Controlling Scanned Synthesis by Body Operation

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Abstract

This paper describes a development of sound synthesis system as application of new sound generating technique "Scanned Synthesis". As the first step of this research, algorithm of scanning sound synthesis in real time and physical model control in real time were realized simultaneously. As the 2nd step of research, the EMG sensor which outputs simultaneous detection of the muscular electric potential of 16 channels in real time was developed. The author proposed a new sound synthesis system which is applying EMG information with the correlation to the real-time control with many parameters of Scanned Synthesis, and is different from unrelated parameter control.

1. Introduction

In the technique of Sound Synthesis, comparatively new "Scanned Synthesis" was proposed by Max Mathews and others ([1]-[3]). By this technique, it has a different possibility from FFT that intuitively excellent Sound Synthesis will be realizable, by making into another dimension the scanning rate which carries out the simulation of the oscillating state of a physical model, and the sampling rate which compounds a sound signal (Fig.1).

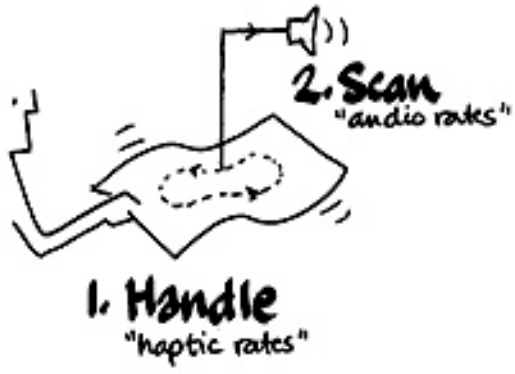

Figure 1 : Scanned Synthesis

The author has continued activity in the research domain about Computer Music : (1)Sound Synthesis systems, such as Granular Synthesis and Attractor Synthesis, (2)Composition and Performance in multimedia art, and (3)Developments of many original sensors, etc ([4]-[15]). This research is the report about the experiment of the new proposal which applied the technique of author's EMG sensor system to this new "Scanned Synthesis."

2. Realization of the algorithm

Since Bill Verplank, Rob Shaw, and Interval Research Co. developed Scanned Synthesis with Max Mathews, generally, this system is mounted on CSound and studied. However, as a platform of Computer Music research, "Max" which the pupils of Max Mathews developed is a world time-tested product, and Max carries out extended development with the real-time signal processing system MSP and the 64 dimensional matrix processing system Jitter, and can build the extensive real-time operation from a sound to graphics in the flexible GUI environment. Thus, in this research, I started with the experiment programming Scanned Synthesis on Max/MSP as the first step (Fig.2).

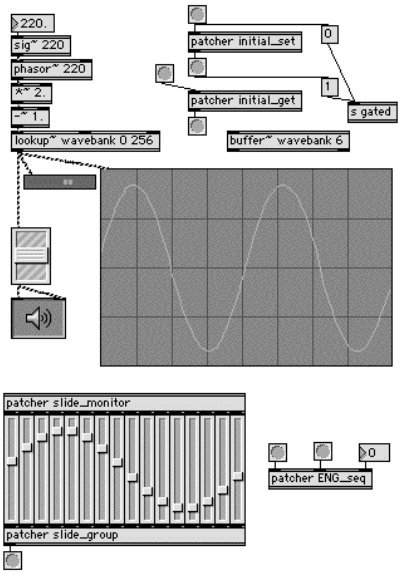

Figure 2 : "Scanned Synthesis" patch in Max/MSP

Fig. 2 is the example of a screen of the Max/MSP main patch under its development / experiment, and it sets a sinusoid waveform to the waveform memory actually divided into 16 bands as an initial value here, it carries out scan to real time by 44.1kHz, and it is generating the sound of arbitrary pitches.

2-1. Waveform Buffer and Initialization

The "buffer~" object of Max/MSP was defined as a waveform buffer of 6msecs, and 256 bytes of head of this buffer which serves as 264.6 samples by 44.1kHz sampling was used. The scanning memory divided into 16 bands which constitute the physical model of Scanned Synthesis put in order and constituted 16 "vslider" objects for visualization of data. Thereby, the data of each band which changed is visualized by the slider on real time, and simultaneously, a user can operate each slider of this with a mouse, and can also change a parameter individually.

