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STYLES OF PARTICIPATION AND ENGAGEMENT IN COLLECTIVE SOUND PERFORMANCE PROJECTS

Kazuhiro Jo, Yasuhiro Yamamoto, Kumiyo Nakakoji

The SINE WAVE ORCHESTRA (SWO) is a collaborative sound performance project that has been actively performing for the past several years. The basic idea is that each participant plays a sine wave, and by changing its frequency and volume, creates a collection of sine waves as a collective sound representation. Although all SWO works use the same sound representation (i.e., sine waves), different SWO works use different temporal, physical, environmental, and procedural settings. The different settings have resulted in different types of sound experiences for the participants. This paper examines six of the SWO works and discusses what aspects of the settings affect how people engage in collective sound representations.

The network prevalence and the advance of communication technologies work as enablers for a variety of collective representation projects to emerge (Jorda 2005)(Weinberg 2002). Collective sound representations have varied forms, which can be represented in four types of sound projects: collocated synchronous (e.g., The Hub (Gresham-Lancaster 1998), Jam-O-Drum (Blaine and Perkis 2003), and MidiBall (Jacobson et al. 1993)); distributed synchronous (e.g., Global String (Tanaka and Bongers 2001) and TransJam (Burk, P. 2000); collocated asynchronous (e.g., The SINE WAVE ORCHESTRA stay (Jo et al. 2005)—see the later sections of this paper for more details); and distributed asynchronous (e.g., FMOL (Jorda 1999) and Public Sound Object (Barbosa and Kaltenbrunner 2002)). The numbers of people involved vary, ranging from a few (e.g., Global String (Tanaka and Bongers 2001)) to several (e.g., The Hub (Gresham-Lancaster 1998)) to thousands (e.g., MidiBall (Jacobson et al. 1993)).

From the viewpoint of what people experience by engaging in such projects, temporal and physical collocation and the size of the group of participants do not seem to be the only factors that determine the participants' experiences. What motivates people to engage in such a project and what processes the people go through to engage in a project have not been studied in much detail.

A SWO work is a collective sound representation project by which participants collectively produce sine waves. Although all SWO works use the same sound representation (i.e., sine waves), different SWO

works use different temporal, physical, environmental, and procedural settings. These different settings have resulted in different types of musical experiences for the participants (Fischer and Giaccardi 2006)(Tanaka 2006). This paper reports case studies of six of The SINE WAVE ORCHESTRA (SWO) works to explore the issues and to discuss design implications for collective sound representation projects. Examining six SWO works allows us to focus on what aspects of the settings affect the differences in how people participate and engage in collective sound performances.

2. THE SINE WAVE ORCHESTRA WORKS

The SINE WAVE ORCHESTRA (http://swo.jp) is a collaborative sound performance project. One of the authors has served in the group of four core organizers of the project. SWO has been actively performing for the past several years in various exhibitions, both long-term and short-term, including at NTT ICC (InterCommunication Center), DEAF (Dutch Electronic Art Festival), ParticipART and ISEA (International Symposium of Electronic Art). Figure 1 presents snapshots of the six works of SWO, which will be described in detail below.

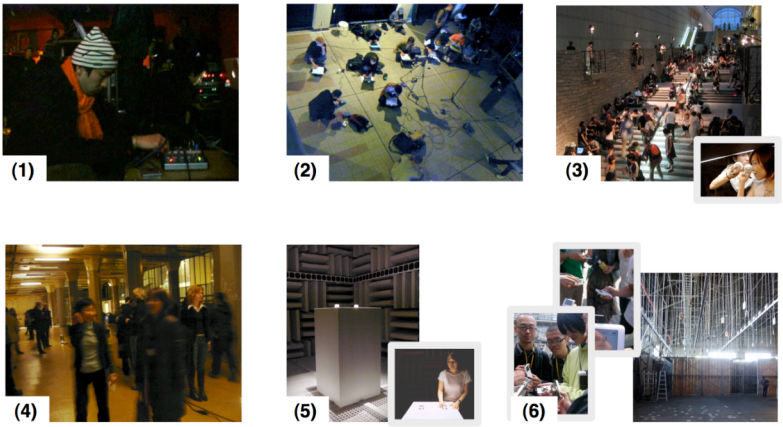

Figure 1 – Six SWO Works: (1) SWO-clicks, (2) SWO-TAU, (3) SWO-stairway, (4) SWO-district, (5) SWO-stay, and (6) SWO-nomadic.

