Filmachine/filmachine phonics

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Abstract

"Filmachine" (film + machine) is a virtual soundscape and a gigantic machine, which generates acoustic space/time/motion structures. "Filmachine" is a black spherical skeleton surrounded by twenty-four speakers suspended from the ceiling. The "Filmachine" replays streams of sound files that are completely controlled by the 3D acoustic system "Huron," accompanying flashing running LED patterns. A floor is composed of black cubes that converge towards the center of "Filmachine." An audience can experience the sound of "Filmachine" from various positions. Filmachine is the product of a new principle of sound composition called third term music. In addition to this real world sound installation, we also present a CD that can only be experienced through headphones.

Filmachine emulates a virtual 3D acoustic space by using twenty-four speakers fixed in space. When we want to have the same effect with a CD, we have to generate sound with only two micro speakers of a headphone. This difficulty was overcome by the novel reproduction of sound technology called the personal surround technology (PST). This technique enables us to make not only a left-right difference of auditory impression but also an up and down difference with a headphone. “Filmachine phonics” is the CD that regenerates the auditory experience of Filmachine through this unique technology.

This paper will explain the background and the concrete methods of how to organize the sound structure of these two contrasted works, Filmachine and Filmachine phonics, and its for the history of sound art.

1 Introduction

Timbre is the most important issue in modern acoustics. It isn’t specific solely to electronic music that uses computer technology, but it is of crucial importance in all music. The history of western music has evolved from non-harmonic to twelve-tone
composition, and from twelve-tone to serial music, and then to minimalism. But the issue of timbre appears even outside the history of western music.

Some prefer older instruments and ensembles over contemporary ones, but nevertheless older instruments are less functional than modern ones in precision and speed. The timbre problem isn’t a simple problem of precision and speed, it is more about our perception mechanism. Namely, the question is about what we listen to when we listen to music.

In the western way of thinking of music, timbre exists outside the sound structure. The structure appears in the score and to highlight the structure timbre has been sacrificed, and its only manifestation is believed to be a result of nothing more than the exceptional maestro. However, the problem of timbre can’t be resolved into a simple universal problem such as “what is a good timbre?” or “a flash of shakuhachi sound.” We have to avoid a dichotomy between timbre and structure to create a new principle, i.e. third term music. The goal of third-term music is to go beyond the concept of drone and melody, two fundamental elements of music composition, and provide the possibility of third element such as the composition of timbre and sound dynamics as a meta-framework.

I don’t want to merely propose a new method for automatic composition with computer technology but instead a way to produce a minimal timbre element for composing music. In other words, there is no dichotomy between timbre and structure, but instead a timbre that has a structure. By saying structure, I don’t mean it is a structure in the western style of music but a dynamic and open structure created by chaos, genetic algorithms, and some other open-ended evolutionary systems. Timbre should be taken from the point of view of technological materialism and should not be taken as a mere effect of performance. From the techno-materialism point of view, we just convert a variety of time series into AIFF files. In this way we are connecting any structure to music, which is a serious critique against standard electronic music in an academic sense.

Making music with a computer is to combine different timbres. If this is true, when timbre has a structure, computer music can generate unpredictable structures. The acoustic object generated by this method is releasing music from the concept of wholeness, avoiding a sort of simplicity found in electronic music. This way of making music is sympathetic to the complex systems approach; synthesizing is easier than description. All these generating methods make it possible to generate very complex and radical sound timbres.
In order to realize the idea of third term music, we have presented sound installations and live concerts. Particularly, the filmachine sounds were recorded with the personal surround technology and sold as a new CD entitled “Filmachinephonics”. In the next section, we will describe the overview of the Filmachine installation.

2 FILMACHINE installation

FILMACHINE = film + machine is a sound installation with a three-dimensional acoustic system. It is a virtual soundscape and a gigantic machine which generates acoustic space/time/motion structures. FILMACHINE is a black spherical skeleton surrounded by twenty-four speakers suspended from the ceiling. FILMACHINE replays streams of sound files that are completely controlled by the three-dimensional acoustic system called “Huron” that accompanies flashes of LED patterns. A floor is composed of black cubes that converge towards the center of FILMACHINE in order to experience the sound from various positions (See Fig.1).