2-2. Load from Scan Memory to Wave Memory

Since the amount of information decreases, loading from the waveform memory in the above-mentioned initialization to a scanning memory should just extract a representation value. Fig. 3 is a subpatch which sets up the data of a waveform memory conversely when this specific value of the scanning memory of 16 bands changes. Here, since it will become a discontinuous noise if a boundary with neighboring bands does not connect, it carried out the median and the boundary value of a contiguity band between alignment assistant, respectively, and it not only sets up the median of each band, but has determined waveform data.

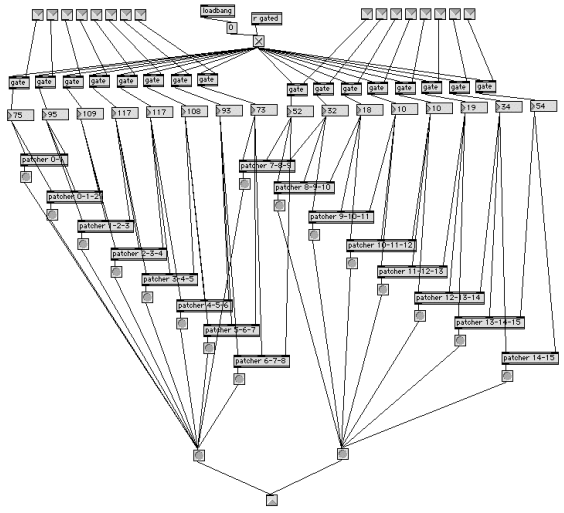

Figure 3 : SubPatch to set Waveform Memory

2-3. Calculationg the sample data

Fig. 4 is one of the subpatches which calculates the waveform data of each band called one after another from the subpatch of Fig. 3, and it is adjusting timing so that rewriting of the read-out audio sampling rate of 44.1kHz and data may not compete.

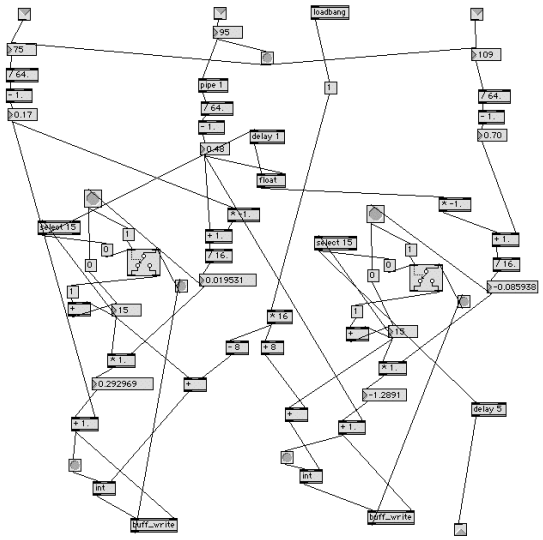

Figure 4 : SubPatch to calculate each bands

3. MiniBioMuse-III

If it is called an EMG sensor, expensive equipment called BioMuse is famous. However, the author has dared further experiment and development named "MiniBioMuse." This is the original development project of the simple and cheap EMG sensor which carries out the MIDI output of the EMG information on small, lightweight, portable, a battery drive, and real time.

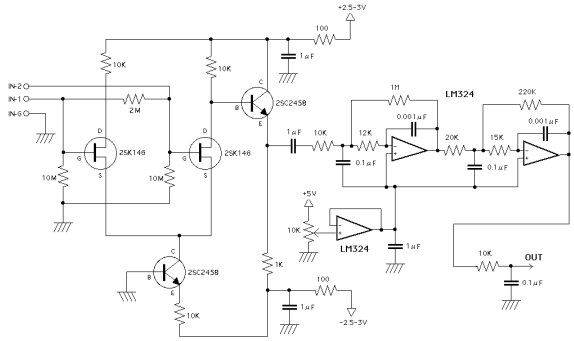

Figure 5 : Front-end circuit of MiniBioMuse-III

Fig. 5 is the improved front end circuit of the 3rd generation. By the Differential Amplifier circuit which used FET by which heat combination was carried out, high sensitivity, the low noise, and the small system were realizable.

Fig. 6 is the contact belt (a part for one hand) which arranged two disk contacts of pure silver in the flexible belt at a time over nine sequences. Eight EMG information which carries out an arm 1 round can be sensed stably independently.

