques of dynamical systems* (Hélie *et al.* 1999) (Hélie, Vergez and Rodet 2001) and *learning techniques* (D'Haes and Rodet 2001).

3.6 Score Following

A research area related to gestural control of music, is the development of a system for automatic accompaniment. After several experiments performed by B. Vercoe, M. Puckette and others at IRCAM as of the mid eighties, a new project called *suivi de partition* (score following) started in 2000 conducted by N. Orío with guest composers. Results can be found in (Orío and Dechelle 2001).

3.7 Modeling Performer Gestures

M. Wanderley and Ph. Depalle developed research on gesture capture, modeling and application to the control of sound synthesis by signal models (Depalle, Tassart and Wanderley 1997) (Wanderley, Depalle and Warusfel 1999). The analysis of clarinetists movements has been carried out in collaboration with the NICI, Nijmegen and the Free University Amsterdam (Wanderley 1999), (Wanderley 2001a) (Wanderley 2001b) in order to understand the basis of performance gestures.

3.8 Study of Mapping Strategies for Instrumental Performance

The influence of the choice of mapping strategies (Wanderley and Depalle 1999) in performance with digital musical instruments, specifically the clarinet (Rován *et al.* 1997) was developed in the context of the ESCHER project (Cf. section 3.2). In a collaboration with the York Music Technology Group, it was proposed a review of the literature on mapping in music, showing the various developments to date (Hunt, Wanderley and Kirk 2000).

3.9 Wacom Tablet

Together with the CNMAT, a research project on the use of the WACOM tablet as an instrument controller has been carried out funded by the France-Berkeley Fund. During this period, a MSc. thesis and a final undergraduate report were produced (Wanderley *et al.* 2000). J.-Ph. Viollet implemented a real-time control of CHANT in Max/MSP using the WACOM tablet, while F. Isart studied the ergonomics of the tablet when used as a tool for the simulation of a cello bow (Isart 1999). S. Serafin has used the WACOM tablet to control a physical model of a violin (Serafin *et al.* 1999).

4 Pedagogy and Production

Many activities related to gestural control have been carried out by the Pedagogy and Production Department, under the directorship of M.-H. Serra and A. Jacquinet. (J.-B. Barrière until May 1997).

4.1 Compositions

Young composers are accepted each year as part of the 'Cursus de Composition', a one year course on computer music. During the last years, three compositions have been created using different sensors and/or gestural interfaces: S. Goto - *Virtual AERI*, L. Ronchetti - *Eluvion-Etude*, and R. Auzet - *OROC.PAT*.

4.2 Applied Studies

S. Goto (Goto 1999), a composer/performer at the Cursus developed the *SuperPolm* violin controller in collaboration with P. Pierrot and A. Terrier. Seven sensors integrated in a violin-like controller provide 11 continuous output variables. The ensemble provides an interface that is able to control different synthesis parameters departing from a gesticulation similar to that of a violin player.



Figure 4. Suguru Goto and the SuperPolm.

E. Morin and cellist B. Carat developed a joint project on the measurement of cellists bowing techniques by developing a sensor (FSR) glove and measuring different performances of various performers (Morin 1999).

4.3 Courses

Also regarding the Pedagogy department, a regular course on sensors and gestural capture is given yearly. They are part of the ATIAM MSc. Or of the cursus de composition (one-year long), or offered as weekend courses. Lecturers included C. Cadoz, M. Waisvisz, B. Rován, E. Flety, B. Thigpen and M. Wanderley.

4.4 MSc Course on Multimedia at CNAM

In the school years 1998-1999 and 1999-2000, the Pedagogy Department at IRCAM has taken part in the MSc. course at the Conservatoire National des Arts et Métiers offering a week-long course on Sound and Interactivity. This course deals with different subjects such as sound synthesis, interactive synthesis, new instrument design, gestural control, etc. Apart from IRCAM lecturers, invited speakers included, among others, S.-J. Norman, M. Waisvisz, R. Bargar, I. Choi, and R. Minard.

4.5 Session and Workshop at ISEA 2000

M.-H. Serra and M. Wandelely organized a special session at ISEA2000: *Towards a Descriptive Approach of Gesture and Sound Interaction*. It consisted of four lectures by researchers M. Wanderley (with N. Orio and N. Schnell) and A. Camurri and percussionist R. Auzet and composer Y. Maresz. They were joined by choreographer F. Raffinot in a round table coordinated by M.-H. Serra. E. Flety and B. Thigpen gave a workshop on sensors and interactive systems.

4.6 Hardware Developments:

Engineer E. Fléty has developed several devices these last years at IRCAM. These include the AtoMIC Pro I and II Analog-to-MIDI interface, a ultrasound sensor (Flety 2000) (Flety 2001), and an infrared sensor used for interactive dance pieces by the Choreography Department recently created at IRCAM.



Figure 5. AtoMIC Pro Analog-to-MIDI interface.

5 Dance

The Choreography Department, headed by F. Raffinot, was created in 1999. One example is the collaboration between Raffinot and composer Y. Maresz called *Al Segno*. During one of its movements it uses an IR sensor frame of 2 by 1.5 meters developed by E. Fléty (Fléty 2001).

6 Other Activities: Discussion Group - Gesture Research in Music Homepage²

The *Groupe de Discussion sur le Geste Musical* was created in 1997 by composer B. Rován, and researchers M. Wanderley and S. Dubnov. The group's main activities were

² <http://www.ircam.fr/gesture>

the development of a bibliography on the subject and the organization of regular discussions on different subjects.

Several meetings have been organized as discussions on a pre-determined theme or consisted of invited lectures by researchers in this field, including D. L. Wessel, A. Mulder, M. Goldstein, C. Ramstein, D. Pai, R. Bargar, I. Choi, A. Tanaka, Camel and S. Coleman, C. Cadoz, R. Minard, S.-J. Norman, M. Waisvisz, among many others.

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