The three-dimensional acoustic system “Huron” enables us to powerfully program the orientation, movements, and location of sound images along the timeline. The system not only provides an ideal sound experience in a fixed point, but also makes it possible to create a new acoustic space where we can perceive the autonomous movement of the sound stream on a virtual three-dimensional space. In addition, we designed each sound structure by using the previous cellular automaton and some other chaotic dynamics. Mapping a sound pattern by spacio-temporal pattern is somewhat arbitrary, but here we directly translate the spacio-temporal pattern into decibel (db) values nonlinearly, and directly output them onto the timeline. As a result, a pseudo jet engine sound, reminding one of take-off and landing, moves upwards and downwards. Or, slightly different sounds made from cellular automaton sequentially flow along the surface of the virtual cylinder. How to combine each sound pattern with the motion in the virtual space determines how we hear the sound, or the qualia of sound. For example, using the pattern of rule 110, we happened to produce a sound as if a violin is played in distance. We then coupled it with a motion rising high up into the sky, and it generates the sound in tragic tone. Thus FILMACHINE provides a new sound-installation using a three-dimensional acoustic system, but at the same time it is the expression of the various textures of Complex Systems Studies such as class 4., When verbalizing what and how we simulate, the texture of the simulation gets retired into the background. The non-verbalized part indicates the interesting aspect of Complex Systems Studies that it is difficult to
categorize as a traditional science. Filmachine is an important application of Complex Systems Studies which focuses on the texture of simulations. Fig. 2 gives a view of the entrance of FILMACHINE. In the next section, we will describe how we generate 3D acoustic image, LED patterns, and sound images in detail.

Fig.1. A panoramic view of Filamchine. The overall size is 7m x 7m x10m (height).

Fig.2. An entrance view of Filmachine installation. Here we put three panels of 3D acoustic image, sound file image and LED pattern.

3 Methods

3.1. The 3D acoustic system

The 3D acoustic system "Huron," developed by the Lake Technology Company in Australia, enables us to powerfully program the orientation, movement, and locations of sound images along the time line. The system not only provides an ideal sound experience in a fixed point, but it also makes it possible to create a new acoustic space where we can perceive the autonomous movement of the sound stream in a virtual
3D space. "Filmachine" uses various kinds of objects ranging from variations of spiral motions to strange attractors (e.g. Lorentz, Roessler, and Langford) that appear in nonlinear systems, and the displayed sound pattern itinerates among those complex dynamics with different time scales.

A Huron system generates a virtual sound localization by making virtual walls and creating virtual reflections from the wall. This algorithm is basically used for designing music halls and theaters without actually building them. But here we use it for creating freely moving and localizing sound images, irrespective of the real speaker locations. Fig. 3 and 4 demonstrate the examples of the virtual movement of sound images in a 3D space.

![Fig3 Generation of 3D sound space by using the Lanford attractor. The white ball represents the sound image.](image)

![Fig4 16 sound images go up and down with making spirals. This motion structure is perceived as having a sound film going up and down.](image)

3.2 The visual effects

When the sound images are moving around, we also let LED patterns move around in some contingent ways. We used eight LED poles to surround the circular area with twenty-four speakers. Each pole has fourteen LED units and we made the flashing patterns demonstrate complex spatio-temporal patterns. For example, soliton parti-
cles are falling down from the upper LED unit, in a falling pattern that is generated by an elementary cellular automata (CA) of rule 54 (See Fig. 5).

Fig. 5 An example of LED pattern generated by CA rule 54.

3.3. Sound structures

Sound files are created by combining and modifying initial bit strings by virtual genetic/evolutionary processes. Such a variation mechanism of bit strings is based on the co-evolution dynamics of Machines and Tapes (Ikegami and Hashimoto 1997, 1996, and Ikegami 1999). This evolutionary dynamic elaborates two kinds of noise, which are fluctuations of bits originated in the internal and external mechanisms. That is, sound bit strings are recursively varied by the effect of external noise and specifications of deterministic programs. Depending on who reads the tape (or which program rewrites the input string), there can be an immense variety. Fig. 6 shows an example of a mutually catalytic network of machines and tapes. A system creates such a network to maintain the reproduction of machines and tapes temporally.

In case of sound file synthesis, a machine rewrites a tape by using the wave form information to increase/decrease pulses or by using the interference between the intensity of sounds (db) and the sampling rate. Some other machines receive two input files and let one file act as a program on the other file, or combine them with variations like a method used in a genetic algorithm. In this way, the initial sound files have unexpected structures as if acquiring life-like autonomy.
The other important time structure of sound patterns is to use the hierarchical composition of biased white noise generated by the Logistic map or by Cellular Automaton. Here, within a short time span, time series from those systems have apparent structures and prove their difference from a structure generated by random coin toss. For example, by combining the same white noise from the Logistic map but with a slightly different nonlinear parameter, we can generate ample differences as a sensory experience. Cellular automaton is a time evolving system that updates the state of each cell distributed regularly in space. When a cell is linearly arranged (called one-dimensional cellular automaton) and the state is 0 or 1, the overall cell behavior has been studied intensively. In particular, they create different spatio-temporal patterns depending on the updated rules. Especially, rules 54 and 10 have unique spatio-temporal patterns, which we perceive as very strange. Rule 110 generates various particles of different speeds and forms that are unpredictable from the initial configuration, and rule 54 generates randomly fluctuating raindrop-like patterns. These patterns look neither regular nor random and are classified as "class 4" by Steven Wolfram (e.g. the encyclopedia of CA entitled "A New Kind of Science"2002). These class 4 rules are believed to have universal computability and can be found at the edge of chaos, but we don’t yet have a clear definition of what it is. On the other hand, the texture of class 4 is apparent. The complexity found in a transient process before reaching an attractor implies the simulation capability of life processes. The texture of class 4 is an anomalous dynamic that can’t be analyzed by the usual statistics.
Fig. 7 This is the snapshot of the return map of the logistic map whose nonlinear parameter is also evolving in time.