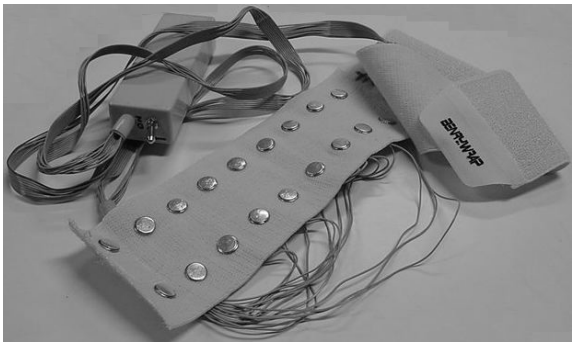

Figure 6 : Contact belt of MiniBioMuse-III

Fig. 7 is an example of the analog sensed output signal of MiniBioMuse-III, the upper row is an EMG output signal at the time of calm, and the lower berth is an example of the EMG output signal at the time of strain.

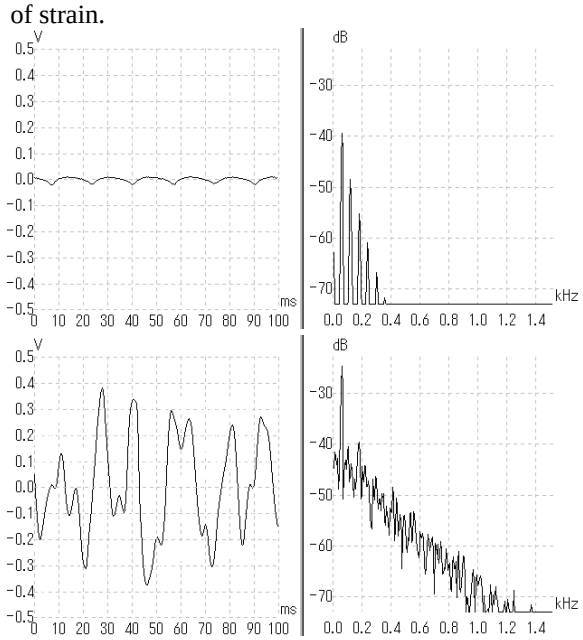

Figure 7 : Output signals of MiniBioMuse-III

Fig. 8 is an example of screen which gave a real-time indication of the MIDI output information on "MiniBioMuse-III" by Max. The screen is "left-hand 1ch-4ch" from left-hand side to the bottom, and most right-hand side is "right-hand 5ch-8ch." This figure is the example which becomes tense and loosened both arms by turns, and can grasp the difference in operation of the muscles of time synchronicity and each arm. In this research, this information on 16 channels that it became independent was mapped as a parameter corresponding to 16 bands of Scanned Synthesis.

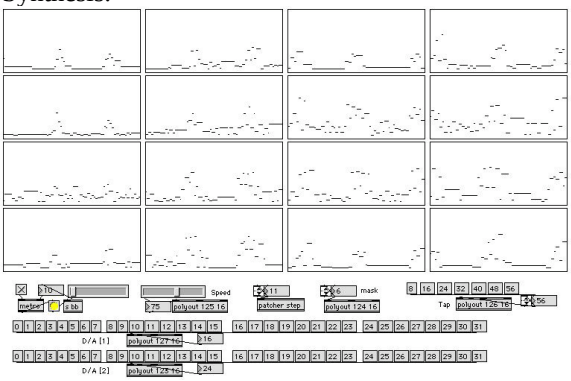

Figure 8 : MIDI output of MiniBioMuse-III

4. Scanned Synthesis Control with EMG

The simplest method of mapping the output from MiniBioMuse-III in Scanned Synthesis is giving the 16 channels EMG information to the value of the scanning memory of 16 bands itself, and linking it directly. In order that Fig. 9 may carry out the simulation of this method, it is just going to verify the actual sound. The information from a human body that it equipped with MiniBioMuse-III is beforehand recorded as data of SMF form. This data is reproduced by the "seq" object of Max/MSP.

