The Music One Participates In: Analysis of participatory musical practice at the beginning of 21st century

https://doi.org/10.15017/1500449

出版情報：九州大学，2014, 博士（芸術工学），論文博士
バージョン：published
権利関係：全文ファイル公表済
The Music One Participates In:
Analysis of participatory musical practice at the beginning of 21st century

（参加する音楽 - 21世紀初頭における参加型の音楽実践の分析 -）

城一裕
Kazuhiro Jo
2015年3月
ACKNOWLEDGEMENTS

1. INTRODUCTION

1.1 General Introduction

1.1.1 The Emergence of Read/Write (RW) Culture

1.1.2 The Era of Composition

1.1.3 Musicking as a Social Act

1.1.4 “The music one listens to” and “the music one plays”

1.1.5 Roku-Gaku

1.1.6 Objective

1.2 “The Music One Participates In”

1.3 Structure of the Dissertation

2. PARTICIPATION

2.1 The Ladder of Citizen Participation - Social Science

2.2 Participatory Design and Communities of Practice - Human Computer Interaction

2.3 Creativity and Participation - Cognitive Science

2.4 Paradox in Paradise - Contemporary Art

3. PERFORMANCE: The SINE WAVE ORCHESTRA

3.1 Introduction

3.2 Tools and Instruments

3.3 Related Work

3.3.1 Classical Orchestra

3.3.2 Drum Circle
3.3.3 Scratch Orchestra [Cardew, 1969]

3.3.4 33 ⅓ [Cage, 1969]

3.3.5 Dialtones (A Telesymphony) [Levin, 2001]

3.3.6 Orchestra [Otomo, 2014]

3.3.7 Catch and Throw [Sangatsu, 2011]

3.4 Nine Works of The SINE WAVE ORCHESTRA

3.4.1 The SINE WAVE ORCHESTRA and if you like some clicks

3.4.2 The SINE WAVE ORCHESTRA in Tama Art University

3.4.3 The Stairway of The SINE WAVE ORCHESTRA

3.4.4 The SINE WAVE ORCHESTRA district

3.4.5 The SINE WAVE ORCHESTRA stay

3.4.6 The SINE WAVE ORCHESTRA nomadic

3.4.7 The SINE WAVE ORCHESTRA at ZeroOne San Jose / ISEA

3.4.8 The SINE WAVE ORCHESTRA mediate

3.4.9 The SINE WAVE ORCHESTRA in the sun

3.5 Elements of the Instruments

3.5.1 Frequency Control

3.5.2 Volume Control

3.5.3 Display Environment

3.5.4 Number of Participants and Instruments

3.6 Styles of Musical Participation

3.6.1 Identification and Association
3.6.2 Moving Around

3.6.3 Temporal and Spatial Co-Presence

3.7 Reviews

3.7.1 Deconstruction of the Ego of Self-Expression

3.7.2 From a Bottom-Up to a Virtual Community

3.7.3 Mathematical Formulation to a Pure Chance

3.8 Contribution

4. WORKSHOP: Chiptune Marching Band, Generative Music Workshop, and other practices

4.1 Introduction

4.1.1 Workshops

4.1.2 do-it-yourself (DIY) Activities

4.1.3 DIY Musical Instrument Workshops

4.2 Workshop Reports

4.2.1 Chiptune Marching Band

4.2.2 Generative Music Workshop

4.2.3 How to Turn Your iPhone into a Musical Instrument

4.2.4 Social Inclusion through the Digital Economy

4.3 Discussion

4.3.1 Rather than Completion of a Task

4.3.2 Spectrum of Participation

4.3.3 Shift of Roles

4.3.4 Away from the Paradox
5. REPRODUCTION: A record without (or with) prior acoustic information

5.1 Introduction

5.2 cutting record

5.2.1 Cutting Machines

5.2.2 A record without Prior Acoustic Information

5.2.3 A record with Prior Acoustic Information

5.3 Technical Issues

5.3.1 Sampling Frequency

5.3.2 Limitation of Anchor Points

5.3.3 Melt and Hook

5.4 Discussion

5.4.1 The Lack of Original Sounds

5.4.2 Material

5.4.3 Expertise, Cost, and Reproduction

5.4.4 Performance and Workshop

5.5 Contribution

6. CONCLUSIONS
APPENDIX II: Chiptune Marching Band - SIGGRAPH ASIA 2009
Course notes [Jo, Allen, 2009] 120

ACKNOWLEDGEMENTS

I am more than appreciative for the advice, encouragement, and support from numerous people whom have made this dissertation through a decade of struggle. Especially, I would like to appreciate following people.


Committee members: Kiyoshi Tomimatsu, and Masato Yako.

Curators: Yukiko Shikata, Minoru Hatanaka, yoyo, Taro Amano, Eriko Kimura, Kent Shimizu, Sabine Himmelsbach, Hyojung Seo, and other organizers.

Fellows: Ken Furudate, Daisuke Ishida, Mizuki Noguchi, Jamie Allen, Areti Galani, Adam Parkinson, Tomotaro Kaneko, Koichiro Sugiyama, Norihisa Nagano, Kanta Horio, exonemo, EYE, and Taeki Sawai.

Members in IAMAS: Mitsuhito Ando, Yuki Kimpara, So Yamada, johnsmith, and other students and colleagues.

Members in Art Media Center, Tokyo University of the Arts: Takuya Hoshi, Shunsuke Takawo, and other colleagues.

Members in Culture Lab, Newcastle University: Lalya Gaye, Joëlle Bitton, Joey Scully, Tom Schofield, Ko Le Chen, Pete Hindle, Thomas Gray, Tikul Tikul, Andrzej Wojtas, and Will Schrimshaw.


Family: Maiko Jo, Ayumu Jo, Sakura Jo, Mari Jo, Masanori Jo, and Michisuke Jo.

At the last I would like to thank all of the participants who joined The SINE WAVE ORCHESTRA, Chiptune Marching Band, Generative Music Workshop and other practices.
1. INTRODUCTION

Music is prophecy. Its styles and economic organization are ahead of the rest of society because it explores, much faster than material reality can, the entire range of possibilities in a given code. [Attali, 1977]

1.1 General Introduction

1.1.1 The Emergence of Read/Write (RW) Culture

Content created by people is a public affair, in the cultural field of music that includes diverse activities of listening, recording, sharing, remixing. A founding member of the Creative Commons and a Stanford Law professor Lawrence Lessig describes a re-emergence of creative acts of ordinary citizens under a term of Read/Write (RW) culture [Lessig, 2008].

He argues that, in the last century, with the arrival of recording and broadcasting technologies, people would become practiced in selecting what they wanted to hear, but less practiced in producing stuff for others to hear as they used to do. However, at the latest decade of twentieth-century, spread of digital technologies revived the creativity. People share and remix their music by using the same tools the professional uses on their laptop. With the technologies, people not just “read” their culture by listening but also “write” their culture by creating and re-creating the culture around them.

The argument is supported with the notion of “remix”. At the field of music, he described the notion with the emerging trend of mash up where people mix many samples drawn from many other musics. However, as Brad Tromel pointed out, the music (i.e. mash up) shortly lost its dominance [Tromel, 2012]. The music of RW culture still does not clearly present its figure. The music would not emerge not from the distinction between “amateur” and “professional” creativity.

1.1.2 The Era of Composition

French philosopher and economist, Jacques Attali predicted that in the future, music would become a network of “composition”, where people actively participating in music-as-process become a form of collective play [Attali, 1977]. He describes that “the place for music to be expressed, heard and exchanged”
under the term of ‘network’. He argues that music has been shifting its mode in 
according to four networks from “sacrificial ritual”, through “representation” and “repetition” to “composition”. In his view, music once functioned as a

distributive network of the orders, myths, and religious, social, 
or economic relations of symbolic societies
<sacrificial ritual>

shifts

a spectacle attended at specific places: concert halls, the closed 
space of the simulacrum of ritual - a confinement made 
necessary by the collection of entrance fees.
<representation>

In accordance with the recording technology, a new network appeared.

...the consumption of music is individualized, ... The network is 
no longer a form of sociality, an opportunity for spectators to 
meet and communicate, but rather a tool making the 
individualized stockpiling of music possible on a huge scale
<repetition>

After the repetitive mass production of capitalism, he envisions an emergence of “composition”. In this network,

what is heard by others would be a by-product of what the 
composer or interpreter wrote or performed for the sake of 
hearing it ... The listener is the operator. ... Music is no longer 
made to be represented or stockpiled, but for participation in 
collective play, in an ongoing quest for new, immediate 
communication, without ritual and always unstable.
<composition>

The shift of network pointed out the transition of music till the end of twentieth-century. Of course, the emergence of streaming service (e.g. Spotify) 
comprehensibly depicts the decline of the network of “repetition” (i.e. music as 
stockpiles), the network of “representation” still has kept its lingering scent with
the spectacles in combination with the collection of capitals. The coming network is waited eagerly with its concrete instance for participation.

1.1.3 Musicking as a Social Act

Musicologist, Christopher Small framed a question, “What does it mean to take part in a performance of Western concert music in a concert hall in these closing years of the twentieth century?” [Small, 1998] He coined the term “musicking” to explore the question. The word covers all participation in a musical performance from performing and listening through rehearsing or practicing to providing material (i.e. composing) or dancing. He argues that the primary meanings of music are not individual at all but social. It lies in action and in what people do.

Small argued “performance is the primary process of musicking” instead of a general process or specific works of music. He mentioned that the uncentralized power relationships within nonliterate composition and performance were the ideal of musicking. However, the exact references are taken from folklore music such as the Balinese gamelan or Mozambique ensembles. Therefore, it is hardly to realize the type of performance / musicking at the beginning years of the present century.

1.1.4 “The music one listens to” and “the music one plays”

Barthes [Barthes, 1970] divides music into two categories: the music one listens to and the music one plays. He argues that

There are two musics (at least so I have always thought): the music one listens to, the music one plays. These two musics are two totally different arts, each with its own history, its own sociology, its own aesthetics, its own erotic; the same composer can be minor if you listen to him, tremendous if you play him (even badly) –such is Schumann.

In his view, the former comes where people engage passively with sound representations through the act of listening while the latter occurs when people subjectively engage in the creation of sound. With the arrival of ‘the democracy of the bourgeoisie’, the latter, the music that people play individually or jointly with their friends for themselves has faded out. The birth of passive, and receptive
music (i.e. concert, festival, record, radio) urges the dusk of amateurs, ‘a role defined much more by a style than by a technical imperfection’, and the professionals, who abolish ‘the very notion of doing’, have arrived.

1.1.5 Roku-Gaku

Composer, Masahiro Miwa distinguished “recorded music” from music in general under a term of “Roku-gaku”. According to his argument, the two are totally different as if photography and cinema are different from a painting and a drama [Miwa, 2008]. He argued that all of the recorded sounds, which we listened today are not music but “Roku-gaku”, and music only exists in a performance performed by human being.

With this point of view, Miwa proposed “Reverse-simulation music” that extend the notion of algorithmic composition by treating performers as a part of operation system based on an algorithm composed by Miwa. The music clearly denied a performance with recorded sound and pointed out alternative possibility of humanity in musical performance with a help of the digital process. However, as he mentioned, the music itself is legitimately in a family tree of western music, and the structure of composer, performer, and audience tightly keeps its relationship. In this regard, the reverse-simulation music is not a result of Read Write culture where ordinary citizens involve its creation, nor an outcome of the network of composition in which the listener is the operator. Instead, the music seems to re-invent the network of “sacrificial ritual” with a help of imaginative tales instead of a religious lesson.

1.1.6 Objective

After the arrival of the internet, the roles of the professionals are again called into question. The prudent views of Read Write culture, network of composition, musicking, music one listens to and plays, and Roku-gaku have foreseen an emergent form of music where the public enters into the process of co-creation. Though the views failing to represent any specific case of the form of music, it is understandable that the form should not be a retrogression to the spectacle of live performance with capitals [Byrne, 2007], nor a nostalgia for the old albums made

---

1 In Japanese, music, is called as “On-gaku”. The term “Roku-gaku” uses the word “Roku” which means recording, instead of “On” which means sound.
with vinyls [Hann, 2014]. Instead, the music would be no longer made to be represented or stockpiled and based on wider participation in its creation. People would participate unrepeatable musical practice for-by themselves with a help of instruments.

The objective of the dissertation is to depict the emergent form of music in the 21st century under a notion of “the music one participates in”. For that purpose, the dissertation situates the following three challenges.

1. Blurring the boundary between the performer and the listener in a performance.

2. Extending the notion of musical participation through creative do-it-yourself workshop.

3. Re-examining the role of reproduction under a current technological environment.

For the challenges, the dissertation situates the analysis of own practices, The SINE WAVE ORCHESTRA, Chiptune Marching Band and Generative Music Workshop, and A Record without (or with) prior acoustic information. Each of the practices intended to enable people,

1. To have diverse ways of musical participation through abolishing the central authority in a performance. <The SINE WAVE ORCHESTRA>

2. To accommodate musical technology into physical acts of everyday creativity through its creation in workshop that differed from traditional music masterclass-trainings. <Chiptune Marching Band>, <Generative Music Workshop>

and

3. To produce personal music in reproduction without reminiscences of recordings. <A Record without (or with) prior acoustic information>
The goal of the dissertation is not to systematically theorize the whole emergent form of music in relation with extensive social conditions include the law and the economy. Instead, the dissertation tries to point out a specific diversity of the form with very minute examinations of each practice under the notion of “the music one participates in”.

1.2 “The Music One Participates In”

The dissertation extends Barthes’ binary divisions of music to proposes a notion of “the music one participates in”, a form of musical practice where people subjectively engage with sound representations through listening and simultaneously engage with the creation of sound.

The practice is close to Attali's ancient ‘sacrificial ritual’ where the sounds awake commonality of people as ‘a substitute for myth’ or Barthes’s ‘the music one plays’ where the music was performed ‘with no other audience than its participants’. However, the music one participates in is different from the others in that respect where it represented no religious and ritualized power, nor idleness of the privileged class. It also does not owe to the nineteenth-century’s receptive manner where the exceptional performers in a stage play the composition written by the composer for the audience, nor the twentieth-century’s playback product where the recording of the artist are circulated through distribution networks for the listener with a form of vinyl, cd, or mp3.

Instead, the form of music tries to get rid of such vested notions (i.e. religion, composition, recording), and casts a concern on the classic distinctions between composers, performers, and audiences, or, for that matter, between musicians and non-musicians. The evolution of the collective sound representation depends on the involvement of each participant, and the result might be unpredictable. In the practice, conventional musical training and skills, while still useful, are no longer an absolute requirement: each participant, regardless of level of training, is able to produce something they could call and enjoy as, “music”. [Auslander, 2000]
1.3 Structure of the Dissertation

The dissertation situates the notion of “the music one participates in” as a tip on music till 20th century (Figure 1-1) among the emerging form of music in the 21st century. The analysis of each practice are carried out in a following structure (Figure 1-2).

1. Introduction

   ↓

2. Participation

   ⇣  ⇣  ⇣


   ⇣  ⇣  ⇣

6. Conclusions

Chapter 2 outlines diverse discourses of participation ranging from social science and cognitive science through human computer interaction and Do-It-Yourself (DIY) to contemporary art. The dissertation regards that the role and the dynamics of participation are the fundamental pieces of “the music one participates in” by which a musical practice is built and examined. The idea of the ladder of participation [Arnstein, 1969] [Hart, 1982], the community of practice [Lave and
Wenger, 1991], Big/small creativity [Boden, 1991], the theory of flow [Csikszentmihalyi, 1997], and suspicions in participation [Bishop, 2012][Foster, 2004] are adapted for musical practice to examine the role and the dynamics of participation.

Chapter 3 situates the practice of The SINE WAVE ORCHESTRA (SWO) [Jo, Furudate, Ishida, Noguchi, 2008] to adopt the first challenge of “burring the boundary”. In the practice, the boundary between the performer and the listener is blurred through abolishment of a stage and a conductor. Although all SWO works use the same sound representation (i.e., sine waves), each SWO work uses a different instrument with a variety of temporal, physical, environmental, and procedural settings. The differences have resulted in diverse types of musical experiences of the participants. Based on a distinction between tools and instruments, and reference to existing musical practices, this chapter reports case studies of nine of The SINE WAVE ORCHESTRA works to explore the difference with detailed investigation of elements of each instrument. Following the exploration, the chapter considers the diversity of performance by analyzing their styles of musical participation of the participants with reviews of the works by critics. Such analysis allows us to focus on what aspect of the work affects the difference in how people participate and engage in a participatory musical practice.

Chapter 4 examines the second challenge of “Extending the notion of musical participation through creative do-it-yourself workshop” [Jo, Parkinson, Tanaka, 2013] by taking examples from the practice of Chiptune Marching Band [Jo, Allen, Galani, 2009], Generative Music Workshop [Kaneko, Jo, 2010], and others. The chapter looks at the range of different methods that make up the term, workshop, as well as emergent relationships between facilitator and participant in creative do-it-yourself activities to frame the discussion of participatory music practice.

Chapter 5 faces the third challenge of “Re-examining the role of reproduction under a current technological environment” by situating the practice of a record without (or with) prior acoustic information [Jo, 2014a] as its instance. In contrast with the previous recording technologies, the proposed method enable people to produce personal music with the lack of original sounds. The chapter examines its
technical specification as well as its aesthetic consequences by situating the practice in a historical context.

Chapter 6 concludes the dissertation by presenting a consequence of the analysis of the own practices to depict the emergent form of music, “the music one participates in”. The consequence reveals the nature of each challenge which the dissertation situates in the beginning, as well as points out the potential of each practice as a base to consider the meaning of performance, workshop, and reproduction in musical practice at the beginning of the 21st century. Discussion with extensive social conditions should be conducted in the future work.
2. PARTICIPATION

In participatory practices, the notion of authority is often challenged and problematised. Content is no longer seen as a static object created by a single author, but instead, becomes part of an emergent and sustained relationship between authors (artists, designers, managers) and participants (audiences, users, workers). In order to map notions of participation to music in the era of Lessig’s R/W practices, the dissertation needs first to unwrap the diversity of participation across a range of domains. Similar to the multiple definitions of the word music, there are a variety of interpretations of the term, participation, with each field exploring different aspects of its implementation. This chapter examines the nature of participation across disciplines from social science through human computer interaction and cognitive science leading up to reviews in contemporary art.

2.1 The Ladder of Citizen Participation - Social Science

Participation in social science is an umbrella term to cover decision-making processes in various activities including politics, economics, management, and education. Arnstein defines three broad levels of citizen participation: non-participation, tokenism, and citizen power within which are eight rungs (from manipulation to citizen control) of a ladder [Arnstein, 1969].