Fig. 8 A spatio-temporal pattern of CA rule 110 which uses two states and 1 neighborhood rule. The system size here is 400 bits.

Having those time series created by either the logistic maps or cellular automata, we transformed them into sound files by our newly-developed sound converter sndchanger software. First of all, we have to create the text files of sound amplitude from the spatio-temporal pattern. The generation of the text file from the logistic map is rather straightforward. We simply used the state variables as a sound amplitude. On the other hand, we examined several ways in case of cellular automata. We basically used a binary (bit pattern) to decimal conversion to get a floating data set. Then in the next step, we used the sndchanger to convert these floating text data into aiff sound files. The sndchanger is a reversal sound text converter from/to a text file to/from float 32bit sound files. This software is now available on the web (Ogai 2006).

Using those new complex sound files, we layered them out in the NUENDO interface (Fig. 9). Collecting a variety of sound files, Keiichiro Shibuya actually composed the music pattern by considering the affinity and virtual movements between different
sound patterns. Filmachine used the twenty-four channels, and each of them corresponds to twenty-four speakers used in the installation.

Fig.9 NUENDO interface that is actually used in the filmchine.

4 Filmachine phonics

Filmachine emulates a virtual 3D acoustic by a unique system called "Huron," (the Lake Technology Company) with twenty-four speakers fixed in a space. The greater the number of speakers we use, the easier we can emulate the 3D dynamics of sound images. On the other hand, it is difficult to have the same effect with headphones, because we have to generate the up/down movement of the sound image using only two speakers. This difficulty was overcome by the novel reproduction of sound technology called the personal surround technology, which is based on the parametric HRTF (head related transfer function) technique.

The parametric HRTF method was developed by K. Iida and M. Itoh (2006) to effectively and universally realize the sound localization in 3-dimensional space. The algorithm is to recompose all or part of the sound spectrum from only one peak and two notches found in the HRTF extracted from the psychological experiments. This technique may originally have been developed for mobile phones, but here we used it for recomposing the Filmachine sound structures.

It has been thought impossible to let sound images move in the perpendicular direction or pass in front of the listener using headphones. But we think this is due to the lack of 3D composed music. In making Filmachine, we have generated freely moving
and localizing sound images in space, which can not be generated by mere panning among multi-channels. But not only does this technique generate a 3D sound effect, we think that the sound images created by complex dynamical systems and evolutionary systems have high affinity with 3D music composition with dynamic sound images.

5 Discussions

What FILMACHINE aims for is similar to what John Cage wanted to achieve. There is a unique composition style developed by Cage at the age of 75, which he called “time bracket.” It has no repeated notes on a score, and on top of each note, Cage wrote a special kind of mark to indicate when to start playing the note and when to stop it using time windows. Sometimes a window overlaps other successive windows. On the scores composed in this method, the Number Piece series, the qualia of sound changes by a player’s intention, the timing, and the characteristics of instruments. Even with the same score, the total length of the performance varies, and this uncertainty creates tension between the player and the audience, which in turn affects the sound process. Music composed on the time bracket is a fragile network of textures where each texture is loosely correlated with each other. Trying to play the same note, for example, by violin won’t hold the same timbre, which usually varies at the beginning and end of each performance. In this sense, each sound unit as a constituent texture has dynamic structure for itself. On the other hand, FILMACHINE strictly designs multi-layered sound files with the precision of one millisecond. But each sound file has its own time structure that is out of our control. In this sense, FILMACHINE provides a strongly correlated network of textures with no redundancy at all. Cage’s Number Piece and FILMACHINE are antithetical to each other at a glance. The thing that connects the two is the “openness.”

Openness means “fluctuation” = autonomy = a kind of randomness that remains unwritten. In Cage’s Number Piece, the width of the time bracket and the inevitable autonomy of each instrument are the source of sound autonomy. In case of FILMACHINE, chaotic instability, indeterminacy by class 4 rules, and virtual motion structures give a source of sound autonomy. But, there are more than these. Players have the freedom to choose when to play and when to finish within a range of the time bracket. Here, the fluctuation of “free will” exists. FILMACHINE is a spatially extended installation and the audience can perceive it by walking around freely or by lying on the mosaic floor. This provides the other form of fluctuation. If what Cage wanted to express was this kind of indeterminacy and open experiences, FILMA-
CHINE achieves them by deterministic randomness (of chaos and class 4 rules) and the observer’s embodied subjectivity.

What Complex Systems Studies can pay tribute to, as an art activity, is a new way of simulating the world that is not story-telling by bundling the details of each event with a strong intentionality, but using the integrity of a distinct texture (this time it is a fine structure of sound timbre at each instance of time) network presented as an open system.

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