2.1 The SINE WAVE ORCHESTRA and if you like, some clicks

The SINE WAVE ORCHESTRA and if you like, some clicks (SWO-clicks) was the first work of SWO, which took place in one day in December 2002 and lasted for about two hours. About 30 participants, mostly musicians, were invited to get together at a small concert hall and were

asked to each bring a device that can generate a sine wave, such as a laptop PC, synthesizer, analog oscillator, or PDA. The organizers of SWO provided two audio mixers at the center of the hall and four speakers, one at each corner of the hall. The audio mixers mixed each participant's audio output and distributed it to the four speakers.

The participants were then asked to generate a sine wave and change its frequency and volume as they liked. During the performance, the organizers occasionally provided a little guidance on what the participants should do, such as "start your sine wave" or "keep 440 Hz," but not much in the way of detailed instructions.

2.2 The SINE WAVE ORCHESTRA in Tama Art University

The SINE WAVE ORCHESTRA in Tama Art University (SWO-TAU) took place at the university in April 2003. About 100 students and musicians produced sine waves with changing frequencies and volumes in the foyer of one of the university buildings for about one hour by using devices, each of which generated a sine wave with a built-in or an individual separate speaker. Thus, the sound of each sine wave came from a separate speaker.

The organizers provided some instruction on how to play sine waves, similar to that provided in SWO-click.

2.3 The Stairway of The SINE WAVE ORCHESTRA

The Stairway of The SINE WAVE ORCHESTRA (SWO-stairway) is a work that took place at the NTT ICC in June 2004, as a part of the n_ext exhibition. In this work, about 200 participants played sine waves for about two hours in the large hallway by the stairs of the ICC building. Those who had brought their own devices (e.g., laptop PCs and PDAs) used them to generate sine waves with varying frequencies and volumes. Some people used the devices that the organizers provided, each of which consisted of an oscillator, a CDS photocell, a speaker, and a battery. Depending on the amount of light these devices received, they produced different frequencies of the sine wave. Those who used the provided devices therefore produced varieties of frequencies of the sine waves by moving around in the hallway and placing the devices in different positions.

2.4 The SINE WAVE ORCHESTRA district

The SINE WAVE ORCHESTRA district (SWO-district) took place at DEAF04 in November 2004. SWO-district installed a speaker behind each of 24 columns in a walkway to the building where the festival took place.

Each speaker at each column was assigned a sine wave. What frequency each speaker played was preprogrammed by the organizers and changed over time. Some sine waves were set to interfere with each other. The speakers were capable of playing very low tones (i.e., sine waves with long wavelengths). The volume of each speaker was set quite high.

What a person heard changed drastically, depending on where the person stood in the walkway in terms of the locations of the 24 columns (i.e., speakers). When a person walked by the walkway passing the columns, the person could therefore experience dynamically changing sounds.

2.5 The SINE WAVE ORCHESTRA stay

The SINE WAVE ORCHESTRA stay (SWO-stay) was a work exhibited at NTT ICC from April to July 2005 as a part of the Open Nature Exhibition. A total of about 8,000 people participated in the work during the exhibition period. The technical aspect of the project is detailed by Jo and colleagues (Jo et al. 2005).

SWO-stay was installed in an anechoic 4m x 4m room equipped with 116 speakers horizontally placed along the wall. A podium was placed in the center of the room. The podium had two rotational controllers: one for changing the frequency and the other for changing the source position of the sine wave in a horizontal direction by choosing which speaker to produce the sound.

When entering the room, each participant was exposed to a sound field that consisted of sine waves that previous participants had generated. When the participant touched the controllers, a new sine wave started playing with higher volume than other sine waves. The brightness of the room light also increased from the initial level. As the participant rotated the controllers, the frequency and the sound source position of the sine wave changed. The participant then selected the frequency and the sound source position for his/her sine wave by pushing the controllers. That sine wave was then persistently added to the sound field of the room. The volume of the sine wave was then gradually decreased to the equal level as other sine waves, the brightness of the room was gradually decreased to the initial level. The person then left the room.

The volume of the sine wave created by each participant gradually attenuated over a period of two weeks and completely disappeared after the two-week period. As more participants entered the room and left sine waves, more sine waves were accumulated, resulting in a richer collective sound representation.