![Ladder of Citizen Participation](image)

Figure 2-1. Three levels on the ladder of citizen participation [Arnstein, 1969]
The ladder serves to illustrate gradations of participation in society and depicts potentially deceptive political and economical actions of power holders. Arnstein argues, “participation without redistribution of power is an empty and frustrating process for the powerless.”

Environmental psychologist Roger Hart extends Arnstein’s ladder, using it as a starting point to think about children’s participation in social benefits projects [Hart, 1992]. In collaborative work with UNICEF (the United Nations Children’s Fund), he opposes the judgement that “participation by children is a naive notion for children who simply do not have the decision-making power of adults” and argues for the importance of the involvement of children, the least listened to members of society, in meaningful projects with adults. To depict circumstances where children’s involvement is ambiguous and even subject to manipulation, Hart proposes four requirements as a basis for a project to be truly considered as participatory:

1. That participants understand the intentions of the project;
2. That they know who makes decisions concerning their involvement and why;
3. They have meaningful (rather than ‘decorative’) roles;
4. They volunteer for the project once the project has been made clear to them.

Hart’s criteria serve to elucidate the real distinction between forms of full participation compared to the token forms of participation midway down Arnstein’s ladder. Whether or not we subscribe to political activism, this points out that forms of agency are necessary to genuine participation. The dissertation will make use of these four criteria in describing the kinds of participation in own practices presented in following chapters.

2.2 Participatory Design and Communities of Practice - Human Computer Interaction

In HCI, participation is a core part of a family of user-centric methods in qualitative research used to study technology-mediated interaction from workplace design through situated learning to online social networking.
One important tradition of participatory design comes from Scandinavian research practice dating back to the 1960’s where researchers discussed approaches to computer systems design with the very people destined to use the system and to engage with them as a critical role in the designing process. Czyzewski et al., describe “workers’ determinability for their work” and attach importance to “the user’s perceptions and feelings about technology” [Czyzewski, Johnson, Roberts, 1990]. They view computer systems “as processes rather than as products”. In these approaches, the privilege of the expert is called into question. For the success of a project, it is important to have a partnership between implementers and users.

In the workplace literature, Lave and Wenger view learning as a situated activity [Lave, Wenger, 1991] that forms communities of practice. They use examples from apprenticeship programmes to describe processes by which newcomers become part of a community around shared objectives. They argue that the need to acquire knowledge and skill motivates newcomers to participate fully in the socio-cultural practices of a professional community. Preece and Schneiderman extend these notions beyond the workplace by proposing the Reader-to-Leader Framework as a way to understand people's participation in online social activities [Preece, Schneiderman, 2009]. They identify usability and sociability factors at different stages, evolving from Readers of discussion boards, blog posts, and photos to Contributors of user-generated content including music, video, or text articles, through Collaborators who form tightly connected groups with lively discussion, to Leaders who govern activities of an online community by setting and upholding policies, vetting content, or mentoring novices.

2.3 Creativity and Participation - Cognitive Science

Activities in participatory practices often invoke questioning of authority. These practices do not always have definite destinations for their outcomes, such as museums, concert halls, or boutiques. Rather they try to seek less tangible, but palpable personal sense of fulfilment such as making friends, assembling gadgets, or acquiring skills. Wang and Kaye [Wang and Kaye, 2011] coin the phrase Inventive Leisure Practices (ILP) to describe such “small-c” activities - to denote creativity in lower case, creative acts, those that do not carry artistic pretensions of Big-C Creativity [Boden, 1998]. Small-c creativity is not goal oriented, but
rather process based, where, according to Csikszentmihalyi’s Theory of Flow, people “experience the world in novel and original ways” [Csikszentmihalyi, 1997]. Wang and Kaye represent these creative processes as forms of practice that are “complex and messy” and include in their activities such as creative hacking and craft. These activities use appropriation, are decoupled from the market economy, are based on skill and not accreditation, and take place in the absence of a central authority. These characteristics of ILP’s are a useful way to distinguish participatory practices from Big C arts creativity that are often highly centralised, and are based on a recognition linked to levels of training.

2.4 Paradox in Paradise - Contemporary Art

Since the 1960s, in the field of contemporary art, under a name of participation, artists are striving to collapse the distinction between performer and audience, professional and amateur, production and reception. Their emphasis is not only on the activation of the individual viewer in so-called ‘interactive’ art and installation nor on collaboration, and the collective dimension of social experience.

Art theorists have cast their attention on participatory art, and in the process of doing so, have raised issues and concerns about the maturing process of participation and its ultimate robustness in a succession of practices. Bishop notes a mismatch of social and artistic judgement in participatory art practices [Bishop, 2012]. She coined the term of “Delegated Performance” for situations where the artist uses people as the medium to undertake the job on behalf of the artist.

Curator Rudolf Frieling points out a paradox in 1960's participatory art.

By embracing chance, by giving up control, by inviting others to participate in the production of the artwork, by claiming the radical dismantling of traditional systems for evaluating art, these pioneering figures faced a paradox from the very start: how to do away with art by making art. Art and antiart, and art and life, have always been closely intertwined in this paradox. [Frieling, 2009]

American theorist, Hal Foster also indicates a tendency towards “a promiscuity of collaboration” [Foster, 2004]. He argues that “the discursivity and sociability” in these works risks to be illegible to the viewer. Sometimes the effects of
juxtaposition of projects are more chaotic than communicative. He wonders if the illegibility

might introduce the artist as the principle figure and the primary exegete of the work.

Such a paradox points out a lingering authoritarian position of the artist despite the supposedly horizontal nature of participatory practice. In essence, the question is whether Big-C artists can legitimately create art objects that celebrate small-c creativity?
3. PERFORMANCE: The SINE WAVE ORCHESTRA

3.1 Introduction

This chapter presents diverse ways of musical participation in performance to adopt the first challenge of “blurring the boundary” through the transition of works on The SINE WAVE ORCHESTRA [Jo, Furudate, Ishida, Noguchi, 2008]. The SINE WAVE ORCHESTRA (SWO) is a participatory sound performance project that has been performing at various exhibitions, for both long and short periods of time since 2002 (Appendix I). The author has served as one of the four core organizers of the project. Under the basic concept that each participant plays a sine wave by changing its frequency, volume, position, and/or duration, people are invited to create a sea of sine waves as a collective sound representation. SWO has been actively performing for the past decade in various exhibitions, both long-term and short-term, including at NTT ICC (InterCommunication Center), Yokohama Triennale, ISEA (International Symposium of Electronic Art), Sendai Mediatheque, and Edith-Russ-Haus (Figure 3-1).

Figure 3-1. The Stairway of The SINE WAVE ORCHESTRA, The SINE WAVE ORCHESTRA stay, The SINE WAVE ORCHESTRA nomadic, The SINE WAVE ORCHESTRA at ZeroOne San Jose / ISEA 2006, The SINE WAVE ORCHESTRA mediate, The SINE WAVE ORCHESTRA in the sun (from left to right).

This chapter reports case studies of nine of The SINE WAVE ORCHESTRA works to analyze different styles of musical participation with a strong interest in their employment of instruments. The analysis of nine SWO works allows us to focus on what aspects of the settings affect the differences in how people participate and engage in performance of “the music one participates in”.
Through the analysis, the dissertation distinguishes instruments from tools (3.2), compares the practice of SWO with other musical practices (3.3), explains each SWO work and instrument in detail (3.4), discusses what elements of the instrument affect how people create collective sound representations (3.5), describes the styles of participation (3.6), and examines critical reviews (3.7).

### 3.2 Tools and Instruments

Although all SWO works use the same sound representation (i.e., sine waves), each SWO work employs specific temporal, physical, environmental, and procedural setting with its unique instrument. These variations have resulted in different styles of musical participation. To examine the uniqueness of instruments, this chapter firstly distinguishes instruments from tools.

Tools are objects created by people for a specific purpose with certain functions. People use tools in a variety of ways, such as to achieve a certain goal more quickly, to develop and learn a certain skill and knowledge, or to have a certain experience [Nakakoji, 2006]. From Human Computer Interaction (HCI) point of view, computational application systems are also referred as tools. These tools are not only used to produce end products but also to create other tools [Beyers, 1995]. They are often classified by their users and types of activities that they offer [Shneiderman, 2002]. For the design of such tools, Nielsen proposed the following aspects under the term of usability [Nielsen 1993]:

1. **Learnability:** The system should be easy to learn so that the user can rapidly start getting some work done with the system.

2. **Efficiency:** The system should be efficient to use, so that ones the user has learned the system, a high level of productivity is possible.

3. **Memorability:** The system should be easy to remember, so that the causal user is able to return to the system after some period of not having used it, without having to learn everything allover again.

4. **Errors:** The system should have a low error rate, so that users make few errors during the use of the system, and so that if they
do make errors they can easily recover from them. Further catastrophic errors must not occur.

5. Satisfaction: The system should be pleasant to use so that users are subjectively satisfied when using it; they like it.

However, if the evaluation naively done ‘by rule’ rather than ‘by thought’, it can mute creative ideas that do not conform to current interface norms, quash what could have been an inspired vision, or forestall tomorrow's eager acceptance [Greenberg, Buxton, 2008]. Furthermore, the usage of tools in unintended or abused manner from its original purpose is out of these definitions. Sometimes, such blindness keeps us away from the shift to innovation. We may have to change from creating only fast and efficient tools to be used during a limited time in specific situations, to creating technology that surrounds us and therefore is a part of our activities for long periods of time [Hallnas, Redstrom, 2001].

To keep the chance of invention and retain the potential to unintended use, this dissertation proposes to use a term “Instruments” instead of using a term “Tools”. They also provide some functions however they are not mean to take a specific task. In collate with the aspects of the usability, they could be described as follows:

1. Learnability: They might require time to learn, but the time might provide people to achieve virtuosity.

2. Efficiency: They might be inefficient to use and provide less productivity, but might display distinguish characters in the outcome.

3: Memorability: They might lack consistency in their behavior, but the behavior might inspire people to have a new idea in each time.

4: Errors: They might have a high error late, so that people need to cope with the error during the use, but the error might give unexpected findings.
5: Satisfaction: They might be severe to use, and require training. However, the practice severeness might provide people to reach elaborate outcome.

As Bertelsen, et al. described [Bertelsen et al., 2007], the use of instruments exceeds what is initially designed for. Their aesthetics of use is pointing to alternative values, and differing from traditional usability.

In the field of music, the change of its style has occurred with the invention of such unintended use.

Even if the object produce same representation (i.e. sound), people employ the objects in a different way. In the case of drum which produces the sound by a membrane stretched over the opening of either a frame or a hollow body of any shape [Sachs, 1940], people are employing the instrument as a percussion to perform their composition in a symphony orchestra, a jazz quintet, or a rock band. However, with one of the drums, talking drum, African people developed acoustic speech surrogates to communicate verbalized messages with specific operation. They are often at a distance greater than that which articulate speech itself can cover [Ong, 1977].

In Cologne WDR(West Deutsche Radio) studio between 1958 and 1959, one of the representative composers in the early days of electronic music, Karlheinz Stockhausen, was mixing his first electronic composition, Kontakte. In the studio, he employed discarded U.S. Army equipments, the pulse generator, indicating amplifier, band-pass filter, as well as the sine and square wave oscillators to produce materials for his composition. These abuses produce distinctive sounds which are different from the sounds by standard audio equipments [Kittler, 1999].

In 1977, Grand Wizard Theodore innovated the scratching with Technics SL-1200, a direct drive turntable. The innovation is a technique to perform with the vinyl record, and is one of the start point of Hip hop [Hansen, 2000]. With the strong motor of the turntable that originally developed to keep the rotation accurately, he rubbed the vinyl back and forth against the stylus to produce different pattern and rhythms.

Tanaka described a raison-d'être of a musical instrument as follows:
The evolution of an instrument is less driven by practical concerns and is motivated instead by the quality of sound the instrument produces. In this regard, it is not so necessary for an instrument to be perfect as much as it is important for it to display distinguishing characteristics, or “personality”. What might be considered imperfections or limitations from the perspective of tool design often contribute to a “voice” of a musical instrument. … [Tanaka, 2006]

The instrument for producing sound is a unity of the sound source and interface [Bongers, 2007]. In an acoustic instrument, the playing interface is tightly coupled to the sound source. However, in electronic and computer instruments, the interface is usually completely separated from the sound source, and the relationship between them has to be defined. How we choose the interface, and the relationship affects the perception and the playability of the instrument [Hunt, Wanderley, Paradis, 2002].

Even the instruments of SWO only produce a same sound source / timbre [ASA, 1960] (i.e. sine wave), each instrument has its unique character. The resulted collective sound representation actively changes its state through involvements of participants. The sound and instrument act as dynamic interactive systems to include the output from the participants [Cornock and Edmonds, 1973]. In a traditional classical orchestra, skilled performers produce collective sound representations by playing instruments on which they have practiced for long periods of time. In SWO works, the instrument is an unfamiliar device to the participants. By restricting its sonic possibilities, participants quickly learn to play it in the course of their participation. Analyzing nine of SWO works with different instruments will allow us to focus on what elements in the instruments affect how people create collective sound representations.

3.3 Related Work

In this section, the dissertation compares the practice of SWO with other musical practices where people perform together to produce a collective sound representation. In these practices, the collective sound representations have varied forms with different temporal, physical, environmental, and procedural settings. However, what processes the people go through to engage in practice have not
been studied in much detail ¹. The dissertation situates existing musical practices to illustrate the variation in the collective sound representations with an emphasis on the role of central authority by referring to Artstein’s three levels of participation. These practices range from traditional musical ensembles through historical avant-garde compositions and sound-based works in the field of media art to recent experiments in popular music scene.

### 3.3.1 Classical Orchestra

The classical orchestra typically performs and interprets music notated in score form. The score, as written by the composer is regarded as the original work and the performance is an act of interpretation, a medium to pass the experience of the work to the listener. An instrumentalist in the orchestra engages at several levels of participation. As the score indicates precise instrumentation, the instrumentation or orchestration of a traditional symphonic work is not actively modified by performers. Meanwhile, the performer articulates tonal expression through interpretation of dynamics markings in the score. From the point of view of tonal or timbral, thereby the participant (instrumentalist in this case) “hears and is heard” (i.e. their interpretation) has a real impact on the resulting music, but do not engage at the level of “changing the status quo” (do not actually alter the structure of the composition). The act of performing from a score, and following a conductor is a process that could be considered as *Tokenism* in Artstein’s point of view. However, the notion of “hear and is heard” point out the interaction between conductor and performer. A successful orchestral performance is contingent not only on the precision of the score or the quality of the conductor, but on inter-performer communication that lies at a level of subtlety between the written note and between the conducted beats. The orchestra member's engagement with this act of listening-as-performance is crucial to the success of a concert.

The audience of an orchestral concert experience in a concert is a way markedly different from the performers. Members of the audience are typically assigned pre-assigned seating and thus fixed spatial and temporal occupation at the venue. They are not able to influence the event, and so the act of communicative listening amongst audience members remains at *Non-participation* in the collective sound representation.

---

¹ Initial studies of this section have been conducted by the author and colleagues [Jo, Tanaka, 2009].
Though the classical orchestra and The SINE WAVE ORCHESTRA (SWO) have correspondence in their names, the two practices are totally different from the point of roles of people in a performance. In the performance of SWO, the conductor is absent, and the distinction between audience and performer (instrumentalist) is futile. Instead of the score, there is a principle for each participant to play a sine wave with her/his instrument <Non-participation>. According to the behavior of participants, the resulted collective sound representation transforms its spatial and spectral form <Citizen Power>.

3.3.2 Drum Circle

A drum circle is a group of people playing drums together in a self-organized fashion. Stevens [Stevens, 2003] describes the principles of drum circle as follows: “There is no audience”, “There is no rehearsal”, “There is no right or wrong”, “There is no teacher”, “It is inclusive”, “Spontaneity thrives”, and “It's about more than drumming.” In this practice, the sound and the instrument are tightly coupled as a form of extended “drum.” People manage their drumming within the constraints of the drum of their choice. There is no score, but the pulse and foundational rhythm are set by a facilitator. The performance has a duality of self-expression and the unity of group rhythm, open contributions to collective rhythm that is nonetheless implicitly guided by a named or unnamed group leader.

Of course, the practice is different from SWO in terms of its guide by the facilitator <Tokenism> with a different choice of sounds (i.e. drums and sine waves). However, its treatment of participants as a group (no audience!) corresponds with the objective of SWO to blur the boundary between performers and audience.

3.3.3 Scratch Orchestra [Cardew, 1969]

The Scratch Orchestra is a collective organized by composer Cornelius Cardew which welcomed anyone from musically-trained to non-musically-trained people [Cardew, 1969] with arrangement of his or her basic repertory categories, including scratch music, poplar classics, improvisation rites, compositions, and research project. In their practice, a concert is designed in rotation (starting with the youngest) of each member <Citizen Power> with the repertoires. The details of
the concert are decided by the selected member, however, if the member refuses the decision, the concert is delegated to random methods or voting.

The Scratch Orchestra shows a potential to consider SWO as a repertory of the practice. However, the organization of the practice is different from SWO in which the selected member acts as an authority for other members instead of the organizers invite people to participate.

3.3.4 33 ⅓ [Cage, 1969]

33-⅓ is a work by the American composer John Cage [Hitchcock, 1992]. In the work, people enter a room where a set of turntables and more than 200 vinyl records are arranged on tables around a room surrounded by speakers. Despite the lack of explicit instructions, people can play records on the turntables. The selection of which record and music to play are left with each participant, who listened to what music other participants were then playing.

The practice mixes sounds from vinyl records in a space instead of sine waves of SWO. The resulted collective sound representation should be dissimilar (unless every record have a sine wave). However, the way to stimulate people to perform with a simple procedure (i.e. put record on a turntable) has a similarity to the way of SWO in which participants are asked to perform a sound with few parameters.

3.3.5 Dialtones (A Telesymphony) [Levin, 2001]

Dialtones (A Telesymphony) is a work whose sounds are produced through the audience’s mobile phones. Participants are assigned the seat at the site, and new “ringing tones” are automatically downloaded to their mobile phones. During the performance, the artists dial the telephone numbers of the audience, causing their mobile phones to ring. While audience member's telephones are used as instruments, they have no control in how they are used, resulting in. With their spatial position and sounds from their phones, people listen spatially distributed melodies and chords determined entirely by their fixed seating and dialing activity by the artists, creating ultimately.

Though its choreographic approach for participants is different from SWO where the result is left to participants, the practice shows a similarity with SWO in terms of the use of personal object (i.e. mobile phone and laptop) for performance. Such
unintended or abused manner from its original purpose predicts subsequent occurrences (e.g. iPhone).

