The Case Study of Application of Advanced Gesture Interface and Mapping Interface,
- Virtual Musical Instrument " Le SuperPolm" and Gesture Controller "BodySuit"

Suguru Goto
(Composer)
82, rue Charles Nodier, 93500 Pantin, France
sugurugoto@csi.com

Takahiko Suzuki
(Waseda University)
1-104 Totsukamachi, Shinjuku-ku, Tokyo, 169-8050, Japan
suzuki@aoni.waseda.jp

ABSTRACT
We will discuss the case study of application of the Virtual Musical Instrument and Sound Synthesis. Doing this application, the main subject is advanced Mapping Interface in order to connect these. For this experiment, our discussion also refers to Neural Network, as well as a brief introduction of the Virtual Musical Instrument "Le SuperPolm" and Gesture Controller "BodySuit".

Keywords
Virtual Musical Instrument, Gesture Controller, Mapping Interface

INTRODUCTION
A composer, Suguru Goto has previously developed his Virtual Musical Instrument "Le SuperPolm" and Gesture Interface "Bodysuit" at IRCAM in 1996-1998. The main goal in this experiment is to connect "Le SuperPolm" or "BodySuit with Sound Synthesis and Interactive Video System in real time. Doing so, the important point is the bridge between these, which is called "Mapping Interface. In order to develop this, an intelligent Mapping Interface is required. This may allow us to work efficiently, as well as having more musical expression with the Virtual Musical Instrument. There are numerous researches in the field of the Gesture Controller, and Sound Synthesis in real time. Yet, this relationship is rarely discussed, and an example of advance application has not sufficiently evolved by others yet. Gesture of a player is transformed into analog signal with a sensor, and then is converted to digital signal. As soon as these are captured in a computer, these can be merely treated as numerical data. However, gesture and musical expression have much meaning for human being more than numbers. The contradiction may rise, when these are tried to express these gesture and musical expression with Sound Synthesis as output, although these are flattened to be merely numerical data inside a computer. Our interest is to raise a question, if the programming is further developed, it would help to find the solution, while a computer merely transforms the signals, and gesture and sound results are subjective matter for a human being.

1. The Theoretical background of Mapping Interface
Mapping Interface refers to a bridge between "Le SuperPolm" or "BodySuit" and sound synthesis here. In other words, this programming translates from input data to the parameters for Sound Synthesis. Mapping Interface has functions as scaling input data, switching in and off for each input, changing a curve, matrix, etc. After Mapping Interface, the data can be directly sent to inputs of Sound Synthesis. Otherwise, this may go through Algorithm in order to generate automatic musical events. This may be also selected depending on an application in terms of compositional processes.

What we are interested in here, is advanced and intelligent Mapping Interface. This may learn the input data by itself, then decide some suitable output data. It is flexibly altered automatically, depending on the situation of input data. These are eventually meant to be a well-trained translator between an expression of performer and an expression of musical sound.

A sensor may not always be able to send an expected data, with a reason of technical side or a human player side. For example, 0 to 5 volt signal can be translated into either MIDI or Ethernet protocol. Inside a program, this can be any number of bits. In other case, depending of sound synthesis, a finger position does not always correspond to same frequency. In other words, there is no way to learn exact finger position in order to control pitch precisely, unless one single sound present constantly remain in entire composition. Due to this situation, Mapping Interface can understand where a finger is on a fingerboard and what this means for sound. Working with Granular Synthesis, many parameters are necessary to be controlled at the same time. In this sort of situation, a performer may sometimes mistake, because of an excessive complexity of control. Then, Mapping Interface can learn the habit of player, and then can analyze a tendency of mistake.

Fuzzy logic can apply to flexible understanding for the input data. Instead of demanding the precise input data, this can tolerate certain amount of range, and then choose some parameters, which are necessary.

Neural Network offers other possibilities for Mapping Interface. This may learn the habit of player. This eliminates unwanted data, such as noise. Then, it recognizes a pattern of gesture, musical materials, violin technique, and human player expression. These are categorized in a certain method. Some expected input data are prepared beforehand, and then recognized patterns are treated into required parameters for sound.

In Granular Synthesis, some preset sounds are prepared beforehand. Each preset consists of multiple parameters, and this gradually changes one to another, according to the input data. In order to do this, Morphing technique is applied to this Mapping Interface

2. The Virtual Violin, "Le SuperPolm"

Virtual Musical Instruments refer to a system that a gesture of performer is translated into electric signals. One may control sound or video image of computer with movement of body in real time. In "Le SuperPolm", there is neither string nor hair of bow. A gesture of performance with a violin is merely modeled.

"Le SuperPolm" was built in 1996 with a collaboration of an engineer, Patrice Pierrot at IRCAM. "Le SuperPolm" is played in a similar manner to the violin, except that the fingers touch sensors on a fingerboard instead of pressing strings. Sounds may also be modified by movements of the bow, which records variations in resistance. An eight-button keyboard situated on the body of the instrument can change the program and the sounds as well as triggering different pitches, like a normal keyboard.

"Le SuperPolm" was built in such a way as to respond to body movements. However it can be assigned new functions by programming, so as to take into account the compositional needs of each piece: for instance a sensor can be used to trigger sounds in one composition, whereas in another it can be used to change the pitch.

3. Introducing "BodySuit"

A performer wears a data suit, on which 12 sensors are attached on each joint of the body. This data suit functions as an interface of gesture. Depending on a movement, sound and video images are changed in real time. This differs from a traditional instrument and a controller. A player performs with larger movements, such as stretching and bending joints, twisting arms and so on. This gesture does not really function like dance or theater. It contains, however, an element of "performance" within the live musical context. The gesture is not previously decided in a strict sense. An audience may observe an obvious difference of intensity of movement between a static section and a kinetic section in the composition.

4. REFERENCES

[1] Suguru Goto: The Aesthetics and Technological Aspects of Virtual Musical Instruments: The Case of the SuperPolm MIDI Violin, Leonardo Music journal, Vol.9, 1999

[2] Suguru Goto: Virtual Musical Instruments: Technological Aspects and Interactive Performance Issues, IRCAM. Trends in Gestural Control of Music, 2000

[3] Masafumi Hagiwara: Neuro, Fuzzy, Genetic Algorithm, Sangyo tosho, Tokyo, Japan

[4] Kazuo Yana, Yoshitake Suzuki: Neuro Jyoho Shori Gijyutsu, Kaibundo, Tokyo, Japan

[5] Robert Row: Machine Musicianship, The MIT Press, 2001

[6] Michael Lee, Matt Wright: "mlp" external object of Max/MSP, CNMAT, University of California, U.S.A