2.6 The SINE WAVE ORCHESTRA nomadic

The SINE WAVE ORCHESTRA nomadic (SWO-nomadic) was a work exhibited as a part of the International Triennale of contemporary art exhibit in Yokohama, which took place between September and December 2005. About 190,000 people visited the art exhibition during the period.

SWO-nomadic consisted of two parts. In the first part, five small-scale one-hour collaborative sound performances took place every other week in different outdoor places in Yokohama, including parks and wharves. In each performance, about 20 participants played sine waves with the devices the organizers provided, each of which was a speaker-equipped iPod to control the frequency and the volume of a sine wave. After each performance, the participants moved to the exhibition site. Each participant then set the volume and frequency of a sine wave by using his/her device, and exhibited the device at the site by attaching it to a string hanging from the high ceiling. Each participant was also asked to leave a message on a small tile and place it on the floor beneath the exhibited device. Those devices continued to produce sine waves during the exhibition.

Each of the five performances added a collective sound representation generated by 20 devices in the exhibition. Thus, the sound exhibition at the site grew every time each performance took place. In the end, the site exhibited a collective sine wave sound representation generated by 100 devices, which visitors to the exhibition could listen to. In addition, the visitors to the exhibition could see the accompanying 100 tiles showing the messages left by the participants.

In the second part, the participants of the five performances were all invited to join a large-scale performance, which took place at the end of the exhibition period. They removed the devices they had exhibited from the exhibition site, and walked to a nearby park, where they played sine waves with their devices. Passers-by at the site were invited to join to play the devices for which the original participants were not present. The performance lasted for a few hours.

3. DIFFERENT STYLES OF ENGAGEMENTS

Although all of the six works used synthesized sine waves *experienced* by participants as a collective sound representation, participants in each work had different sound experiences due to the different designs of how the participants shared the space and time, in what environments, and with what procedural settings. This section compares such different styles of engagement across SWO works.

3.1 Engagement through Moving Around

In five of the six SWO works, the participants engaged in collective sound representations by each using a device to control the properties of a sine wave, such as the frequency, volume, and sound source position. In addition, changing the position of "listening to" sine waves greatly changes one's sound experience. SWO-district, for instance, did not allow people to directly change the properties of the played sine waves but allowed people to engage in a variety of ways of listening to the sine waves by walking through the speaker-equipped columns in the walkway.

SWO-TAU, SWO-stairway, and SWO-nomadic were designed differently from SWO-click and SWO-stay in terms of speaker settings. In SWO-click, the participants shared two centralized mixers attached to the four loudspeakers that surrounded the room. SWO-stay had 116 speakers lined up in an anechoic room and let each participant choose which speaker to use for his/her sine wave.

In contrast, SWO-TAU, SWO-stairway, and SWO-nomadic used separate, individual built-in speakers, each equipped with a sine-wave-generating device. The participants in those works naturally started walking around during the performances. In the works, each participant held a sine-wave-generating speaker in his/her hand. If the participant moved to another position holding the device, not only did what he/she listened to change, but so did the sound source position of what that participant was generating, resulting in changes of the collective sound representation. In addition, because the sine-wave-generating devices provided by the organizers in SWO-stairway were light sensitive, the location and orientation of the devices changed the frequency of the sine waves. The participants seemed to engage in the collective performances by experiencing dynamically changing sound representations caused by their locations at the sites and hand-positions while holding the devices.

3.2 Engagement through Temporal and Spatial Co-Presence

The participants in SWO-click, SWO-TAU, SWO-stairway, and small performances of SWO-nomadic were collocated and played sine waves simultaneously.

The participants in SWO-district were occasionally collocated, but because the sine waves were pre-programmed, the actions of the other participants would not affect what any other participant experienced.

The participants of SWO-stay shared the space but not the time; they collectively created a sound representation in an asynchronous manner. In SWO-stay, participants were not necessarily aware that they were co-creating a sound representation with other people. By listening to the

sound as collective sine wave representations generated by the previous participants in the anechoic room, each participant designed his/her own sine wave through controlling the frequency and the sound source position within the environment. By adding the sound to the room, the participants created a collective sound representation performance.

SWO-nomadic involves different styles of collective sound performances. Each of the five small-scale performances of the first part of the SWO-nomadic demonstrated synchronous, collocated collective sound performances. The results were accumulated one by one at the exhibition site, by the participants' hanging the devices, each playing a sine wave, from the ceiling, synthesizing the five synchronous collaborative sound representations into a single "persistent" sound representation at the site. Visitors to the exhibition site could experience the asynchronously collected sound representations at the site. The large-scale performance in the second part of SWO-nomadic invited the participants of the previous five performances to reexperience the face-to-face synchronous collective sound performance at the end of the exhibition period.