3.3.6 Orchestra [Otomo, 2014]

Orchestra is a project initiated by Yoshihide Otomo around the beginning of the 21st century [Otomo, 2014]. According to Otomo, the basic idea of the project is coming from Butch Morris’s conduction which intended to create, “A vocabulary of ideographic signs and gestures activated to modify or construct a real-time musical arrangement (of any notation) or composition” (http://www.conduction.us/).

In the Orchestra, a diverse range of people from elderly through musician to disabled people are invited to participate with their instruments to produce sounds. The instrument is varied from traditional musical instrument to an everyday object. In their performance, each participant plays his/her instrument according to eight simple signs, such as “a forefinger” for short tone, “three fingers” for rhythm, and “push by a thumb” for stop, of a conductor. Dynamic change of the conductor within a performance is desired to away from the fixed hierarchy and the central authority.

The way to invite diverse people with different instruments bears resemblance to SWO. The intention to refuse the existing tradition seems to respond the first challenge of dissertation to blur the boundary between the performer and the listener. However, the practice is different from SWO in that it still has a conductor.

3.3.7 Catch and Throw [Sangatsu, 2011]

Catch and Throw is a series of musical practice developed by Japanese music band “Sangatsu” from 2011. In the series, they prescribe a set of structures or rules to produce sounds such as using a numerical sequence to create drum pattern or making signs for call and response with drums, as a platform. The platform is changing with feedbacks from themselves and others. They treat each platform as a musical work instead of a repeatable / recordable piece of music and try to present the growing process for the audience instead of finished one.

The way to prescribe a performance with a simple procedure is close to the way of SWO, though the practice is not for people to participate but for the band members to play.
3.4 Nine Works of The SINE WAVE ORCHESTRA


3.4.1 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 an instrument that can generate a sine wave, such as a laptop PC, synthesizer, analog oscillator, or PDA (see Figure 3-1). 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.

![Figure 3-1. The SINE WAVE ORCHESTRA and if you like some clicks.](image)

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.
3.4.2 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 (Figure 3-2). About 100 students and musicians were invited to produce sine waves with their instruments in the same manner of SWO clicks. During the performance, they were changing frequencies and volumes in the foyer of one of the university buildings. The performance lasted about one hour by using instruments, 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.

Figure 3-2. The SINE WAVE ORCHESTRA in Tama Art University.

3.4.3 The Stairway of The SINE WAVE ORCHESTRA

The Stairway of The SINE WAVE ORCHESTRA (SWO-stairway) took place at the NTT InterCommunication Center on 19th June 2004 as a part of the n_ext exhibition (see Figure 3-3).

Figure 3-3. The Stairway of The SINE WAVE ORCHESTRA.

The public were invited to participate via website and mailing list announcements; passers-by at the site were invited as well. The organizers provided the participants with 50 instruments, and some people brought their own as well (e.g., laptop PCs and synthesizers) to play sine waves at varying frequencies and volumes. About 200 participants came to the performance, and played sine waves
on the instruments for about two hours around sunset in the large hallway by the stairs of the ICC building. As they played, they moved around the hallway and produced varieties of sine wave frequencies.

The instrument consists of an oscillator, a CDS photocell, a speaker, and a battery within a hand-held plastic sphere. The frequency and volume of the sine waves changes depending on the amount of light the instrument receives (see Figure 3-4).

![Diagram of the instrument](image)

Figure 3-4. The instrument for The Stairway of The SINE WAVE ORCHESTRA

The oscillator consists of an analog circuit. The CDS photocell mounted on the top of the sphere is connected to the part that controls the frequency and volume of a sine wave. Depending on the amount of light received by the CDS photocell, the oscillator changes the frequency and the volume of the sine wave. The range of frequency was set at about 420Hz to 480Hz, and the range of volume at about that of a whisper, at zero. If the CDS photocell receives no light, the sine wave will have no volume. The battery is used for the oscillator and lasts about a day. The sine wave from the oscillator is output through a speaker mounted on the bottom of the sphere. There are holes at the bottom of the sphere, and if people cover the holes, the volume of the sine wave decreases.

3.4.4 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 (Figure 3-5).
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 experience dynamically changing sounds.

### 3.4.5 The SINE WAVE ORCHESTRA stay

The SINE WAVE ORCHESTRA stay (SWO-stay) was premiered at an open nature exhibition at NTT InterCommunication Center from 29th April to 3rd July 2005 (see Figure 3-6).
Here is the statement for the work.

It is hard for us to relate to artworks that can stand alone without human interference. We find it unnatural that the artwork makes sense by itself regardless of the existence of humans, because the relationship between people is more important than that between the artwork and people.

People may just want to be overwhelmed. But we don’t want to make artwork like that. We want to connect with other people, hold hands and hug each other. The medium of a sine wave is our connection. Not content with being overwhelmed, nor seeking any unison/integration, our individual intentions stride away.

We cannot offer anything to the world. All we can is to connect to, hold hands with and give a hug to others (that is you). We hesitate to call it “love”.

Why did we decide on sine waves? Or why were they chosen?
All the sound can be dissolved into a number of sine waves. A note without harmonics. A note each brought in by different people is overlaid with others. Because of their purity, the notes create friction in the space. Individual sound stand on the same horizon and a relationship emerges between undulating sounds. It, at the very least, depicts and outlines the relationship. Upon arriving at an extremely sparse room, he or she leaves a sine aware as proof of the visit. During the performance which takes more than two months, the traces will gradually face.

But even after the performance finishes, they will not be terminated. They will keep on resonating somewhere until they stop.

According to the statement, the author and colleagues situated the work in an echoless chamber. When entering the room, each participant was exposed to a collective sound representation consisting of sine waves produced by the previous participants. When a participant touches the controllers, a new sine wave starts to play at a higher volume than the other sine waves. The brightness of the room also increases from the initial level. As a participant rotates the controllers, the frequency and position of the sound source of the sine wave changes. The participant then selects the frequency and the sound source position of his/her sine wave by pushing the controllers. That sine wave is then added to the sound field of the room. Then the volume of the sine wave is gradually decreased until it is equal to the other sine waves and the light in the room is gradually decreased to the initial level. The volume of the sine wave produced by each participant is gradually attenuated over a period of two weeks and disappears after the two-week period. As more participants enter the room and leave sine waves, more sine waves are accumulated. During the exhibition, the collective sound representation changed from a phase where each sine wave was discriminable to a cluster consisting of mutually interfering sine waves like white noise that contained all frequencies.

About 8,000 people participated in this work during the exhibition period. The instrument was a set of controllers, the control engine, light, sound synthesis engine, and multiple speakers. The set of controllers is connected to the control
engine. The control engine controls the light and the sound synthesis engine. The sound synthesis engine, connected to multiple speakers, synthesizes sine waves in real time. The multiple speakers are mounted on the wall horizontally to encircle the participant. The controller, the light, and the multiple speakers are set in a 4m x 4m echoless chamber (see Figure 3-7).

![Diagram of system setup](image)

Figure 3-7. The instrument for The SINE WAVE ORCHESTRA stay.

SWO-stay sets two rotational controllers Griffin Powermate (http://www.griffintechnology.com/products/powermate) in the center of an echoless chamber. One controller is for changing the frequency of a sine wave from 100Hz to 12000Hz, and the other is for changing the position of a sine wave in an omni-horizontal direction through 116 speakers. To generate a release message for the sine wave after configuring these parameters, the participant presses both controllers. At that moment, the frequency and the position of the corresponding sine wave are fixed, and this control data is sent to the control engine.

The control engine receives data from the controller and sends it to the light and the sound synthesis engines. It is implemented with MaxMSP (https://cycling74.com/). The frequency and the position-control messages are only used for the sound synthesis engine. The release message of the sine wave is used for both the light and sound synthesis engines. After the release message is received, the control engine is locked in order to restrict multiple releases of sine waves from one participant.
A light is mounted on the ceiling. When it receives a release message from the control engine through a MIDI-based light controller, the brightness of the light is decreased in correspondence with the volume of the sine wave.

The sound synthesis engine treats all sine waves produced by the participants, and is implemented with SuperCollider (http://www.audiosynth.com/). The frequency and the position control messages from the control engine are transmitted through the Open Sound Control Protocol (http://cnmat.cnmat.berkeley.edu/OSC/), and used as parameters for real-time sine wave synthesis. The sound synthesis engine controls the frequency and the position of sine waves. The position is managed by changing the audio interface's output channel (116ch) (Motu 24. http://www.motu.com/). Each audio interface's output is connected to one of the multiple speakers. When it receives a release message from the control engine, the frequency and the position of the sine wave are fixed, and the volume of the sine wave is decreased to a level equal to the other sine waves. The volume of each sine wave gradually attenuates over two weeks and then disappears.

All the sine waves from the sound synthesis engine are output through multiple speakers mounted on the wall of the echoless chamber. In total, 116 speakers encircle the participant from an omni-horizontal direction.

The controller and the multiple speakers are set in an echoless chamber. In order to listen to the sine waves which are transmitted directly from multiple speakers, and to prevent any noise entering from the outside, the door of the room is kept shut while people are inside.

3.4.6 The SINE WAVE ORCHESTRA nomadic

The SINE WAVE ORCHESTRA nomadic (SWO-nomadic) is a work exhibited as a part of the International Triennale at Yokohama, which took place between 28th September and 18th December 2005 (see Figure 3-8).
As a reference of the work, the dissertation introduces a remark of Tadashi Kawamata, the director of Yokohama Triennale 2005 [Kawamata, 2005]. He described the role of “those involved in some form in its creation”, as “are able to see it more objectively than the artist himself”, and argued a need for “a great jump” to have “art as a dialogue” by “the removal of the fundamental barriers between the artist and the viewer”.

Followings are the ideas which proposed for the event by him.

1. Participation to enable “The viewer suddenly finds himself participating in an artwork and gives himself to that experience”,

2. Involvement with People “To move from a viewing appreciation of art into an actual physical involvement in it”,

3. Involvement with the Site to “look for meaning in doing things that can only be done here, in this place.”,

and,

4. The Exhibition as a Work-in-Progress, where “something will continually be taking place at this exhibition. With each successive visit, moreover, the artworks themselves will be seen to have changed. Artworks that grow.”

In his text, though Kawamata did not directly mentioned about the work of The SINE WAVE ORCHESTRA but to the concept of the triennale which clearly
depicted the nature of The SINE WAVE ORCHESTRA nomadic which the author and colleagues presented at the event.

SWO-nomadic was made up of two parts (see Figure 3-9). During the first part, five small-scale, one-hour collaborative sound performances took place every other week in different outdoor places in Yokohama. In each performance, about 20 preregistered participants played sine waves with the instruments provided by the organizers. After each performance, the participants moved to the exhibition site. Each participant set the frequency and the volume of a sine wave by using his or her instrument, and exhibited the instrument at the site by attaching it to a string hanging from the high ceiling from a power cable. Each participant was also asked to leave a message on a small tile and to place it on the floor beneath their instruments, which continued to produce sine waves during the exhibition.

Each of the five performances at the exhibition added 20 sine waves produced by 20 instruments. Thus, the collective sound representation at the exhibition site grew after every performance. In the end, the site had a collective sound representation of 100 sine waves produced by 100 instruments that visitors to the exhibition could listen to, and they could also see the accompanying 100 tiles showing the messages left by the participants.

During 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 instruments from the exhibition site and walked to a nearby park where they played sine waves with their instruments. Passersby were invited to join in and play the instruments of those original participants who were not present. The performance lasted for a few hours until all the batteries of the instruments wore out.
About 190,000 people visited the work during the exhibition period; the instrument was a Linux-installed-iPod and a speaker. The iPod's wheel and center button are for changing the frequency; the forward and rewind buttons are for changing the volume of a sine wave. The screen shows the current frequency and the volume of a sine wave. The output port is connected to a speaker attached to the back of the iPod (see Figure 3-10).

iPodLinux, Podzilla, and a customized version of an audio generator application (iPodLinux. http://ipodlinux.org/) are installed on an Apple iPod 3rd-generation model. The wheel changes the frequency of the sine wave, and the center button changes the interval of the frequency (1Hz, 10Hz, 100Hz). The forward and rewind buttons change the volume of the sine wave (up and down). The screen shows the current frequency and volume of the sine wave. The frequency range of the sine wave is set from 400Hz to 8000Hz; and the volume range of the sine wave is set to zero, at the level of people's normal voices. The battery of the iPod...
The Music One Participates In

lasts about three hours. The speaker is connected to the output port of the iPod and is attached to the back of the iPod with glue. When people cover the speaker, the volume of the sine wave goes down.

3.4.7 The SINE WAVE ORCHESTRA at ZeroOne San Jose / ISEA

The SINE WAVE ORCHESTRA at ZeroOne San Jose / ISEA (SWO-isea) took place at SOFA Area, San Jose on 12th August 2006, as a part of ZeroOne San Jose / ISEA 2006 (see Figure 3-11).

![Figure 3-11. The SINE WAVE ORCHESTRA at ZeroOne San Jose / ISEA.](image)

The public was invited to participate via website and mailing list announcements; passers-by at the site were also invited to participate. The organizers provided 50 instruments for the participants; in addition, some people brought their own instruments (e.g., laptop PCs and synthesizers) to produce sine waves with varying frequencies and volumes, in the same way as for SWO-stairway.

About 100 participants came, one after another, to the performance. They played sine waves with the instruments for about one hour in an open outdoor space in downtown San Jose. Participants moved around the space and produced varieties of sine wave frequencies.

The instrument consists of an oscillator, a knob, a switch, a speaker, and a battery inside a hand-held plastic egg. The angle of the knob changes the frequency of the sine wave and the switch turns the sound on and off (see Figure 3-12).
The oscillator consists of an analog circuit. A variable resistor with a knob is mounted on the bottom of an egg. It is connected to the frequency control part of the circuit; the oscillator changes the frequency of a sine wave depending on the angle of the knob. The range of the frequency is set to around 1200Hz to 2400Hz. The volume is fixed at about the level of people's loud voices. The switch mounted on the bottom of the egg turns the volume of the sine wave on and off. The battery is used for the oscillator and lasts about a day. The speaker is mounted directly on the bottom of the egg. When people cover the speaker, the volume of the sine wave decreases.

3.4.8 The SINE WAVE ORCHESTRA mediate

The SINE WAVE ORCHESTRA mediate (SWO-mediate) was premiered at Re:search, Art Collaboration exhibition between Australia and Japan at Sendai mediatheque from 26th November to 25th December 2006 (see Figure 3-13).

There was an instruction, “Touch, Play, Leave”, for the work on the wall of the exhibition space. As each participant touches the moving fader, the fader stops moving. The participant changes the frequency of a sine wave by moving the
position of the fader with his or her hand. The sine wave is output from the speaker on the same board. All of his or her performance is recorded.

After the participant releases the fader, the control engine moves the fader recursively, along with the performance record. The sound synthesis engine changes the frequency of the sine wave based on the position of the fader. If another participant touches the fader, the fader stops moving again. After the participant releases the fader, the control engine interposes the participant’s performance record into the previous performances. Every time a participant touches the instrument, the period of recursion increases. The eight sets of instruments have different periods of recursion, depending on the number of participants and the time of performance.

A total of about 3,000 people participated in the work during the exhibition period. The instrument was made up of eight sets of boards with a moving fader and a speaker, a control engine, and a sound synthesis engine. The moving faders are connected to the control engine through a converter. The control engine controls the sound synthesis engine, which is connected to eight speakers through an audio interface and synthesizes eight sine waves. Each set of the board is hung from the ceiling in the exhibition space (see Figure 3-14).

Figure 3-14. The instrument for The SINE WAVE ORCHESTRA mediate.
SWO-mediates uses eight sets of wooden boards with a moving fader and a speaker. The size of the board is 3600mm x 450mm x 30mm. The speaker is mounted in the center of the board; the fader is mounted vertically under the speaker. Each speaker outputs a sine wave from the sound synthesis engine through the audio interface. The moving fader consists of a motor, a variable resistor, and a fader with a touch sensor. The motor is connected to the variable resistor with a belt transmission. The fader is directly mounted on the variable resistor. The control engine moves the fader by sending data to the motor through the converter, Make Controller Kit (http://www.makezine.com/controller/). When a participant touches the fader, the touch sensor sends a signal to the control engine and the control engine stops to move the fader. Based on the position of the fader, the variable resistor changes its value. The value is sent to the control engine through the converter to change the frequency of a sine wave from 100Hz to 10000Hz in realtime. The boards are hung from the ceiling facing in the same direction and alternately arranged in an 8 x 8 matrix.

The control engine is implemented with MaxMSP. It controls and records the movements of the fader, and separately receives data from eight moving faders. The position of the fader is sent directly to the sound synthesis engine for changing the frequency of a sine wave. When a participant touches the fader, the control engine starts to record the position of the fader with the change in the value of the variable resistor. After the participant releases the fader, the engine sends the data recursively to the motor to move the fader. When another participant touches the fader, the engine stops sending data to the motor and starts to record the positional data again. After the release, the engine interposes the recorded data into that part where it stops sending data to the motor. Every time a participant touches the fader, the length of the positional data increases.

The sound synthesis engine treats eight sine waves for eight speakers. It is implemented with SuperCollider and changes the frequency of each sine wave based on the positional data of the fader from the control engine. Each sine wave is treated as a separate audio signal and is directly output from each speaker through the audio interface, MOTU Traveller (http://www.motu.com/). The range of the frequency is set at about 100Hz to 15000Hz. The volume of each sine wave is fixed at about the level of a talking voice.
3.4.9 The SINE WAVE ORCHESTRA in the sun

The SINE WAVE ORCHESTRA in the sun was developed at Edith Russ Site, supported by Stiftung Niedersachsen work stipends for Media Art 2009 at Edith Russ Site for Media Art (Figure 3-15).

About 100 people participated in this work during the exhibition period. Each participant plays and leaves a sine wave with the provided instrument. When he/she walked around the room, he/she dynamically listened the differences with phase and volume of sine waves with divergent frequencies instruments. The performance lasted around 1 week and people freely come and leave in the period.

The core of the piece is a set of instruments that translate the progression of the sun into the spatiality of sound. Each instrument consists of a solar panel that actuates an oscillator then produces a sine wave through a speaker. The amount of light picked up by the solar panel regulates the volume and a dial defines the frequency (Figure 3-16). The instrument only plays a sine wave when exposed to strong light (i.e. sunlight).

Participant who comes in the exhibition period faces the collective sound of the sine waves produced by the irradiated instruments that have already been placed.
Each of them should choose a location for a new instrument and fix the frequency with the dial. The sine waves produced by each participant accumulate over the exhibition period of the piece.