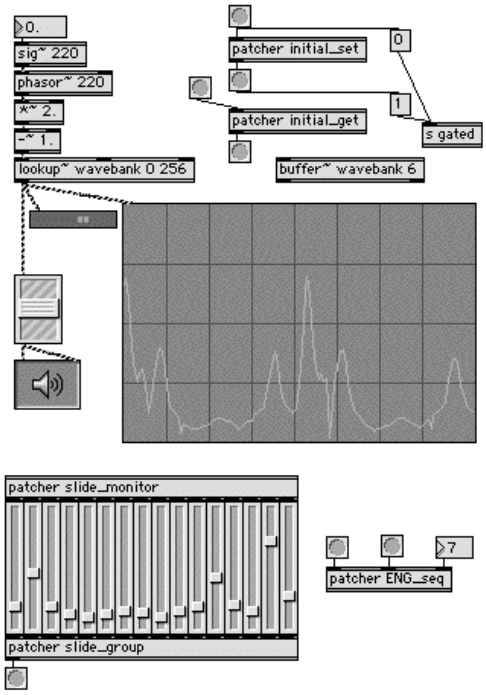

Figure 9 : EMG controlled Scanned Synthesis

However, by this method, correspondence with a relation with a scanning memory without the meaning divided especially by eight channels has the fault that necessity is missing, to the input which wound 8 contacts around circumference and the arm per right-hand man, and put two of them in order. Since there is cooperation nature with each independency, respectively in the case of muscles, it can be said that it is in matching this with the characteristic of Scanned Synthesis that the adjoining band is connected with continuity about a meaning.

Figure 10 : Performance with MiniBioMuse-III

Fig. 10 is the scenery of the public performance of the author's work using MiniBioMuse-III. With this work, the EMG information on 16 channels was used for the parameter of 16 sinusoidal synthesis, and was mapped by the parameter of multiplex FM synthesis. I am composing the work which controlled real time Scanned Synthesis by this EMG sensor as a target of this research, and performing, and want to verify the result.

5. Conclusions

This paper proposed a new sound synthesis system which is applying multi-channels EMG information with the correlation to the real-time control with many parameters of Scanned Synthesis. I want to advance experimental composition with development of a system and to continue to verify the result by actual performance.

6. References

[1] Max Mathews, *Scanned Synthesis*, http://www.musique.umontreal.ca/electro/Activites/MaxMathews.html

[2] cSounds.com, *Scanned Synthesis*, http://www.csounds.com/scanned/

[3] The Alternative Csound Reference Manual, *Signal Generators - Scanned Synthesis*, http://kevindumpscore.com/docs/csound-manual/siggenscantop.html

[4] Yoichi Nagashima, *Art and Science Laboratory*, http://nagasm.org

[5] Yoichi Nagashima, *An Experiment of Real-Time Control for Psuedo Granular Synthesis*, Proc. of International Symposium on Musical Acoustics, 1992

[6] Yoichi Nagashima, *Real-Time Control System for "Pseudo" Granulation*, Proc. of 1992 International Computer Music Conference

[7] Yoichi Nagashima, *Multimedia Interactive Art : System Design and Artistic Concept of Real-Time Performance with Computer Graphics and Computer Music*, Proc. of Sixth International Conference on Human-Computer Interaction, 1995

[8] Yoichi Nagashima, *A Compositional Environment with Interaction and Intersection between Musical Model and Graphical Model --- "Listen to the Graphics, Watch the Music"* ---, Proc. of 1995 International Computer Music Conference

[9] Yoichi Nagashima, *Real-Time Interactive Performance with Computer Graphics and Computer Music*, Proc. of the 7th IFAC/IFIP/IFORS/IEA Symposium on Analysis, Design, and Evaluation of Man-Machine Systems

[10] Yoichi Nagashima, *BioSensorFusion : New Interfaces for Interactive Multimedia Art*, Proc. of 1998 International Computer Music Conference

[11] Yoichi Nagashima, *"It's SHO time" --- An Interactive Environment for SHO(Sheng) Performance*, Proc. of 1999 International Computer Music Conference

[12] Yoichi Nagashima, *Interactive Multi-Media Performance with Bio-Sensing and Bio-Feedback*, Proc. of International Conference on Audible Display, 2002

[13] Yoichi Nagashima, *Interactive Multimedia Art with Biological Interfaces*, Proc. of 17th Congress of the International Association of Empirical Aesthetics, 2002

[14] Yoichi Nagashima, *Bio-Sensing Systems and Bio-Feedback Systems for Interactive Media Arts*, Proc. of 3rd International Conference on New Interfaces for Musical Expression, 2003

[15] Yoichi Nagashima, *Combined Force Display System of EMG Sensor for Interactive Performance*, Proc. of 2003 International Computer Music Conference