3.3 Engagement through Identification and Association

The participants of the SWO works seemed to have engaged not only in the creation of a collective sound representation, but also in the identification of their sine waves. Some of the participants seemed to have begun to feel that they "owned" the sine waves they created, and associated sine waves with other individuals also participating in the performance.

In SWO-clicks, and partly in SWO-TAU, SWO-stairway, and SWO-nomadic, we observed that the participants made the volume of their own sine waves louder so that they could identify which sine waves were their own. This, however, sometimes resulted in a distortion of the collective sine waves.

In SWO-stay, when a participant in the room controlled his/her sine wave, the volume of the sine wave was increased. This was designed so that the participants could easily identify how their own sine waves sounded while controlling the frequency and sound source position. By having separate, individual speakers, as in SWO-TAU, SWO-stairway, and SWO-nomadic, the participants seemed to be more easily able to identify their own sine waves without making the volume louder.

Some participants also seemed to engage in identifying sine waves of their friends. We observed a number of participants who were leaning their heads toward their speakers, or the speakers of their friends' devices, during the performances of SWO-stairway.

Through informal interviews managed during breaks with the participants and a post-performance questionnaire conducted with the participants of SWO-nomadic, we have observed that some participants tried to find a sound among the collection of sine waves they were listening to that resonated with their own sine waves. Some walked around the environment to find a person who generated such a resonating sound. Some even reported that they missed the sound when they "lost" the sound on which they were concentrating. Some felt lonely when they could not find the sounds that resonated with their own sine waves.

4. DISCUSSION

Overall, the participants engaged in the SWO works through a series of experimentations by playing "*what-if*'s." By examining the six SWO works, we have identified four types of experimentations in which participants took a part. Such experimentations seem to play an important role in making people feel that they are not simply "using" a tool but "engaged" in the interaction with a tool. A single SWO work typically involved more than one type of these experimentations.

The first type is to *examine how the overall sound experience changes by spectating*. Participants of SWO-district engaged in the performance not by directly affecting the collective representation but by moving around the site and experiencing a variety of ways of listening to the sine waves. This is a typical way of how spectators (Reeves et al. 2005) engaged in performances.

The second type is to *examine how the collective sound representation changes by controlling the properties of the participant's sine wave*. Participants of SWO-click, SWO-TAU, and SWO-stay engaged in the performances by each changing the frequency, volume, and/or sound source position of their sine waves. In order to do so, participants had to identify their own sine waves among a number of collectively played sine waves (see the next point discussed below). Some participants moved around the site to engage in spectating the sound representations (see the first point above).

The third type is to *examine how a participant's sine wave sounds in the collective representation by identifying his/her sine wave*. Having individual speakers in the devices allowed the participants of SWO-stairway and SWO-nomadic to more easily engage in the performance by concentrating on their own sine waves. Participants of SWO-click, in contrast, had to make the volume extremely loud to do so, which caused a distortion of the collective sound representations, making their experience less engaging.

The fourth type is to *examine how a participant's sine wave resonates with those of others by associating sine waves with other participants*. Once they identified their own sine waves, participants of SWO-stairway, for instance, engaged in making their sine waves resonate with those of others. Temporal and spatial co-presence allowed the participants to engage in this type of experimentation. At the same time, however, the participants might have been less interested in the overall sound representations (see the second type, discussed above).

While traditional forms of arts allow people to engage in art works through the first type of experimentations, modern forms of arts, such as John Cage's 33-1/3 work (Emmerik 1996) allowed people to engage in the second type of experiment. In fact, a number of collective performance projects encourage participants to take part in this style, such as those listed in Section 1. Computer-based collective performances, such as Frequency and Volume (Lozano-Hemmer 2005) allow people to engage in a rich type of first-person experience through their third type of experimentation. Network-based collective art performances, such as SwarmSketch (Edmunds 2006) and rgb f__cker (Exonemo 2003) encourage people's engagement through the fourth type of experimentation.

The types of engagement and experimentations listed in this paper are based on our hypotheses developed by examining six of the SWO works. Our future work includes further investigating them through more case studies, not only limited in domains of collective art performances but also in those of knowledge communities (Nakakoji et al. 2005), and developing design implications for systems for collective performances that enable a rich user engagement experience.

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