If there is no light, there is no sound. In the work, the transition of the sound representation beyond control by the participants nor the organizers, even their shadows dynamically affects their listening while they walk around the space. Instead, according to the movement of the light, the collective sound representation transforms its resonance. During a day, the installation will vary from phases when each sine wave is discriminable (e.g. at sunrise), through sound clusters consisting of mutually interfering sine waves when exposed to direct sunlight, to silence (e.g. at sunset).
3.5 Elements of the Instruments

Though each instrument for an SWO work is unique and gives a more subtle presentation than the specific focus of this section, the chapter tries to discuss those instrument elements that affect how people create collective sound representations. Even if the instruments produce the same sound source (i.e., a sine wave), each instrument has its own distinctive interface and relationship. The instruments are classified according to the following elements: frequency control, volume control, display environment, and number of participants and Instruments (which are summarized in Table 3-1 and discussed in the following sections).

Table 3-1. Elements of the Instruments

<table>
<thead>
<tr>
<th>Work</th>
<th>Frequency Control / Range (Hz)</th>
<th>Volume Control / Level</th>
<th>Display Environment</th>
<th>Number of Participants / Instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWO-click</td>
<td>Free / Free</td>
<td>Free / Quite high</td>
<td>Mixer with 4 speakers</td>
<td>&quot;30&quot; / &quot;30&quot;</td>
</tr>
<tr>
<td>SWO-TAU</td>
<td>Free / Free</td>
<td>Free / Talking voice</td>
<td>Speaker</td>
<td>&quot;100&quot; / &quot;100&quot;</td>
</tr>
<tr>
<td>SWO-stairway</td>
<td>CDS Photocell / 420 - 480</td>
<td>Amount of light / Whisper voice to 0</td>
<td>Speaker</td>
<td>&quot;200&quot; / &quot;50&quot;</td>
</tr>
<tr>
<td>SWO-district</td>
<td>- / 20 - 20000</td>
<td>- / Quite high</td>
<td>Multiple speakers (24)</td>
<td>&quot;200&quot; / &quot;24&quot;</td>
</tr>
<tr>
<td>SWO-stay</td>
<td>Rotational Controller / 100 - 12000</td>
<td>- / Gradually attenuated</td>
<td>Multiple speakers (116)</td>
<td>&quot;8,000&quot; / &quot;1&quot;</td>
</tr>
<tr>
<td>SWO-nomadic</td>
<td>iPod's wheel, Button / 400 - 8000</td>
<td>Buttons / Whisper voice to 0</td>
<td>Speaker, Screen</td>
<td>&quot;100&quot; / &quot;100&quot;</td>
</tr>
<tr>
<td>SWO-sea</td>
<td>Knob / 1200 - 2400</td>
<td>Switch / Talking voice or 0</td>
<td>Speaker</td>
<td>&quot;100&quot; / &quot;50&quot;</td>
</tr>
<tr>
<td>SWO-mEDIATE</td>
<td>Moving Fader / 100 - 15000</td>
<td>- / Talking voice</td>
<td>Speaker</td>
<td>&quot;3000&quot; / &quot;8&quot;</td>
</tr>
<tr>
<td>SWO-sun</td>
<td>Dial / 1000 - 2000</td>
<td>Light / Whisper voice</td>
<td>Speaker</td>
<td>&quot;100&quot; / &quot;100&quot;</td>
</tr>
</tbody>
</table>

3.5.1 Frequency Control

The instruments utilized different types of physical techniques for frequency control to provide distinctive characteristics for each instrument. Each instrument has a different frequency range, depending on the capacity of the circuit, the application, and/or the speaker.
In SWO-click and SWO-TAU, the participants brought own instruments, therefore the control of frequency is left to them.

The instrument for SWO-stairway employs the CDS photocell for frequency control, which changes its frequency depending on the amount of light. The frequency range is approximately from 420Hz to 480Hz, based on the capacity of the circuit.

In SWO-district, the organizers pre-programmed the change of frequency in a sequence for each speaker.

The instrument for SWO-stay employs the rotational controller for frequency control, which makes it possible to change the frequency continuously from 100Hz to 12000Hz by turning the controller. It has no limits on its rotation, and the frequency range is almost the same as the capability of the speaker and the threshold of hearing. Therefore, when people continuously rotate the controller, the frequency reaches the upper/lower limits of the speaker and goes out of the range of hearing. Every time a participant uses the instrument, one sine wave is added to the collective sound representation. During the exhibition, the collective sound representation changed from a phase where each sine wave was discriminable, to a cluster which consisted of mutually interfering sine waves, like a white noise that contains all frequencies.

The instrument on SWO-nomadic employs the iPod's wheel for frequency control. The center button on the iPod changes the interval of the frequency (1Hz, 10Hz, 100Hz), which makes it possible to change the frequency discontinuously. Although the wheel has no limits to its rotation, as in SWO-stay, it limits its frequency range from 400Hz to 8000Hz due to the capability of the application. Therefore, when people continuously rotate the controller, the frequency reaches the upper/lower limits before it reaches the capability of the speaker or the threshold of hearing.

The instrument for SWO-isea employs the knob connected to the variable resistor for frequency control, which allows changing the frequency with the angle of the knob from 1200Hz to 2400Hz. Based on the capability of the circuit, the frequency range is defined by the limit of the resistor’s rotation; the resistor turns about 270 degrees.
The instrument for SWO-mediate employs the moving fader for frequency control, which enables changing the frequency continuously from 100Hz to 12000Hz by moving its position. The frequency range is almost the same as the capability of the speaker. So when people move the fader to the upper/lower edge, the frequency reaches the upper/lower limits of the speaker and goes out of the hearing.

The instrument for SWO-sun employs the dial connected to the variable resistor for frequency control, which allows changing the frequency with the angle of the knob from 1000Hz to 2000Hz. Based on the capability of the circuit, the frequency range is defined by the limit of the resistor’s rotation; the resistor turns about 270 degrees.

### 3.5.2 Volume Control

The instruments employ different types of physical techniques for volume control. This provides distinguishing characteristics for each instrument in the same way as frequency control. Depending on the capability of the circuit, the application, and/or the speaker, each instrument has different volume level.

SWO-click allows each participant to control a fader of mixer which is connected to his/her instrument as well as the volume within the instrument.

SWO-TAU also allows each participant to control his/her volume, however, instead of using a shared mixer, the participants are asked to use a built-in or separate speaker for each.

The instrument for SWO-stairway employs the CDS photocell for volume control. Depending on the amount of light, it changes its volume from a whisper to zero. With this instrument, a change in the amount of light produces change in the volume.

In SWO-district, the volume for each speaker is almost fixed in a quite high level around a shout of a human voice.

The instrument for SWO-stay changes the volume of the sine wave as the work progresses. When a participant touches the controller, the volume increases from the ordinary level so as to distinguish the participant’s sine wave from other sine waves. After the participant chooses the frequency and the position, and leaves his
or her own sine wave in the work, the volume decreases to the ordinary level. Then the volume gradually attenuates over the period of two weeks and disappears.

The instrument for SWO-nomadic employs the iPod's forward and rewind buttons for volume control. Based on the capability of the speaker, the maximum volume of the sine wave is at about the level of a whisper.

SWO-isea employs the switch for volume control, which enables turning the volume of the sine wave on and off. The volume level of the sine wave is fixed at about the level of a loud voice.

SWOmediate employs no method for volume control. It fixes the volume of the sine wave at about the level of a talking voice.

The instrument for SWO-sun employs the solar panel for power. If there is no light, there is no sound. The volume itself is fixed around a whisper.

### 3.5.3 Display Environment

The instruments employ a variety of speakers and/or visual screens to display sine waves. A sine wave is identified by its frequency and volume. All sine waves are equivalent as long as they have the same frequency and volume, so there is a problem in distinguishing a particular sine wave from other sine waves.

In SWO-click, the problem is evident. Because of the sharing of four speakers with two mixers, most of the participants try to make the volume of their sine wave louder with the fader of the mixers. The frequency is also rapidly controlled. Therefore, the result is a varied distortion of collective sine waves.

To solve the problem of distortion, SWO-TAU, SWO-stairway, SWO-nomadic, SWO-isea, and SWO-sun employ a speaker for each instrument. Since the instruments are equipped with individual speakers, the participants are able to identify their own sine wave; such speakers also allow the participants to walk around freely during the performance. If the participant moves to another position while holding the instrument, this not only changes what he or she listens to, but also change the position of the sound source produced by the participant, resulting in changes in the collective sound representation. SWO-nomadic also employs a screen to show the current frequency and volume of the sine wave.
SWO-district is different from other works. The work employs 24 fixed speakers for 24 sine waves with pre-programmed frequency controls. The volume is louder enough to distinguish each sine wave from the others.

SWO-stay uses 116 speakers for the instrument. When the participant controls the frequency and position, the volume of the sine wave is increased to identify the participant’s own sine wave among other sine waves from multiple speakers. Each speaker outputs a cluster that consists of mutually interfering sine waves with different frequencies from different participants. Therefore, depending on where the participant stands in the room relative to the location of the multiple speakers, what a participant listens to changes dynamically.

SWO-mediate employs a speaker for each of eight instruments. Each speaker produces a sine wave. Based on the movement of the fader, the frequency each speaker produces changes over time. Some sine waves occasionally interfere with each other.

### 3.5.4 Number of Participants and Instruments

The number of participants and the instruments greatly influence the resulting collective sound representation. Each instrument for an SWO work is suitable for varying numbers of participants, under the basic concept that each participant will play a sine wave by changing its frequency, volume, position, and/or duration.

SWO-click and SWO-TAU, the participants are invited to perform with their instruments. Even though there are several ways to play a sine wave, to bring an instrument limits the target of people to whom relatively familiar with sine waves.

Instead, SWO-stairway, SWO-nomadic, SWO-isea, and SWO-sun provides an instrument for each participant. SWO-nomadic and SWO-sun provides instruments for only 100 preregistered <SWO-nomadic> / first come <SWO-sun> participants. For SWO-stairway and SWO-isea, passers-by at the site are also invited to participate. Hundreds of participants come one after another, share the instruments and play sine waves for several hours. In addition to those who are provided with instruments, some participants in SWO-stairway and SWO-isea bring their own instruments (e.g., laptop PCs and synthesizers).
SWO-district does not ask to bring nor provide instrument for each participant. The 24 speakers at columns work as shared instrument for around 200 participants.

SWO-stay provides an instrument for 8,000 participants. Each participant, one by one, produces a sine wave at different times. Every time a participant uses an instrument, one sine wave is added to the collective sound representation.

SWO-mediate provides eight instruments to 3,000 of participants. Each participant plays a sine wave with one of the eight instruments. Each instrument recursively changes the frequency of the sine wave. Every time a participant plays an instrument, the duration of the recursion increased. The eight instruments have different periods of recursion and a dynamically changing collective sound representation.

### 3.6 Styles of Musical Participation

Although all of the nine works used synthesized sine waves experienced by participants as a collective sound representation, participants in each work had different styles of musical participation due to the different instrument with a variety of temporal, physical, environmental, and procedural settings. This section analyzes such different styles of musical participation across SWO works with three points of view, *identification and association*, *moving around*, and *temporal and spatial co-presence*.

#### 3.6.1 Identification and Association

The participants of the SWO works 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 also have associated sine waves with other individuals participating in the performance.

In SWO-clicks, the author observed that the participants made the volume of their sine waves louder within their instruments as well as with the faders of mixer, so that they could identify which sine waves were their own. This, however, resulted in a distortion of the collective sine waves.

In SWO-TAU, to avoid the issue of distortion, the participants were asked to use a built-in or an individual separate speaker. With the setting, some participants
tried to identify sine waves of own and their friends. A number of participants were leaning their heads toward their laptops, or the laptops of their friends’ during the performances while others were bringing the laptops together to form a cluster of sine waves. During the performance, some of them shared their knowledge, showed others how to play on the provided instruments, and negotiated the way to play on them.

In SWO-stairway, the provided instrument could not produce sound with the small amount of light at sunset. The author observed that participants with the instruments were gathered around the fixed light. The amount of light, that defines the frequency almost matches the available light, so mutually interfering sine waves, were produced by the instruments. The author also observed that some participants dynamically changed the volume by illuminating the instrument with a flashlight. The performance also has some participants who brought their instruments to produce sine waves (e.g., laptop PCs and synthesizers). During the performance, the author also observed communications within participants in a close manner as SWO-TAU, especially between participants with and without own instruments. Some interested passersby asked the participants what they were doing and took part in the performance with the provided instruments.

In SWO-district, the author observed that the participants resonate their bodies with utterance with the sine waves from speakers. The resonance was occurred between the formants of participants voice and the sine waves with frequencies around the formants and enough amplitude to actuate the lungs.

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 sine waves sounded while controlling the frequency and sound source position.

In SWO-nomadic, the instrument limited its frequency range from 400Hz to 8000Hz; these limits are under the threshold of hearing. During the performance, the author observed that some participants complained about the upper/lower limits of the frequency; the maximum volume of the instrument is at about the level of a whisper. In a performance in an outdoor space, with noise from other sources (e.g., waterfall, public address system), a number of participants are leaning closer to each other and turning their ears toward the speakers of the other
participants. The instruments show the current frequency and the volume of the sine wave on the screen. During a moment after each performance, some participants set the frequency to a number that was meaningful to them (e.g., a birthday, etc.).

Through informal interviews managed during breaks with the participants and a post-performance questionnaire conducted with the participants of SWO-nomadic, the author has observed that some participants tried to find a sound among the collection of sine waves they were listening to that resonated with their 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 even lonely when they could not find the sounds that resonated with their sine waves.

In SWO-isea, the instrument has a knob and a switch in a hand-held plastic egg. During the performance, some participants did not hold the body but held the knob instead and dynamically turned the body up and down. The performance also had participants who dynamically changed the volume: some turned the switch on and off, some put their hands on the speaker, and others covered their instruments with their mouths. These ways of performance were rapidly spread among participants during the performance.

In SWO-mediate, the movements of the faders scared some participants to leave their sine waves. They hesitated to touch the faders because of their animated motions. According to the increase in the period of recursion of the movements, some participants lost their recognition for their sine waves even the fader replay their movement one time.

In SWO-sun, participants mainly situated their instruments at sunny spot due to the character of the instruments. According to the transition of sunlight, the spot itself changed its location. As a result, the work had a locus of the transition as a series of instruments at the exhibition space. After the arrival of first 100 participants, (run out of instruments), some visitors performed with the situated instruments. It was not the organizer’s initial intention. However, the organizers accepted the situation to have more amendment in the collective sound representation.
Of course, it is difficult to identify a sine wave from a collection of sine waves because of its lack of overtone. However, in the works of SWO, the difficulty arouses each participant to prick up her/his ears to identify her/his sine wave among a collective sound representation. The lack of overtone also forms a physical association of participants through the interferences between sine waves.

### 3.6.2 Moving Around

Each participant of SWO is allowed/recommended to move around during a performance instead of stand on a stage or sit in a seat. In eight of the nine SWO works except SWO-district, each participant engaged in collective sound representations by each using an instrument 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.

The exception, SWO-district, 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-click, SWO-stay, and SWO-mediate were designed differently from other works in terms of their 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 SWO-mediate, eight of each speaker mounted on a board with a fader produce the recursive sine waves.

In contrast, SWO-TAU, SWO-stairway, SWO-nomadic, and SWO-isea used separate, individual built-in speakers, each equipped with a sine-wave-generating instrument. 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 instrument, 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 instruments provided by the organizers in SWO-stairway were light
sensitive, the location and orientation of the instruments changed the frequency of the sine waves.

In SWO-sun, the organizers extended the sensitiveness of instruments for light to make the instrument sounded only in bright sunlight with a solar panel. Because of the setting, each participant sets her/his instrument on a certain place of the venue in association with her/his period of stay (i.e. diurnal motion of the sun). The activation of the instrument depends on the time of day and the weather. The shadows of participants who are walking around the site also affected the sounds.

In the works of SWO, even at a place with fixed sine waves (e.g. SWO-district, SWO-nomadic exhibition), because of phase shifts of sine waves, the sound to be able to listen is changing according to the direction of ears. When each sine wave changes its frequency and position (i.e. most of SWO works), the collective sound dynamically transform its spectrum. In this respect, each participant in SWO work listens a unique fragment of the collective sound representation. Even if the whole transition of sine waves could be reproduced (e.g. practically possible with SWO-district, SWO-stay, or SWO-mediate), only a fragment could be recorded (i.e. not a Roku-gaku).

3.6.3 Temporal and Spatial Co-Presence

Each instrument of SWO works enabled participants to perform with a sine wave in different temporal and spatial setting. This section discusses how participants shared the time and space resulted in different types of collective sound representation.

The participants in SWO-click, SWO-TAU, SWO-stairway, small performances of SWO-nomadic, and SWO-isea 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, SWO-nomadic, SWO-mediate, and SWO-sun shared 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 instruments, 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 experience the face-to-face synchronous collective sound performance at the end of the exhibition period.

In SWO-mediate, the number of sine waves was fixed. Each participant played one of the sine waves by moving the fader. The performance of each participant was interposed in previous performances. The sine wave changed its frequency recursively along with the recorded data of the performance. Every time a participant took part in the work, the period of recursion increased. The sine wave were extended, and the collective sound representation changed from a phase where each recursion of a sine wave was detectable as a drone, consisting of continuously changing sine waves with the different periods of recursion.

In SWO-sun, the number of sine waves depends on the number of instruments. Each of the first 100 participants fixes the frequency of a sine wave and situates the instruments in the space. However, the number of the sine waves were amended during the period of the exhibition according to the transition of the sun and the weather.

Overall, from temporal and spatial co-presence point of view, the works of SWO could be divided into two types, collocated synchronous <SWO-click, TAU,
stairway, district, performance of nomadic, and idea> and collocated asynchronous <SWO-stay, exhibition of nomadic, mediate, and sun>. In the former type, participants perform/listen together by sharing time and space. The later type could be split into further categories, extended and accumulated. The example of extended is SWO-mediate where the period of recursion of each sine wave is extended (while the number of the sine waves is fixed to 8) with the involvement (i.e. performance) of participants. Instead, SWO-stay, nomadie, and sun accumulate the number of sine waves (frequencies are fixed) during the performance period. Furthermore, in accumulated, the volume of each sine wave is gradually attenuated <SWO-stay>, retained with a message <SWO-nomadic>, and controlled by chance (i.e. sun) <SWO-sun>.

3.7 Reviews

This section reflects the practice of The SINE WAVE ORCHESTRA with objective criticism. The reviews for the works of SWO by critics and curators are presented with three brackets, 1. Sincere Intention for Expression and Deconstruction of the Ego of Self-Expression, 2. From a bottom-up to a virtual community, and 3. Mathematical Formulation Enabled by New Technologies to A Symphonic Experience Integrated Pure Chance.

