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## ► To cite this version:

Jean-Loup Florens, Claude Cadoz. Instrumental gesture, computer and retroactive gestic transducers. ICMC 1984, Oct 1984, Paris, France. pp.194-195. hal-00483916

**HAL Id: hal-00483916**

**<https://hal.science/hal-00483916>**

Submitted on 25 Feb 2014

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## Instrumental gesture, computer and retroactive gestic transducers

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With regard to equipment, any sound generation unit is a system producing a high information flow acoustic signal (i.e. signal analysis) thanks to a series of movements which being human are necessarily of the low information flow type.

State of the art technology includes a wide variety of processes capable of filling this requirement as well as numerous and varied relationships between acts and the resulting sound event.

The computer is one of these means. It offers unprecedented capabilities, in particular being able to manipulate abstract elaborated attributes having a direct effect on the production of the final (sound) event.

Within the traditional instrumental context, however, there is a specific relationship between an act and a sound event. This has not yet been reproduced by the computer. We are referring to the direct physical relationship between a gesture and an instrument, whereby the gesture itself is involved in the mechanical phenomenon of producing sound vibrations.

The nature of this relationship, far from being just a quirk, is both fundamental and decisive. Indeed, long before any contact with musical instruments as such, this experience covers all sensory-motor relationships thanks to which the world of sound is explored with the help of instruments. Although the computer can produce sounds yet unheard, it can not further the learning process unless it reproduces an instrument-like situation.

For these reasons we (1) (2) have introduced the notion of «instrumental gesture» in the sequences leading to computer-assisted production of sound events. We have developed a special control peripheral, i.e. the Retroactive Gestic Transducer.

Basing ourselves on observations of traditional situations, we can present the main categories and the elements of a typology, even before introducing the computer-related instrumental gesture.

An instrumental gesture consists in acting on a «manipulatable» object. In the case of musical creation, the object is a musical instrument, that is a device necessarily of a mechanical type transforming a gesture into a sound event.

An instrumental gesture can not be separated from the perception linked to the act itself, i.e. tactile and synesthetic perception involved in handling an object. In the instrumental experience, gesture, the sound event and proprioceptive perception are all closely connected.

Since in most cases the instrumentalist is the only source of energy (as opposed to those situations involving electricity), the first function of the instrumental gesture (quantitative) is to convey to the instrument the very energy of sound. This could be called instrument «excitation» or the excitation component of the instrumental gesture, or, briefly, «excitation gesture».

Although the instrumental gesture supplies the totality of sound energy, the total energy of the instrumental gesture is not aimed at producing sound energy. There is in fact another aspect to that gesture: the qualitative or quantitative modification of the physical structure of the instrument, leading to the sound event. This could be called «modifying gesture», bearing in mind that there will be «structural modifications» or «parametric modifications», i.e. two sub categories of the «modifying gesture».

Finally, in many cases, an instrument is an object using several (more or less interconnected) variations of the same device. Choosing one or several of these variations in the course of a single instrumental act occurs thanks to a component of gesture which we could call «selection gesture».

Using ergonomical considerations we can introduce a second series of criteria for our elementary typology:

Gesture amplitude (range): In customary instrumental situations, the instrumentalist's gestures can involve the entire body or be extremely limited, as in the case of finger movements.

Direction: movements are mainly frontal, vertical or lateral.

Grasping or non-grasping of objects: plucking strings with fingers or with a plectrum, striking a key or a drum-skin with a stick, etc.

From the vantage point of computer-created music, the instrumental gesture is part and parcel of a series of acts which, although necessarily gestic, are of a totally different nature. This leads to two basic considerations.

It is necessary to carry out an analysis in order to identify in broad, logical and exhaustive terms all specific gestic acts involved in computer-created music. This requires an exhaustive typology including that of the instrumental gesture.

Furthermore, hardware as well as software must be developed for the instrumental gesture.

The Gestic Transducer is precisely that organ making it possible to link the world of the senses (gesture) to the computer's world of digits, just as is the case for its acoustical (loud-speaker) or visual (cathode ray screen) counterparts. The Retroactive Gestic Transducer is the element making it possible to reproduce the specific bilateral nature of the instrumental gesture.

For technological reasons, the all-purpose gestic transducer can not be built today. That is why the Gestic Transducer, in its present form, is a set of units with complementary functions. The above mentioned typological criteria make it possible to define the appropriate units. For example, while the excitation gesture can only occur via the Retroactive Gestic Transducer, because of the energy exchange of which it is the vehicle, the «modifying» or «selection» gestures can be conceived as simple movements or as pure effort. More simple systems from a mechanical viewpoint (non-retroactive) can be used for these gestures.

(1) CADOZ C., FLORENS J.L. 1978 - «Fondements d'une démarche de recherche informatique/musique» - *Revue d'Acoustique*, 45, pp. 86-96.

(2) CADOZ C., LUCIANI A., FLORENS J.L. 1981 - «Synthèse musicale par simulation des mécanismes instrumentaux. Transducteurs Gestuels Réroactifs pour l'étude du geste instrumental» - *Revue d'Acoustique*, 59.