3.7.1 Deconstruction of the Ego of Self-Expression

Composer Masahiro Miwa's review for The Stairway of The SINE WAVE ORCHESTRA, in a text entitled “Something Altogether Apart from ‘Sincere Intention for Expression’”, says

although the group calls itself an ‘orchestra’, there was no conductor, and it was unclear who were the performers and who were the audience. As eight o'clock drew near, there was no applause -- only comments here and there of ‘I guess we should wrap it up about here...’ with people dispersing in groups of two and three. There would be as many answers as the number of participants for what the event is. However, it was quite impressive that even there are no intentions to perform sounds for others, it still keeps gathering people to appreciate sounds by sharing time and space as ‘event of sound / music’ [Miwa, 2004]
In the review, Miwa clearly noticed the blurring boundary within participants caused by the absence of central authority. In his view, he also mentioned that ‘the appreciation of sounds by sharing time and space’ is a pivot of musical performance.

The juries of Digital Musics, Ars Electronica 2004, pointed out the diversity in the performance of The SINE WAVE ORCHESTRA and went a step further into the discussion of the absence of central in music as

The SINE WAVE ORCHESTRA is a project by young Japanese artists that is part old-school “happening” and part social “audio party” event. The public is invited to bring them any devices that can produce a sine wave, so that the assembled participants join in to produce and unpredictable sound event where the music is simultaneously incidental and a focal point. Thus, a temporary community develops, whose interests is in how the audio outputs fluctuate between the active participants. This type of genre is and example of music being produced outside of traditional music boundaries, a collective deconstruction of the “ego of self-expression” that is prevalent in most musical styles. [Toop, Monohan, Humon, 2004]

In this review, they pointed out a shift of music from “the functions of entertainment, high culture, or sacred worship” to music which “can be produced by people who do not consider themselves full-time artists, who may be producing crafted sounds simply because they have acquired a laptop with access to a variety of music software”. The tip on music till 20th century is obviously observed as a deconstruction of tradition, “the ego of self-expression”, in music.

3.7.2 From a Bottom-Up to a Virtual Community

Independent curator Yukiko Shikata the practice of The SINE WAVE ORCHESTRA as a bottom-up community.

... the SWO invites anyone interested to participate in exploring these extraordinary possibilities in sound variation, conducting live performances in various urban spaces using different methods each time. Anyone can bring along a sine wave and
The Music One Participates In

take part, and the shared format allowing the audience to wander freely around the space has a bottom-up, open community feel to it. ... even their own presence and movements impacting on the phenomenon of sound; and in doing so, each engages in his or her own desired play, while resonating and communing with a certain time and place. ... [Shikata, 2005]

Curator of sendai mediatheque, Kent Shimizu, also mentioned about community in his review of The SINE WAVE ORCHESTRA mediate in relation with the nature of the Internet.

The installation of The SINE WAVE ORCHESTRA invites the audience to take part in their project. It demonstrates how a community is formed through the performance of the sine waves and their archived waves. A sine wave player consisting of a computer-controlled fader and speaker automatically records/replays all audience sine wave performance, and the concept of community is epitomized as the aggregation of the sounds. It is an imitation of community formation on the Internet. Since the Internet may be the one thing that holds the highest level of reality in the modern world. Net communities can no longer be brushed aside as a mere virtual space. On man occasions, virtual communities have actually triggered the formation of real communities with substance. The process is about a global existence leading to the formation of and unevenly distributed, localized existence. [Shimizu, 2007]

While Shikata puts emphasis on a community of people in a certain time and space of the performance, Shimizu stressed a virtual community consists of collection sounds performed by participants over the time. Theorist, Taro Igarashi described the virtuality of The SINE WAVE ORCHESTRA nomadic in another way of saying.

The SINE WAVE ORCHESTRA uses eight automatic players that repeat patterns of pure sine wave tones given by the visitors. The piled up patterns create a three-dimensional sound space in which time is condensed. One computerized note created
represents one person who has already left. Even after all visitors leave, the bustling of the invisible crowd will remain. In other words, the relation between people who never existed simultaneously is reproduced together. [Igarashi, 2007]

The review indicates the co-existence of sounds and relationship between participants.

3.7.3 Mathematical Formulation to a Pure Chance

A curator of WAVES exhibition (where The SINE WAVE ORCHESTRA stay was represented), Armin Medosch described the work of The SINE WAVE ORCHESTRA as follows,

The SINE WAVE ORCHESTRA from Japan focuses on the basic element of the mathematical formulation of a wave, the sine wave. Each member of the audience is asked to add a specific sine wave of her choice, which together creates interfering patterns of noise. Technically very simple, this works literally reverberates with the multitude of individualities contained in WAVES. These exploration of acoustic space have been selected out of dozens of other works that explore sound in an art exhibition context. Work of this type could easily fill a huge exhibition space of its own, as sound art has exploded in recent years, possibly enabled by new technologies. [Medosch, 2006]

In his review, Armin not only simply referred to the co-existence, namely the relationship between the work and the participants with a reference to mathematics, but also likened the relationship to the whole exhibition itself and the work which produce sounds with technologies.

Sabine Himmelsbach, a curator of Edith-Russ-Haus for Media Art, extended the notion of the co-existence with another cast, “weather”, in The SINE WAVE ORCHESTRA in the Sun. She indicated that “The sound only becomes a “symphonic” experience through the interaction of several sine wave instruments” [Himmelsbach, 2011] and notified its unpredictability as follows,
The SINE WA VE ORCHESTRA in the Sun, marked the first time that the orchestra integrated pure chance into its work, aiming to vary the interaction of 100 identical instruments. The group picked up on a tradition of experiment music in which John Cage and in his circle both played a major role, both for composition and performance. But departing from their usual presentation modus, the SINE WA VE ORCHESTRA relied on a power source that lies both outside its own influence and beyond the influence of the audience. The devices were run by solar cells and thus functioned only in bright sunlight. Visitors to the installation The SINE WA VE ORCHESTRA in the Sun, which was set in a light-flooded garden pavilion of the Oldenburg palace gardens, could choose an instrument, bring it into the sun, set the frequency and then place the device in a certain site in the pavilion where it would remain until the end of the installation. When and if this personal sound-making of the sine was activated, and the extend to which and interaction was generated, depended solely on the weather and time of day.

In the work, as she pointed out, “The sun itself played the sine wave instruments”. Here, “the ego of self-expression” is slightly remained as a choice of place. The boundary between the performer and the listener has little meaning in the work. The work even could perform independently without a help of human beings.

3.8 Contribution

The aim of this chapter was to look beyond the fixed roles (i.e. composer, performer, listener) in performance through the analysis of the practice of The SINE WA VE ORCHESTRA. The author is interested in works with indefinite boundaries between the performer and the listener where people subjectively engage with sound representation through listening and simultaneously engage in the creation of sound. In these works, each person is a listener of others, and a performer to others. The evolution of the collective sound representation is unpredictable and depends on the total involvement of the participants [Ascott, 1966].
Eco, in describing open works, notes a shift of initiative from the composer to the individual performer [Eco, 1959]. He mentions the difference between works that the composer arranges in a closed, well-defined manner before presenting it to the listener, and works that are brought to their conclusion by the performer with multiple formal possibilities of the distribution of their elements. With this regard, SWO's approach draws from the lineage of contemporary composer Pauline Oliveros, who posits a “re-orientation of the relationship between performers and audience” by refusing “the normal milieu of the concert world” to have the performance which “includes everyone present so that the active experience of participation is primary; there are no spectators in the usual sense.” [Oliveros, 1973].

Here, the traditional role of the artist, composer, or writer is thus called into question - meanwhile the organizing role in this context is far from obviated; it may no longer necessary to assume that he/she is a specialist in art rather she/he is a catalyst of creative activity [Cornock and Edmonds, 1973] or an author of the situation in a form of “meta-designer” [Giaccardi, 2005]. She/he intervenes in each perspective of sound making practice by sculpting levels of participation. The resulting representation is a collaborative one that is empowering for both author and participant, but is not a flat hierarchy, and can preserve defined, albeit non-traditional roles.

As internet artists exonemo have remarked on their participatory network pieces, “Not having control is interesting. We would like to see where people take things after severe limitations are placed on the work” [exonemo, 2007], the organizers of SWO were enthralled to be spectators to how people shared sound, time, and space to create a collective sound representation within the restriction of a sine wave for each participant with the use of the instrument by controlling the frequency and/or the volume of a sine wave.

It remains unclear whether or not the work of SWO could be called as a “composition” in traditional sense, however, the outcomes of SWO, the sea of sine waves, were precisely the kind of music that the author would like to listen. There is a glimpse of that which to be called as “the music one participates in” at the beginning of the 21st century.
4. WORKSHOP: Chiptune Marching Band, Generative Music Workshop, and other practices

4.1 Introduction

This chapter presents a process-based approach to accommodate musical technology into physical acts of everyday creativity through its creation in workshop which differed from traditional music masterclass-trainings [Jo, Parkinson, Tanaka, 2013]. The chapter considers workshops as a route to participation in collective creative musical practice. By evoking the notion of the Music One Participates In which focuses on a shift from the listener-as-consumer to participant-actor actively engaged in sound perception and production, the chapter looks the range of different methods that make up the term ‘workshop’, as well as emergent relationships between facilitator and participant in creative do-it-yourself activities to frame the facilitation of participatory music practice.

With this conceptual frame as a backdrop, the chapter presents four types of musical instrument workshop that the author and colleagues have conducted across time at different sites with diverse groups of participants. Concepts from the participation literature are applied to analyse the music workshops, and attempt to reconcile the potentially diverging agendas of facilitator and participant. The term, ‘workshopping’, following Small’s conversion of music as a noun to musicking as a process-based act is coined, as a way to understand methods to facilitate musical participation across a range of different stakeholders.

4.1.1 Workshops

There are a number of different dictionary definitions for the word, workshop. Words typically used to describe and characterise workshops include: discussion, activity, intensive, skills, interaction, exchange, creative, improvisation. Workshops may be used in design processes, in ethnographic work to understand users and cultures, or in brainstorming exercises to stimulate innovation. Workshops also exist in academic conferences as a format to facilitate focused and interactive discussion. They are used in industry in the form of focus groups for marketing or as ways to bring about culture change in companies. In the creative arts, workshops can refer to master classes with mentors and well-known artists or information sessions on techniques and materials for practice. In these
contexts, workshops are upstream activities to further research or framing activities to coach artistic practice. Workshops are a central dissemination activity in the creative Do-It-Yourself (DIY) community for skill and knowledge sharing. From this range of similar but distinct formats, this chapter begins to see that workshop is a word with many meanings, something that takes on multiple forms and formats depending on context.

Methods for the delivery of workshops have been codified in different areas of practice such as design, education, and industry. They are most often goal oriented, and typically aim to be effective in realising design tasks, generating learning results, and delivering product innovation. In design, Svanæs [Svanæs, Seland, 2004] and Westerlund [Westerlund, 2007] present step-by-step methods for role-playing, talking, and lo-fi prototyping. Nieters [Nieters, Bollman, 2011] presents case studies from Yahoo! UX design workshops as strategies to bring about corporate culture change and build consensus across a group of mixed stakeholders.

Concepts found in education workshops bring up concepts that undo traditional hierarchies and are relevant to themes that will be discussed here. Spikell and Aghevli [Spikell, Aghevli, 1999] look at the effectiveness of workshop methods in mathematics education. They coin useful terms that describe evolving roles of workshop facilitator and participant. In their workshops, they seek to create “involved and motivated” learners who will allow the workshop leader to be less a “sage on the stage” and more a “guide on the side.”

4.1.2 do-it-yourself (DIY) Activities

The do-it-yourself (DIY) movement, documented in publications like Make magazine and encountered in its associated festival, Maker Faire, puts an emphasis on shared creativity. The Human-Computer Interaction (HCI) field has taken up DIY to gain insight into technology design and dissemination, with Williams and Irani [Williams, Irani, 2010] identifying in DIY projects approaches based on open creativity rather than task oriented performance. Buechley [Buechley, Rosner, Paulos, Williams, 2009] defines DIY as an “array of creative activities in which people use, repurpose and modify” in ways that are “codified and shared so that others can reproduce, re-interpret or extend them.”
Goodman and Rosner in [Goodman, Rosner, 2011] look at the integration of technology into handwork activities and observe three ways in which digital technology is accommodated into physical acts of everyday creativity: 1.) segmenting in which activities affecting the object of handwork can take on independent trajectories, 2.) interjecting where immediate needs for information or coordination prompt brief switches from one activity to another, and 3.) extending in which direct embodied handwork interactions occur as people attend to other stimuli. These modes suggest the richness with which the dissertation can consider participatory practices beyond the simple completion of tasks.

4.1.3 DIY Musical Instrument Workshops

Recently, there are a growing number of workshops that apply DIY methods in teaching music and music technology through making of musical instruments. *Scrapyard Challenge* is a series of workshop where participants build small computational objects out of discarded electronics parts [Moriwaki and Cohen, 2006]. Their workshop format works within a number of constraints, including limited time frame, use of found materials, simple input/output, and accessible hobbyist electronics. With these components, participants create musical controllers that produce MIDI data using simple but with unorthodox materials such as washboards, baby jumpers and helmets.

*Dirty Electronics* is a range of workshop activities that connects live bricolage with instrument building and stage performance [Richards, 2008]. During a Dirty Electronics workshop, participants build sound-generating instruments based on prepared kits. After building an instrument, participants take part in a group performance under the direction of the workshop organiser. In the performances it is common that the participant’s own body becomes part of the electronic circuit, using body resistance/capacitance to modulate characteristics of the sound produced.

The study and evaluation of such hands-on musical workshops/performances often overlaps with the documentation of the events. In Scrapyard Challenges, the organisers discuss workshops in terms of the instruments/artefacts produced by the participants. In Getting the Hands Dirty [Richards, 2008], Richards describes a pedagogical role in considering the relationship between the body and electronic instruments in a performance. He also mentions that for a musician, having built
an electronic instrument by her/himself provides the person a better understanding of the potential use of the instrument in performance. These views provide insight on how individual and collaborative forms of creativity come together in the context of a workshop/performance and how the workshop process and its output as performance might connect with participants’ everyday lives [Allen, Galani and Jo, 2009].

Looking at DIY-Musical instrument workshops, it is interesting to find out in what ways they differed from traditional music masterclass-trainings, and conversely the ways in which musical activity could extend established DIY activities. By describing several types of DIY inspired musical instrument workshops the author and colleagues have conducted, and looking at the conceptual and theoretical underpinnings motivating them, this chapter seeks to identify emerging themes with which the dissertation could characterise participatory music activity.

4.2 Workshop Reports

This section reports four types of music workshop conducted in the period 2009-2012, each delivered a number of times in a range of context to different types of participants.

4.2.1 Chiptune Marching Band

DIY Musical Instruments

“Chiptune Marching Band” (CTMB) is a workshop on DIY practice and participatory music where participants make a very simple, personalised musical instrument based on a self-powered sound producing analogue circuit, and give a street performance with the other participants [Jo, Allen and Galani, 2009]. CTMB broaches the shift of scale and focus from the individual to the community - where people who once passively consumed music become involved in its creation. Interrelationships between music, instruments and environments are explored through performance.

CTMB has taken place in seven (7) different situations, including grassroots artist-run centres (NK Berlin, Space London), large DIY events (Maker Faire Newcastle), art festivals (Bent Festival New York, Pixelache Helsinki), and academic conferences (ACM Creativity and Cognition Berkeley, SIGGRAPH...

During circuit building, participants build an analogue sound producing circuit on a breadboard following step-by-step instructions (Appendix II) and power it with a hand crank generator. They choose a capacitor to set the tonal bandwidth, and select from one of three types of sensor (linear fader, rotary potentiometer, and photo-resistor) to control the frequency output. The circuit and sensor are housed in a cardboard tube that can be personalised with colourful tape, glue, paint, craft paper, and stickers. Through the sessions, the organisers answer questions and provide assistance.

The self-powered nature of the instruments allows them to be played untethered from the power grid. The group discusses how a chiptune instrument “marching band” might perform, and then go outdoors. The performance takes place in public space (street or public square) as a happening and spectacle (Figure. 4-1).

![Figure.4-1 Chiptune Marching Band workshop, Maker Faire Newcastle.](image)

**Lessons learned**

The CTMB had a diverse range of participants across and within sessions, including DIY enthusiasts, teachers, high school and art school students, amateur musicians, composers, and media artists. The background of each participant had an effect on which stage of the workshop presented a challenge or stumbling block – be it clearly challenging steps like circuit building, to less obvious hurdles like gluing, personalising, or performing.

Marching tactics in the CTMB performance varied from group to group and was the most challenging phase of the workshop for the facilitators. The performance, in the spirit of the workshop, was open ended. However, with no performance
plan, it often devolved into a sociable walk by a group of people with strange cardboard tubes, and did not have the impact of a Happening to passers by. While social performance is embedded in everyday life, musical performance does not come naturally or automatically, no matter how empowering the act of instrument building. Ensemble musical performance is typically facilitated by conductors and bandleaders. It was difficult, once the workshop facilitators had established themselves during the workshop as, to use Spikell and Aghevli’s terms, a “guide on the side” to impose themselves as a “sage on the stage”.

4.2.2 Generative Music Workshop

**Aeolian Harp**

Generative Music Workshop is a series of events that reproduce past masterpieces of generative music organised by the author and Tomotaro Kaneko [Kaneko and Jo, 2011]. In this workshop, participants are invited to build and perform a historical instrument, the Aeolian Harp. The workshop allows participants to learn the history and the principle of the instrument, and to listen to the streams of wind with the vibration of string. The workshop has taken place twice – once in an art festival (Koganecho Bazaar) and then at a local artist-run space in Tokyo (403 forbidden) over a half day for each, with roughly 10 participants facilitated by the Generative Music Workshop and the instrument builder/researcher, Koichiro Sugiyama [Sugiyama, 2008].

The workshop consists of three sessions: Lecture, Instrument Building, and Performance. The lecture starts with a historical review of the instrument from its origins in Greek antiquity through its peak in the eighteenth century. Participants then learn its physical structure with basic acoustic theory. During instrument building, participants glue wood boards, blocks and bridges, pound turning pins, and pitch strings over them following a detailed drawing by the facilitators. In the performance, participants take their own instrument outside and explore the field to find a stream of wind to produce sounds (Figure 4-2).
Lessons learned

In the building process, participants made their own instrument according to the straightforward structure of a prepared kit. Because of the deviation from general musical instruments (e.g. tuning strings to the same pitch to make them resonate each other), participants’ pre-existing musical knowledge had little effect in their final outcome.

During the performance, the facilitators realised that the structure of the instrument to leave the production of sounds to winds stimulated participants to perform in public space. Participants explored the potential of the instrument in diverse ways such as walking in a line while putting the instrument on their heads, running with the instrument, or staying at a corner to wait a wind. Participants showed little hesitation to resonate the instrument by wind instead of performing the instrument by blowing on it themselves.

4.2.3 How to Turn Your iPhone into a Musical Instrument

Mobile Music Workshop

“How to Turn Your iPhone into a Musical Instrument” introduces an interactive music programming and performance environment to non-specialists, allowing participants to create custom apps on the mobile where sound sampling and digital audio synthesis are controlled by the accelerometer, multi-touch screen, and GPS. The workshop takes place over a half day, with 12-16 participants and 1-2 workshop facilitators. It has been presented nine (9) times in a range of different settings, from schools to arts festivals, with a range of different kinds of participant, from children, to art school students, to community and social work
groups.

A dense set of information is communicated during the workshop, including graphical programming in Pure Data (PD), ad-hoc wireless communications between the participant’s computer and mobile phone, sensor prototyping with mobile sensors controlling a computer-based audio process, and finalisation of a standalone app on the mobile.

The facilitators perform a concert at the end of the workshop that is open to the public. The workshop participants are invited not just to attend the concert, but also to give a demo or perform in the first part of the concert with their newly made instrument.

**Lessons Learned**

The facilitators realised that the workshops were functioning as a somewhat surreptitious way to introduce participants to data-flow programming within PD, an authoring environment which is often considered to be a ‘dark art’ with a steep learning curve and beyond the reach of the non-specialist. Through focusing on a specific, achievable outcome - the creation of an accelerometer controlled synthesiser - and not dwelling on the complexity of the tools involved in creating nor the theories of signal processing, the facilitators found that many workshop participants very quickly grasped the basics of PD and overcame elements of the learning curve which has been known to put people off using such software. Participants were able to create complex ‘patches’ in a very short time. At the Lisbon workshop, held at IPA on the 27th and 28th October 2011, one participant who was experienced as an improviser and programmer, but with no previous experience using Pure Data or performing with an iPhone, was able to develop a patch within a 6 hour workshop that he then performed with in concert that evening. The Tyneside Factory workshop (28th November, 2011) was a mere 80 minutes long, yet some participants - 15 year olds with no experience in programming - were able to not only implement the workshop synth, but also develop and extend it.

Only a few participants took up the challenge and invitation to perform, instead allowing the workshop facilitators to play the concert. The workshop participants hesitated to transfer their small-c experience to a Big-C performance. At the same
time, according to participants, it was useful for them to see how what they had just learned could be used in a professional, virtuosic presentation. The concert thus served as an effective foil to the workshop. They were complementary, one enhancing an empathic understanding of the other: the performance showing the potential application of the technologies presented in the workshop, and the workshop making the smoke and mirrors behind the performance less opaque.

4.2.4 Social Inclusion through the Digital Economy

Interactive music and social benefit

A series of participatory musical instrument workshops are conducted as part of a major UK research project, Social Inclusion through the Digital Economy (SiDE). The project looked at ways in which access to innovative digital technologies could have life transforming effects on young, old, and disabled people who were at risk of being marginalised in society [Gaye, Tanaka, Richardson, Jo, 2010]. SiDE was a large multidisciplinary project covering areas of health, transport, home, and business. The music workshops took place in a part of the consortium dealing with the Creative Industries.

The facilitators worked with young people, 14-22 years old, in multiple groups of ten to fifteen. These young people had no formal musical training and were often on the margins of society [Tanaka, Gaye, Richardson, 2010]. They were considered the generation of “digital natives”, comfortable with mobile and digital technology by having grown up in an already digital society. The top-level premise was that by introducing new ideas to them through media with which they were familiar, the workshop would provide gateways to access and acceptance of novel, creative and musical ideas. By demonstrating how mobile technologies could allow users to be musically expressive, the facilitators hoped that one outcome of our work would be to undo assumptions that, “technology comes from somewhere else” or that “art is done by others”, and show that the very technologies of media consumption could become instruments of personal expression and everyday creativity.

Lessons Learned

The music technology workshops are conducted in partnership with existing community programmes such as the Regional Youth Work Unit (RYWU),
Generator Music, and education programmes of cultural venues like the Sage Gateshead. In these workshops, the proposition was to provide interactive music technologies that might not otherwise be available to these local and grassroots organisations.

Interestingly, these technologies were not always seized upon for their musical potential. A completely participatory design approach in the RYWU workshop included the young people in the design of the actual activity the facilitators would do with them. After an introduction to interactive music technologies, the participants re-framed the workshop activity to produce a video game like interactive information resource on education pathways. While at first this seemed to shift the focus away from the original musical intentions of the workshop, this underlined the core benefit of the workshop approach as not the creative activity itself (Big-C), but an awareness of the participant’s own agency in creative pursuits (small-c). In the case of interactive technology, a key epiphany for the young participants coming from an economically depressed post-industrial area of the UK, was the realisation that advanced technology happened in their own backyard, and not just in far away places like Japan or Silicon Valley. Their desire to seize this opportunity to take it away from a leisure oriented one (music) towards a career development focus (education) demonstrates a sense of empowerment.

The partnerships with community organisations meant that the contact with participants was brokered by gatekeepers. This exposed an important and complex dynamic of multiple, tiered beneficiaries where there were at times conflicting interests across the facilitators (us), gatekeepers, and participants.

4.3 Discussion

This chapter has highlighted common themes as well as differing perspectives on participation across a range of disciplines. The chapter draws upon dynamics of the DIY movement to emphasise process and activities amongst participants rather than the completion of a tasks or the production of art objects. From the ladder of participation, the chapter have invoked a degree of involvement in musical practice along a spectrum of participation. From the discussion of participatory design and communities of practice, a notion of a shift of roles and the evolving processes involved in participation have been gained. From these
points of view, the chapter takes the emphasis away from making objects and instead focus on building events with participants. Through the review of the literature, one clear, shared argument for “the absolute privilege of the expert” have been noticed. Frieling proposes a paradox of “how to do away with art by making art” and Foster ironically notes a concern for “the artist as principle figure” in participatory art. In the following sections, the chapter examines the workshops from these emergent points of view.

4.3.1 Rather than Completion of a Task

The workshops in this chapter are cultural, non-workplace based, and incorporate creative practice. Although they may involve the completion of a task such as the building of a synthesiser, these are not the primary goals of the workshops. Each workshop has a physical component, be it the CTMB circuit or the Aeolian Harp. Engagement with tangible elements can be considered “handwork” in Goodman and Rosner’s terms. Their three ways of accommodation of technology into the everyday, Segmenting, Interjecting, and Extending, can be applied here as a way to understand how participants in DIY music workshops deal with the introduction of new concepts, tools, and exercises. The workshop formats fit each of these modes – CTMB and Aeolian Harp segmenting conceptual discussion, technical building, personalisation, and performance. Through the workshop, participants were “dividing their time between different genres of activity”: learning background theory and history, making instruments along to instructions, fabricating outcomes in their own way, and playing with them. These segmentations could accommodate the engagement with objects in “independent trajectories”.

The SiDE workshops interject mobile music technologies into regional social engagement. Even to the participants who were considered the generation of “digital natives”, the provided interactive music technologies were hardly noticeable to their local and grassroots organizations. The interjected technologies and the local researchers who presented them, made the participants aware, especially those coming from an economically depressed post-industrial area, that advanced technology development was happening in their own backyard. The interjections could involve not only having fun with musical activities but also “fulfilled participants’ desire” to connect the technologies for their prospective
The iPhone Musical Instrument workshop *extends* a music technology workshop with a concert. Even though the core of the workshop is to introduce participants to interactive music programming, the embedded concert provokes participants to attend other stimuli, not just attending it but also having a demo or a performance with their newly made instrument. Because of the differences between participants, only a few participants took up the proposition, however, such an extension suggests “possibilities for improvisational creativity” such as the case of a musician with no previous technical experience using the programming environment to extend his own traditional instrument within a 6 hour workshop.

### 4.3.2 Spectrum of Participation

In the workshops, the facilitators do not require nor seek artistic accomplishment based on virtuosic skill or scholarly knowledge. Instead the facilitators try to explore small-c musicking in the practices with participants who voluntarily take part in the workshops. The facilitators look at dynamics of participation in the musical practices where the public enters into the process of co-creation to shift from being a listener-as-consumer, to actant, actively involved in sound production. Rather than compare politicians and citizens, or adults and children, as Arnstein and Hart do, this chapter uses the ladder of participation with three levels: *non-participation*, *tokenism*, and *citizen power* to examine the relationships and dynamics between authors and participants in the musical practices. The chapter does not use the word participation with the assumption it is a “good thing” [Graham and Cook, 2010], but examine its possibilities and limitations along the ladder. Instead of explicitly defining each rung as Arnstein and Hart do, the chapter treats the ladder as continuous spectrum of participation.

Hart’s four criteria for meaningful participation is applied to arrive at the following forms of agency that participants along the spectrum of participation exhibit: *understanding intentions, knowing who made decisions, having meaningful roles, and consensual participation*.

In the SiDE workshops, deploying music technology in social work situations pointed out the fact that there is not a single type of workshop participant. In addition to the workshop organisers and the young people, there were the social...
workers who, as facilitators, accompany the young people through a range of activities beyond the workshop. These facilitators are often quick to grasp the potential of technology and imagine the enhancement of activities they deliver while the young participants may lack the confidence to express themselves or think through a hunch or question they may have, but that creating an environment conducive to non-hierarchical discussion can bring out unexpected results. The metaphor of the ladder of participation could be used not just to think about different levels of participation, but of the different types of stakeholder who come together in the workshop.

This can result in a return of hierarchy despite all good intentions. In the iPhone Musical Instrument workshops, the expertise and virtuosity of the facilitator intimidated participants and actually hindered participation by novice participants in the final performances, which was supposed to be open to all. In CTMB, the facilitators held non-hierarchical discussions amongst facilitator and participants to decide on marching tactics and performance scenography. However the outcome was more often than not unclear and resulted in performance that was chaotic and “promiscuous” in Foster’s terms. Participants in the Aeolian Harp workshop had a well structured workshop with a lecture, an instrument building and a performance by experts brought few unexpected results.

4.3.3 Shift of Roles

In the workshops in this chapter, the facilitators try to include participants in a process of building a (temporary) community of practice, drawing upon Czyzewski’s work environments and applying it in the small-c creative workshop context. The process moves from mutual conversation with self-introduction and chatting in a casual manner, to a transfer of knowledge and skills, a programming/building/making stage, and a final presentation which includes performance. The workshops is viewed “as processes”, while trying to maintain participants’ sense of “determinability for their work”.

One challenge in conducting these workshops is the diverse range of previous experience amongst the participants. For example, in the case of CTMB, the facilitators always had some participants who were already familiar with technical aspects (i.e. circuit building), while others in the same workshop had no prior electronics experience. The facilitators observed the emergence of mutual
teaching amongst participants, a kind of self-organising peer learning dynamic based on prior experience. Some even made suggestions for circuit customisation to the workshop organiser. The situations typically depict the exchange and contribution of knowledge in apprenticeship by Lave and Wenger and in socio cultural activity by Preece and Schneiderman.

4.3.4 Away from the Paradox

The paradox of the artist’s own place in participatory art casts a concern on the practices of workshops in terms of its genuineness. Can we consider the workshops art projects at all? As Bishop noted, from artistic point of view, “art and the social are not to be reconciled”. It is problematic to think about the workshop practices from a Big-C, goal oriented point of view - there were the aspects that were troublesome - such as the hesitation in performing in iPhone musical instrument, and the hurdles to organising a successful march in CTMB. On the other hand, by thinking of these workshop activities from a process based, small-c point of view, how creative ideas can be triggered off in participants is observed. In Aeolian Harp, an exceptional style of performance (e.g. walking in a line, running with the instrument, staying at a corner) is observed from the nature of the instrument actuated by wind. In SiDE, there was appropriation by participants who went as far as re-framing and almost hijacking original workshop objectives introducing interactive music technologies to producing a video game like information resource.

4.4 Contribution

This chapter have proposed a process-based approach to considering musical do-it-yourself workshops as a delivery vehicle for emergent forms of music, “the music one participates in”. The goal is not to make musicians out of workshop participants, but to use the activity of sound exploration as a way for engagement and possible conduits to unlock forms of creativity embedded in the everyday. In order to frame the discussion, the nature of participation in different fields are applied in the discussion of a series of workshops with a diverse range of participants. The insights gained not only allow us to think of workshops as a methodology but also enable us to understand the transfer of authority in existing music practices. The workshops in this chapter take up Small’s [Small, 1998] activation of music as the act of musicking through a process of workshopping to
encourage participants not just to listen but also to proactively engage with the creation of sound. The author hopes that this presentation of workshopping as a route to participation in music might establish a basis of further discussion around ideas of collective creative musical practice.
5. REPRODUCTION: A record without (or with) prior acoustic information

This chapter presents a work to produce personal music in reproduction without reminiscences of recordings [Jo, Ando, 2013][Jo, 2014a]. The work tries to examine the role of reproduction under a current technological environment (i.e. personal fabrication). To achieve the objective, this chapter employs a method to make analog records with vector graphics software and two different types of cutting machines: laser cutter, and vinyl cutter. The method enables us to engrave a variety of wave forms on a surface of diverse materials such as paper, wood, acrylic, and leather without or with prior acoustic information. The results could be played as analog records with standard record players. The chapter examines its technical specification as well as its aesthetic consequences by situating the practice in a historical context.

5.1 Introduction

I have suggested to change the gramophone from a reproductive instrument to a productive one, so that on a record without prior acoustic information, the acoustic information, the acoustic phenomenon itself originates by engraving the necessary Rischriftreihen (etched grooves). [Moholy-Nagy, 1923]

In 1923, László Moholy-Nagy, master at the bauhaus, proposed to produce a record without prior acoustic information. It is not clear whether he succeeded or not to achieve the anticipated results, however, the coming practitioners followed his notion with a knife to form different rhythmic patterns on the surface of record (Brinkmann, Thomas, Klick, 2000), or with a second hole to rotate the record off center to induce variations in pitch and speed (Non, Pegan Muzac, 1978) [Samartzis, 2006]. In this chapter, the author proposes an alternative method, which legitimately follows the notion with a help of vector graphics software and current cutting machines.

Analog records have its origin in 1858, the invention of Phonoautograph by Leon Scott. At the moment the instrument only could transform the vibration of sound into graphical forms, however, after over a century, researchers renewed the

---

1 As an example of the outcomes, the author includes “Au Clair de la Lune - For Édouard-Léon Scott and László Moholy-Nagy - (1860/1923/2014)” [Jo, 2014b] in Appendix III of the dissertation.
The history of earliest audio recording by decoding the sound from its graphical forms [Cowen, 2012]. In 1878, Frank Lambert made the talking clock, the first machine, which could play back the inscribed sound into lead with its own mechanism. After few months, Thomas Edison made the Phonograph, which record and reproduce (mainly) voices with a vertically vibrated stylus and a tin foil on a cylinder. In 1887, Emile Berliner proposed the Gramophone to record sounds on a disc. The Gramophone used a flat disk rotated on a horizontal plate as a recording surface. In its recording, a vibration of air according to time (i.e. sound) is converted into a horizontal vibration of stylus to etch a groove into the rotated surface. In play back, the procedure works in a reverse order. The stylus moves along the groove and the vibration is mechanically / electronically amplified to produce a monophonic sound (Figure 5-1). The mechanism also allowed multiple duplications with casting technique.

![Figure 5-1. How a record works](image)

After the Gramophone, the basic mechanism of record continued for a century with several inventions and experiments. For example, the change of diameters and rotational speeds, the appearance of 45/45 stereophonic recording in 1950's [Gold, 2000], and a laser turntable in 1980's [Hensman, 2007]. Diverse materials were tested for the disc include not only standard shellac and vinyl but also other experimental stuff such as rice cake in 1920's [Hashizume, 2005], chocolate [Seiffert, 1989], or ice [Yagi, 2005]. In the late 1960's to 1970's, Dubplate was come from a reggae music scene. It uses an acetate disc, a recordable fragile disc
originally invented for testing purpose with cutting machine. They used the disc to produce an original version (i.e. mixing) for their sound system [Veal, 2007]. The culture of making a unique record has been continued since then such as a building of hand made cutting machine on a CD [Benchoff, 2012], 3D Printed Record [Ghassaei, 2012], or cutting four grooves which cross on each side [Leguay, 2012].

5.2 cutting record

In proposed method, the author follows the invention of Berliner's gramophone. Instead of using a vibration and a stylus, the author employs a computational vector line, and a laser beam or a cutter blade of cutting machine, to engrave a wave form as a groove on a flat surface. The resulted groove could be played as a monophonic record in a same manner as its ancestor. In following sections, the author describes the two cutting machines and two distinct ways of producing analog records without (record-without), or with (record-with) prior acoustic information.

5.2.1 Cutting Machines

To engrave a groove on a surface of a material as a playable record, the author has used two different types of cutting machines: Laser cutter (Universal VLS 2.30) and Vinyl cutter (Silhouette Cameo). Each cutting machine provides a driver software to work with several graphic applications in a similar way to a standard printer.

Laser cutter

Laser cutter is a device to engrave or cut images on a material with a laser beam. To compare with it to standard inkjet or laser printers, it could produce the image without physical contact instead of printing the image with substantial ink or toner. Because of its principle to burn away a surface of a material, it is difficult to treat some materials such as vinyl, which produce poisonous gas or metals with a reflective surface. Besides that, it could be used with diverse materials such as paper, wood, acrylic, and leather. Normally, a laser cutter provides two modes: raster, and vector. In raster, the laser beam horizontally scans (i.e. burn) the surface based on a bitmap or painted data. In vector, the laser beam outlines on the
surface to make a continuous line for engrave and cut based on vector data. In our case, the author mainly used the vector to engrave the wave forms.

**Vinyl cutter**

Vinyl cutter uses a thin cutter blade in place of a laser beam to engrave or cut an image. It works in a similar way to laser cutter. Based on its structure to rotate the blade on the surface, it only could treat vector data with thin materials such as paper, adhesive vinyl, or film. Normally, the cost of a vinyl cutter is about one hundredth of a laser cutter (e.g. $200 vs. $20,000).

### 5.2.2 A record without Prior Acoustic Information

This is a record without prior acoustic information (*record-without*). As Moholy-Nagy suggested, it directly originates acoustic phenomenon from a graphical form. In this type, the author uses a standard vector graphics software (i.e. Adobe Illustrator) to draw a wave form as a computational vector line. Here is a case of making a locked groove (i.e. a concentric circle). With the groove, we could approximately have a range of time from 1.8 seconds in 33RPM (60 sec / 33.3) to 1.3 seconds at 45 RPM (60 sec / 45).

0) Draw a circle.

1) Divide it into a collection of arcs with the scissors tool.

2) Apply the Smooth zigzag effect (Filters > Distort > Zig Zag) for each arc (Figure 5-2).
Fig 5-2. Apply zigzag effect to an arc

The size of zigzag defines the amplitude (i.e. volume) of the wave form. Because of the range of time, when we equally divide the circle into X arcs and apply Z numbers of ridge for each arc, we could have Y vibrations in second (i.e. frequency) with following function.

$$Frequency: \ Y (Hz) = Arcs: \ X * \ Ridges: \ Z / 1.8 \ (or \ 1.3)$$

If the zigzag effect at regular intervals is applied, a beat emerges. The wave form (e.g. draw an envelope) also could be transformed with diverse effects of Illustrator. After applying the effects, the arcs need to be connected as a groove.

3) Draw a periphery circle to satisfy a desired size of a record (7inch=177.8mm, 10inch=254mm, or 12inch=304.8mm).

4) Make a hole in the center (7.24mm in diameter).

5) Adjust the diameter of the zigzag effected circle to fit it into a form of record.

6) Add other information (e.g. title, name) within the circle.

<optional for laser cutter>

7) Differentiate the peripheral circle and the hole for cut, and the effected circle and other information for engraving with different color.

8) Cut the data through cutting machines.
The method also could be extended into a standard spiral groove. In that case, by using the spiral tool in Illustrator, we could attain longer range of time.

5.2.3 A record with Prior Acoustic Information

This is a record with prior acoustic information (*record-with*). In this type, the author converts a digital audio data (i.e. wav) into a vector graphic form (i.e. svg) with software. Here is a case of making a locked groove with SoX (Sound eXchange), gnuplot, and Adobe Illustrator.

0) Prepare a digital audio data with the range of time (1.8 seconds in 33RPM, 1.3 seconds in 45RPM).

1) Convert the audio data with standard uncompressed formats (e.g. .aiff or .wav) to .dat with SoX. SoX is a command line utility to convert various formats of computer audio files in to other formats (http://sox.sourceforge.net/). With the conversion, we could treat each sample of the audio data as text lining up in time series.

2) Draw a continuous vector line (i.e. wave form) with the text as SVG (Scalable Vector Graphics) by using a graphing utility gnuplot (http://www.gnuplot.info/).

3) Import the SVG and make an art brush of the wave form with Illustrator.

4) Draw a circle.

5) Apply the art brush to the circle (Figure 5-3).
Figure 5-3. Apply an art brush of a wave form to a circle

The width of the circle defines the amplitude (i.e. volume) of the wave form in the same way as record-without.

6) Draw a periphery circle, make a hole, add other information, and so forth.

To extend the method into a spiral groove, the author and colleague made a custom application with processing. The application generates a spiral groove with peripheral circle and a center hole in a form of SVG file based on given audio data (Figure 5-4). The application provides parameters of diameter, sampling rate, rpm, amplitude, line space, and margin for adjustment. The resulted SVG file is imported into Illustrator for cutting.
5.3 Technical Issues

Thorough the practice, the author observed following issues in our method.

5.3.1 Sampling Frequency

For record-with, the sampling frequency of source audio data is needed to adjust in relation with the resolution of the cutting machines. The value also relates to the maximum number of ridges in record-without. The sampling frequency determines the number of samples per second. According to Ghassaei's work [Ghassaei, 2012], we could calculate the sampling frequency with a following formula.

\[
\text{Sampling frequency (Hz)} = (\text{Resolution per inch}) \times (\text{Inches per revolution}) \times (\text{Revolution per second})
\]

Our laser cutter (Universal VLS 2.30) provides 1000dpi (0.0254mm intervals) and our vinyl cutter (Silhouette Cameo) provides 508dpi (0.05mm intervals) as their resolution. RIAA standards define a radius of a groove in standard 12inch (30cm) record from 2.25 to 5.75 inch (57.15 to 146.05 mm) [Gold, 2000]. From the values, we could calculate the range of the inches per revolution \((2\pi\times\text{radius})\) from 14 to 36 inch (35.89 to 91.44mm). The revolution per second is 0.55 in 33RPM (33.3/60) and 0.75 in 45RPM (45/60). With the values, we could have following sampling frequencies to prepare the audio data.
Table 5-1. Obtainable sampling frequencies of cutting record

<table>
<thead>
<tr>
<th>Cutting Machine</th>
<th>RPM</th>
<th>circum-ference</th>
<th>Sampling Frequency (Hz)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Laser cutter</strong></td>
<td>33</td>
<td>outer</td>
<td>1000<em>36</em>0.55 = 19,799</td>
</tr>
<tr>
<td></td>
<td></td>
<td>inner</td>
<td>1000<em>14</em>0.55 = 7,700</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>outer</td>
<td>1000<em>36</em>0.75 = 27,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>inner</td>
<td>1000<em>14</em>0.75 = 10,500</td>
</tr>
<tr>
<td><strong>Vinyl cutter</strong></td>
<td>33</td>
<td>outer</td>
<td>508<em>36</em>0.55 = 10,058</td>
</tr>
<tr>
<td></td>
<td></td>
<td>inner</td>
<td>508<em>14</em>0.55 = 3,911</td>
</tr>
<tr>
<td></td>
<td>45</td>
<td>outer</td>
<td>508<em>36</em>0.75 = 13,716</td>
</tr>
<tr>
<td></td>
<td></td>
<td>inner</td>
<td>508<em>14</em>0.75 = 5,334</td>
</tr>
</tbody>
</table>

Theoretically, the half of the sampling frequency defines the maximum frequency of the sampled signal. To compare the results with the frequency response of a standard record (e.g. 20 kHz in LP), we could have approximately one-tenth (Vinyl cutter at 33RPM on inner circle) to two-thirds (Laser cutter at 45RPM on outer circle).

5.3.2 Limitation of Anchor Points

The author has faced limitations of anchor points in both vector graphics software and cutting machines. With *record-without*, The author has used the zigzag effect of Illustrator to have vibrations (i.e. frequency) with the resulted groove. However, the zigzag effect has the upper limit (100) on the number of ridges (i.e. anchor points). Therefore, if we would like to have a higher frequency, we need to repeatedly apply the effect to divided arcs (e.g. 1000Hz in 33rpm needs 18 arcs with 100 ridges on a revolution). Illustrator also has a limitation in the number of anchor points of a single path (i.e. continuous line) around 32,000. For *record-without*, it is not a matter because we've already divided the path into arcs as the author described above. However, for *record-with*, it restricts the range of time in relation with the sampling frequency (e.g. 0.7sec in 44.1KHz). Therefore, in the custom application, the author divide a groove into multiple paths with overlap to achieve longer range of time. The driver software of cutting machines also show limitations with graphic applications. With our trials, the driver of vinyl cutter could not treat data with anchor points over around 100,000. The laser cutter also has a similar problem with Illustrator. Therefore, the author avoids the problem by using a direct import function of the laser cutter. For the vinyl cutter, we're planning to directly control the machine with custom application.
5.3.3 Melt and Hook

Melt by a laser beam, and hook with a cutter blade prevent us to reach desired results in accuracy of sounds. With laser cutter, the author burns away a surface of material with a laser beam. The burning causes a tiny melt or scorch at the edge of the resulted groove. With vinyl cutter, the cutter blade physically contact with a material. The contact causes several hooks with materials when it rapidly changes its movement. In each case, the smallest changes in the groove will disappear and result in a loss of treble in a sound. With laser cutter, the author could achieve higher accuracy by using high-density focusing lens with smaller spot size (0.025mm). The lens also enables us to decrease gaps between cut parts (e.g. arcs in puzzled record). With vinyl cutter, we're planning to use papers made with shorter/thinner fibers to prevent hooks.

5.4 Discussion

This section examines the role of mechanical reproduction in (what was formerly known as) analog records in the age of personal fabrication which the author has been working with a number of performances and workshops at diverse venues including Maker Faire Tokyo 2012, freq2012 at Kyushu University, Yamaguchi Center for Arts and Media (YCAM), Samsung Art and Design Institute (SADI) and Yokohama Creative Center (YCC). The Author investigates the creation of records without inputting sound sources by utilizing a production technique and a variety of materials, in conjunction with a discussion of a performance and workshop extracted from the project.

In 1923 László Bauhaus master Moholy-Nagy made the proposal to produce a record without inputting acoustic information. At the time, it was just a provocative idea. However, after nine decades, the author has realized the idea with the help of mature vinyl audio recording technology [Gelatt, 1977] and current personal fabrication tools [Gershenfeld, 2005].

Instead of using the vibrations of an original sound, the author computationally generates a waveform with a conventional graphics application (Adobe Illustrator). The result is horizontally engraved on such diverse materials as paper, acrylic and wood. In the place of a using mechanical stylus on a lacquered master, the author employs a computer numerical control (CNC) machine with a vinyl
blade or a laser cutter. Each instance is individually produced from the CNC machine, rather than being mass-produced on vinyl with a metal stamper and a pressing machine. The outcome can be played on ordinary analog record players.

5.4.1 The Lack of Original Sounds

The lack of original sounds (the outcome is literally not a record) is reminiscent of the 1930s practices of Rudolf Pfenninger and Oskar Fischinger [Levin, 2003], who produced sounds such as sine waves and square waves without recordings. Of course, the proposed method differs from theirs in its use of computational vector lines instead of optical patterns. However, it is also possible to produce a sine wave from a smooth zigzag pattern (Figure 5-5). For the calculation of desired frequencies, we can use the following function:

\[
\text{Frequency [Hz]} = \text{Number of zigzags} \times \left( \frac{360}{\text{degrees}} \right) \times \left( \frac{\text{rpm}}{60} \right)
\]

For example, the frequency of 75Hz would result from 100 zigzags in one revolution of the disc at 45rpm, and 440Hz would result from 50 zigzags x 22.5 degrees at 33rpm.

While we might play the result on a traditional gramophone by hand, we also can produce typical electronic sounds (i.e. a sine wave) even without electricity.
5.4.2 Material

After Berliner’s Gramophone in 1887, the primary material of analog record (shellac and vinyl) remained the same for a century with a few artistic experiments such as records made of rice cakes in the 1920s [Hashizume, 2005], chocolate in the 1980s [Seiffert, 1989], and ice in the 2000s [Yagi, 2005]. Although the author has a different starting point (a lack of original sounds), the author has extended these experiments with further variations. An example is a reconfigurable record made with a collection of acrylic arcs with a wooden rim cut by a laser cutter (Figure 5-6). With this record, the author can produce different rhythms and beats by changing the order of the arcs as with a step sequencer. We might expect the idea to prompt an alternative style of DJ music, just as, it could be argued, the availability of the cheap bass/drum machine (i.e. TB-303/TR-808) caused the birth of Techno music or the high-quality turntable produced hip-hop [Blashill, 2002].
5.4.3 Expertise, Cost, and Reproduction

Examining the proposed approach as a production technique, we can see it is different from its predecessor (the vinyl record) in terms of its required expertise, cost and ease of reproduction. Instead of requiring the mastery of skills with cutting machines and other equipments, our method of creating records requires only a little knowledge of conventional vector graphics software and personal CNC machines. From the point of view of expense, a laser cutter would be in the same price range as an established cutting machine. The alternative, a vinyl cutter, is relatively inexpensive (costing around 1% as much, or about the same as a home inkjet printer. In terms of duplication, rather than utilizing a vinyl and metal stamper for mass consumption, we must make each one individually, one by one, after choosing tools (i.e. vinyl or laser) and materials (e.g. paper, wood, acrylic). Even if we engrave an identical computational vector line, the sound character will vary depending on the materials chosen for the finished product.
5.4.4 Performance and Workshop

As extrapolations of the practice, the author conducted a number of performances and workshops. The performance consists of two parts. In the first half, the author not only play the project’s outcome on a record player, but also present the process of constructing the groove with Adobe Illustrator graphics software and a CNC machine (vinyl cutter) in front of the audience. In the second half of the performance, the author fabricates a physical record with the sounds from the first half of the performance. Showing the use of computer to audiences in performance is reminiscent of live coding performances. However, the performance differs in terms of its lack of coding and step-by-step sound generation. Instead, the author merely manipulates an ordinary application with few sounds resulting other than those of key typing and the movements of the vinyl cutter, prior to the arrival of the outcome.

The Author has held the workshops mainly with undergraduate-level students that have little knowledge or experience with vinyl records. For the workshop, the author prepares step-by-step instructions and provide a selection of papers, vinyl cutters and record players for students’ use. Within this setting, each participant can produce and play her/his outcomes within a few hours. For most of them, it is the first experience of playing/making (what was formerly known as) a record. The Author also has released some of the results in the form of a (data) compilation.

5.5 Contribution

The Author presented a method to produce analog records on diverse materials with vector graphics software and cutting machines. The method combines the current computational environments and the mature audio technologies to provide a way to think the new and the old in parallel lines. The sound

---

1 Kazuhiro Jo, “cutting record - a record without (or with) prior acoustic information,” freq2012, Kyushu University, Fukuoka, Japan <www.youtube.com/watch?v=vbCLE06P7j0> (2012)


3 For example, “Cutting Record Workshop” at Samsung Art and Design Institute (SADI), July 2013, and “Paper Record Workshop” at Yokohama Creative Center, December 2013.


quality of the resulted records is relatively lower to compare with it to standard analog records. It contains a sound of stepping motor, and takes long time for production (e.g. 9 hours for 5 min). However, especially, in the case of record-without, the record is no longer a work of mechanical reproduction [Benjamin, 1936]. Instead, the record is a craft of personal fabrication [Gershenfeld, 2005]. In the last century, “We would become practiced in selecting what we wanted to hear, but not practiced in producing stuff for others to hear” [Lessig, 2008]. As the cheap bass/drum machine (i.e. TB-303/TR-808) caused the birth of Techno music [Blashill, 2002], the author would like to revive people do not just “listen” music but also “cut” their own music with proposed method.

When the author consider the work in relation to Thomas Edison’s fourth position of the applications of the phonograph (i.e. music) [Edison, 1878], the above practice offers the possibility not only of consuming the artistic creations of experts but also of producing our outcomes for ourselves. As Attali predicted, music will become a network of compositions as a successor to repetition, representation, and sacrifice: “In this network, what is heard by others would be a by-product of what the composer or interpreter wrote or performed for the sake of hearing it” [Attali, 1977].
6. CONCLUSIONS

The dissertation tried to depict the emergent form of music under a notion of “the
music one participates in” with following challenges.

1. Blurring the boundary between the performer and the listener
in a performance.

2. Extending the notion of musical participation through creative
do-it-yourself workshop.

3. Re-examining the role of reproduction under a current
technological environment.

In chapter two, the dissertation examined the diverse discourses of participation as
a foundation for following discussions. The examinations suggested us to concern
a level of participation, an evolution and shift of roles, a creativity in the absence
of a central authority, practices beyond the simple completion of tasks, and a
lingering authoritarian position of the artist in “the music one participates in”.

Chapter three adopted the first challenge of “blurring the boundary” with the
practice of The SINE WAVE ORCHESTRA (SWO) which intended to have
diverse ways of musical participation in performance through abolishing the
central authority such as people on a stage. Through the analysis of SWO, the
chapter revealed the diversity across the works in three following styles of
musical participation,

1) Identification and association from the use of same sound
source (i.e. sine wave),

2) Moving around from the allowance/recommendation to walk
freely during a performance, and

3) Temporal and spatial co-presence from the extension of
performance in time and space.

In each work of SWO, the three styles appear in different forms that hardly be
observed in conventional music customs. The following reviews pointed out, a
deconstruction of “the ego of self-expression” that is prevalent in most musical
styles, as well as a construction of “bottom-up” or “virtual” community consists of a collection of sine waves, and the integration of mathematical formulation (i.e. Fourier transform) and weather to bring a pure “chance” into the work.

In chapter four, the second challenge of “Extending the notion of musical participation through creative do-it-yourself workshop” are examined through the practice of Chiptune Marching Band, Aeolian Harp, and others. Based on the diverse discourse of participation, the chapter leaded four characters of musical participation in a workshop,

1) Rather than Completion of a Task, in which the construction of physical components (i.e. instruments) should not be the primarily goals,

2) Spectrum of Participation, where a return to hierarchy was suggested to achieve a clear outcome (i.e. performance),

3) Shift of Roles, to have a process that moves from mutual conversation to a transfer of knowledge within participants, and

4) Away from the Paradox, to do not think the workshop practice from a Big-C, goal oriented point of view, but to think from small-c point of view to accept unexpected results.

Chapter five faced the third challenge of “Re-examining the role of reproduction under a current technological environment”. With the practice of a record without (or with) prior acoustic information, the chapter examined the role by situating the practice in a historical context of analog records as well as with its technical specifications. The results of the analysis pointed out

1) The Lack of Original Sounds, which is literary no longer a record,

2) The flexibility of Material, to prompt an alternative style of DJ music, and

3) The apparent difference in Expertise, Cost, and Reproduction, between the predecessor (i.e. the vinyl record) and the proposed practice
4) Performance and Workshop as extrapolations of the practice, to present the whole process of production to the audiences, and to invite people to produce and play her/his own outcomes.

Of course, the dissertation only covers a specific diversity of the form with very minute examinations of each practice. The practice of The SINE WAVE ORCHESTRA solely presents the use of single sound source (i.e. sine wave) in a performance. A combination of diverse sounds in a collective sound representation and its consequences are unexplored yet. Workshops raise somewhat contradictory questions for participatory musical practice in terms of their aims. Raison d'être of “the ego of self-expression” needs to be explored in further research. With reproduction, the dissertation only points out initial possibilities of the practice from now on. Extensive social conditions include the law, and the economy are needed to be considered.

The explorations of the emergent form of “the music one participates in” in this dissertation clarified that music is no longer a product to adopt but is a process to participate. In the first half of the last century, Benjamin described the decay of the aura in art with the advent of mechanical production [Benjamin, 1936]. In the latter half of the century, Barthes pointed out the death of the author in conjunction with the birth of the reader [Barthes, 1967]. At the beginning of the present century, the notion of co-creation is gaining currency. The author hopes that this presentation of “the music one participates in” as a route to participation in music might establish a basis of further discussion around ideas of the emergent form of music.
REFERENCES


ASA, (1960) Acoustical terminology, s.1.1, American standards association.


Cage, J. (1969), 33 ⅓, November 21, 1969 at the campus of the University of California at Davis.

Cornock, S. and Edmonds, E. (1973) The creative process where the artist is amplified or superseded by the computer, Leonardo 6, 1, MIT Press, pp.11–16.


Jo, K. (2013a) The Role of Mechanical Reproduction in Music at the Age of Personal Fabrication: Cutting Record---A Record without (or with) Prior Acoustic Information, Fab Research Session, FAB9, Yokohama, Japan, 2013.

Jo, K. (2013b) The Role of Mechanical Reproduction in Music at the Age of Personal Fabrication: Cutting Record---A Record without (or with) Prior Acoustic Information, presented at Media Art Histories 2013: Renew, Riga, Latvia.


The Music One Participates In


APPENDIX

APPENDIX I: The SINE WAVE ORCHESTRA works 2002-2008
**The SINE WAVE ORCHESTRA**

The SINE WAVE ORCHESTRA(S.W.O.) is a participatory sound performance project that has been started since 2002 by four core members (FURUDATE Ken, JO Kazuhiro, ISHIDA Daisuke, NOGUCHI Mizuki). Under the concept that each participant plays a sine wave, people are invited in public to create a sea of sine waves as collective sound representation. By taking in different environment and style. Through sharing/separating the time and the space, the sine wave played by each participant interferes with each other and represents a communication among the participants as an abstract form.

**What is The SINE WAVE? / Background of the project**

Sine wave is a wave which has a form represented by the sine function [fig.1]. The wave is defined with amplitude, frequency, and phase. Based on theory which discovered by Joseph Fourier, a French mathematician, every periodic sound could be composed/decomposed with multiple sine waves.

For the musical concept, sine wave does not have any overtone which is an element characterize tone character. it is called as “Pure Tone”.

In the project, a person uses a sine wave which is most basic element of sound, and common basis of computer music.

**Works**

2002 The SINE WAVE ORCHESTRA and if you like, some clicks. Self Produced Performance

2003 The SINE WAVE ORCHESTRA in Tama Art University held as Collaborative event by TAU and S.W.O.

The SINE WAVE ORCHESTRA static exhibited at TOKYO DESIGNERS BLOCK 2003

2004 Making device for The SINE WAVE ORCHESTRA Workshop for The Stairway of The SINE WAVE ORCHESTRA

The Stairway of The SINE WAVE ORCHESTRA Related event of exhibition "r外墙: New Generation of Media Art", NTTICC

The SINE WAVE ORCHESTRA picnic in Linz Self Produced Performance

The Garden of The SINE WAVE ORCHESTRA held at sonarounds extra, Advanced Music Festival sonarounds tokyo 2004

The SINE WAVE ORCHESTRA district held at V2 Dutch Electronic Art Festival (DEAF04)

2005 The SINE WAVE ORCHESTRA in transmediale05 held at transmediale festival 05

Sine Waved Continuum Related event of exhibition "Open Nature"

The SINE WAVE ORCHESTRA stay exhibited at exhibition "Open Nature"

The SINE WAVE ORCHESTRA nomadic exhibited at International Triennale of Contemporary Art YOKOHAMA 2005

2006 The SINE WAVE ORCHESTRA at ParticipArt performed at exhibition "ParticipART"

The SINE WAVE ORCHESTRA at Interferenze performed at Musical Festival "Interferenze"

The SINE WAVE ORCHESTRA at ZeroOne San Jose / ISEA 2006 performed at festival "ZeroOne San Jose / ISEA 2006"

The SINE WAVE ORCHESTRA stay amplified exhibited at exhibition "ART + COMMUNICATION 2006: WAVES"

The SINE WAVE ORCHESTRA mediate exhibited at exhibition "Re-search"

**Awards**

Honorary Mention of PRIX ARS ELECTRONICA 2004, Digital Music Category

WARSAWA 4th Floor, Tokyo, Japan

Tama Art University, Tokyo, Japan

United Nation University, Tokyo, Japan

Tama Art University, Tokyo, Japan

Galleria, Tokyo Opera City, Tokyo, Japan

Donau Park, Linz, Austria

Yebisu Garden Place, Tokyo, Japan

Van Nelle Ontwerpfabriek, Rotterdam, the Netherlands

Haus der Kulturen der Welt, Berlin, Germany

NTT InterCommunication Center(NTTICC), Tokyo, Japan

NTT InterCommunication Center(NTTICC), Tokyo, Japan

Museum of Art, Rovereto and Trento(MART), Rovereto, Italy

San Martino Valle Caudina, Italy

SOFA Area, San Jose, U.S.

ARSENALES of the Latvian National Museum of Art, Riga, Latvia

Sendai Mediatheque, Miyagi, Japan
The Stairway of The SINE WAVE ORCHESTRA

held as Related event of exhibition "n_ext: New Generation of Media Artists", NTTICC
19th June, 2004
Venue: Galleria, Tokyo Opera City, Tokyo, Japan

- 10m x 30m x 10m(wdh) semi-public space
- Self Made Sine Wave Devices with Light Sensor (ver. 2004) x 50
- Light with DMX Controller x 8
- 200 people who invited

duration: about an hour

All participants were invited in public and played under the notes:
- You can use only the pure sine wave which is not distorted or filtered, modulated.
- We set no limit to the frequency of a sine wave.
- You have an alternate choice: if you use the device which is prepared for the event or your own device which you will bring with yourself.
- A built-in speaker may be used only in the case you use PC.
- Please set a volume of a sine wave about same as the one people talk in.
- If you wish to use your own device, please inform us in advance by E-mail.
- Please use built-in power supply. (There is no power supply in Galleria)
- The devices which will be prepared for the event are the ones which have built-in power supplies and speakers.
- The device is designed to react to a light, we recommend you to bring a light which is equivalent of amout of light of a penlight (Flamables)
The Garden of The SINE WAVE ORCHESTRA

held at sonar sound extra, Advanced Music Festival sonar sound tokyo 2004
11th October, 2004
Venue: Yebisu Garden Place, Tokyo, Japan

- 15m x 15m (w/d) public space
- plant speakers x 20
- more than 20 players with Sine Wave Generator (i.e. Laptop Computer)

duration: about an hour

A performance by using plant speakers.
The speakers were installed in pots, to vibrate and sound the leaves of plants.
We set the plants to make a sine wave each.
All participants were invited in public and played though the plants.
The SINE WAVE ORCHESTRA stay

exhibited at exhibition “Open Nature”, NTTICC
29th April - 3rd July, 2005
Venue: NTT InterCommunication Center (NTTICC), Tokyo, Japan

- Anechoic Chamber x 1
- Control Stand x 1
- Spot Light x 1
- MIDI-DMX Controller x 1
- Audio Interface with 24 output (i.e. MOTU 24/0) x 5
- Mac Pro for generating sound x 1
- Mac Mini for control x 1
- Speakers x 116 (depends on the size of chamber)

duration: 2 months

All participants played sine waves with following procedure:
- He/she goes into the anechoic chamber.
- He/she touches the controller, the volume of a sine wave and the brightness of the light increase from the ordinary level.
- He/she chooses the frequency and the position
- He/she leaves his/her own sine wave in the work.

The volume of the sine wave and the brightness of the light decrease to the ordinary level. Then the volume of the sine wave gradually attenuates over the period of two weeks to disappear. Every time a participant enters the work, one sine wave is added to the work.
During the exhibition, the sound is changing from a phase where each sine wave is discriminable to a cluster, which consists of mutually interfering sine waves like a white noise that contains all frequencies.

This work is not a sound installation but a sound performance.
In this work, participants hear the sine waves generated as a result of other participant’s trace, and leave their own sine wave in their turn. These sine waves form a mutually interfering sound space. If there is no participant, there is no sound neither. Every participant can perform as a collaborator to others through the whole performance time.
exhibited/performed at International Triennale of Contemporary Art YOKOHAMA 2005
28th September - 18th December, 2005

Installation Section:  
- Apple iPod 3G x 120  
- Small Speakers for iPod x 120  
- Metal Bar (12m length) x 3  
- String for hanging iPod x 120  
- Power Supply for iPod x 120  
- Ceramic Tiles x 120

Fieldworks Schedules:  
- 2nd Oct. Yokohama International Passengers Terminal  
- 10th Oct. YOKOHAMA Red Brick Warehouse  
- 3rd Nov. Dockyard Garden  
- 20th Nov. Isszaki Mall  
- 4th Dec. YOKOHAMA Triennale 2005 ZAIM  
- 18th Dec. Yarnshita Park - Grand Final

The work consisted of two parts. In first part, five small-scale performances took place every other week in different outdoor places in Yokohama. About 20 pre-registered participants played sine waves with following procedure:

- He/she played sine waves with the devices (Linux-installed-iPod) that the organizers provided.
- He/she moved to the exhibition site after each performance.
- He/she set the frequency and the volume of a sine wave, and exhibited the device at the site by attaching it to a string hanging from the high ceiling with power cable.
- He/she as also asked to leave a message on a small tile and place it on the floor beneath the exhibited device.

Those instruments continued to produce sine waves during the exhibition. The sound at the exhibition site grew every time each performance took place. In the end, the site exhibited a collective sound representation of 120 sine waves produced by 120 devices.

In the second part, which took place at the end of the exhibition period, the participants of the five performances were all invited to join a large-scale performance.

- He/she removed the device he/she had exhibited from the exhibition site, and walked to a nearby park.
- He/she played sine wave with the device.
- The performance lasted for a few hours until all the battery of the devices turned off.

duration: 3 months (for exhibition) / 1 day (for each workshop/field work)
The SINE WAVE ORCHESTRA tour 2006

3rd August, 2006
The SINE WAVE ORCHESTRA at ParticipART
performed at exhibition ‘ParticipART’
Museum of Art, Rovereto and Trento(MART), Rovereto, Italy

5th August, 2006
The SINE WAVE ORCHESTRA at Interferenze
performed at Musical Festival ‘Interferenze’
San Martino Valle Caudina, Italy

12th August, 2006
The SINE WAVE ORCHESTRA at ZeroOne San Jose / ISEA 2006
performed at festival ‘ZeroOne San Jose / ISEA 2006’
SOFA Area, San Jose, U.S.

- Public Space which can contains 100 people more
- Self Made Sine Wave Devices (ver. 2007) x 50

duration: about an hour each

The SINE WAVE ORCHESTRA tour 2006 consists of three performances, The SINE WAVE ORCHESTRA at ParticipART, The SINE WAVE ORCHESTRA at Interferenze, and The SINE WAVE ORCHESTRA at ZeroOne San Jose / ISEA 2006. In each performance, the organizers provided self made sine wave devices for the participants who were invited from public. (The device consists of an oscillator, a knob, a switch, a speaker, and a battery within a handheld plastic egg.) The participants played sine waves with the devices in outside open space by moving around in the space and producing varieties of frequencies of sine waves.
The SINE WAVE ORCHESTRA tour 2006

The SINE WAVE ORCHESTRA at ParticipART

The SINE WAVE ORCHESTRA at Interference

The SINE WAVE ORCHESTRA at Zero One San Jose / ISEA2006
The SINE WAVE ORCHESTRA stay amplified

exhibited at exhibition "ART + COMMUNICATION 2006: WAVES"
24th August - 17th September, 2006
Venue: ARSENALS of the Latvian National Museum of Art, Riga, Latvia

- 3m*3m Closed Nearly Dead Reflection Cube x 1
- Passive Speaker x 16
- 4ch Amplifier x4, Fader x 1
- Self Made Controller Stand
- Metal Podestal x 1
- Foot Switch x1
- Controller Box with Rotational Controller, Fader x1
- Audio Interface with 16 output x 1
- Mac Pro for generating sound x 1
- Mac Mini for control x 1

duration: 1 month

The SINE WAVE ORCHESTRA stay amplified is an alternate version of "The SINE WAVE ORCHESTRA stay" which was exhibited in the exhibition "Open Nature", NTTiCC, 2005.

This work has same idea of "stay" which is to let every participant leave their trace in the form of their own sine wave.

The difference between "stay" and "stay amplified" is:
- Quantity of Speakers is 16 for this work.
- The volume of the sound is louder than previous.
Other works of The SINE WAVE ORCHESTRA

The SINE WAVE ORCHESTRA and if you like, some clicks. [performance]
7th December, 2002, WARSZAWA 4th floor, Tokyo, Japan

The SINE WAVE ORCHESTRA in Tama Art University [performance]
18th April, 2003, Tama Art University, Tokyo, Japan

The SINE WAVE ORCHESTRA static [installation]
9th-13th December, 2003, Tokyo Designers Block, United Nation University, Tokyo, Japan
Other works of The SINE WAVE ORCHESTRA

Making Devices for The SINE WAVE ORCHESTRA [workshop]
7th, 8th, 11th June, 2004, Tama Art University, Japan

The SINE WAVE ORCHESTRA picnic in Linz [performance]
7th, 8th September, 2004, Donau Park, Linz, Austria

The SINE WAVE ORCHESTRA district [installation performance]
13th November, 2004, V2 Dutch Electronic Art Festival (IDEAF04), Van Nelle Omwerpfabriek, Rotterdam, the Netherlands
Other works of The SINE WAVE ORCHESTRA

The SINE WAVE ORCHESTRA in transmediale06 [performance]
5th February, 2005, transmediale festival 06, Haus der Kulturen der Welt, Berlin, Germany

The SINE WAVE ORCHESTRA mediate [installation]
26th November - 25th December, 2006, Re:search, Sendai mediatheque, Miyagi, Japan

Sine Waved Continuum [workshop, performance]
3rd May, 18th June, 2005, Open Nature, NTTICC, Tokyo, Japan
Publication

Catalog:


Paper:

K. Jo, K. Furudate, D. Ishida, N. Mizuki, Transition of instruments on The SINE WAVE ORCHESTRA. ACM Computers in Entertainment, on October, 2008 (to be published).


Press:


APPENDIX II: Chiptune Marching Band - SIGGRAPH ASIA 2009 Course notes [Jo, Allen, 2009]
Kazuhiro Jo & Jamie Allen
Digital Media, Culture Lab, Newcastle University
Kazuhiro.Jo/jamie.allen1@ncl.ac.uk
AGENDA

COURSE DESCRIPTION
PREREQUISITES
SYLLABUS
  Workshop
  Performance
BOOKLET
“Chiptune Marching Band” (CTMB) is a participatory course about performance and DIY practice. CMB is a public workshop and actual public performance where participants make a sensor driven sound instrument, self-powered by localized power resource, and perform with their instrument. With instruments at the ready, we take the group outside, bringing the event to the streets as the Chiptune Marching Band.

The course invites a group of researchers, students and members of the general public, offering them the opportunity to explore localized resource communities, sound making circuitry, and collective sound performance.

References and reading underpinning the workshop philosophy are available online at:
http://chiptunemarchingband.com/references/
PREREQUISITIES

Prerequisites for the course include an interest in DIY culture, in particular the use of alternative power resources, going 'off grid', and audio circuit building, as well as interest in performance and collaborative creative actions. There are no prerequisites in terms of technical experience or skills, and no musical talent or abilities are required. Open-minded, fun and creative people of all ages and backgrounds are welcome to join us.
SYLLABUS

This course consists of a workshop and a performance.

WORKSHOP
1. Discussion/Presentation (00:00 - 00:50)
At the beginning of the workshop, we provide an introduction of the core concepts addressed during the days’ session. We develop a short historical trajectory of resource use. Creative culture and music creation as a socio-economic concern are addressed. Further, the possibility of a formation of a ‘community of resources’ is discussed as a possibility and condition for relationships between people, creators and performers. Technical information about circuitry and circuit diagrams is also presented here.

2. Circuit Building (01:00 - 01:45)
In this portion of the workshop, participants build a simple sound making circuit with sensor, powered by a localized power resource. We provide an individual kit of parts and an instruction booklet for participants.
3. Instrument Fabrication (01:45-02:30)

We provide materials for the construction and personalization of the overall material structure of the instruments. Examples of materials are colorful cardboards, tapes, glue, paints, papers, and so on. Participants fit their circuit into the cardboard tube with these materials and fabricate their instrument in their own way.

PERFORMANCE

The performance is carried out in a public outside space. Participants, upon finishing their instruments, have a discussion about how to organize their own performance (02:45-03:00). Following the discussion, participants are then grouped together as a "marching band," parading in the streets as a public performance and spectacle (03:00-03:30). At the end of the march, participants take their instruments home.
BREADBOARD
OPAMP: LM386

OPAMP: LM386
RESISTOR: 220Ω  (Red-Red-Brown-Gold)
RESISTOR: 10Ω  
(Brown-Black-Black-Gold)

CAPACITOR: 220µF  
Line(-) to the right
CAPACITOR: 47µF
Line(-) to the left

CAPACITOR: 0.047µF
(473)
JUMP WIRE: Green

JUMP WIRE: Red
JUMP WIRE: Orange

JUMP WIRE: Green
JUMP WIRE: Green

JUMP WIRE: White
JUMP WIRE: Yellow
JUMP WIRE: Yellow
JUMP WIRE: Red

SPEAKER: Black (ground)
SPEAKER: White
(signal)

SWITCH: Bottom Power
(Yellow)
SWITCH: Top Power
(Black)

CRANK: Power
(Red)
CRANK: Ground
(Black)

BATTERY: Power
(Red)
BATTERY: Ground (Black)

TONE CAPACITOR: 0.1uF(104) --> 33uF
SENSOR: (Green)
Photo/Fader/Rotation

SENSOR: (Green)
Photo/Fader/Rotation
"I have suggested to change the gramophone from a reproductive instrument to a productive one, so that on a record without prior acoustic information, the acoustic information, the acoustic phenomenon itself originates by engraving the necessary Ritzchriften (etched grooves)." (Moholy-Nagy, 1923)

In 1923 László Bauhaus master Moholy-Nagy made the above proposal to produce a record without inputting acoustic information. At the time, it was just a provocative idea. However, after 9 decades, we have realized the idea with the help of mature vinyl audio recording technology and current personal fabrication tools.

In this work, instead of using the vibrations of original sound, we computationally generate a waveform with a conventional graphics application (Adobe Illustrator). The waveform represents a french folk song "Au Clair de la Lune" which was also known as the oldest recorded sound by Édouard-Léon Scott in 1960. By engraving the waveform through a laser cutter on a wood [Fig.1], a vinyl cutter on a paper [Fig.2], or engrave the waveform on this page with a cutter (recommend to photocopy the page on a thick paper before you cut the magazine), you could generate an acoustic phenomenon of the french song through your own record player.

ACKNOWLEDGEMENTS
IAMAS, The OGAWA Science and Technology Foundation, JSPS KAKENHI Grant Number 24652029, and So Yamada.

REFERENCES

Jo, K. The Role of Mechanical Reproduction in (What Was Formerly Known as) the Record in the Age of Personal Fabrication, Leonardo Music Journal, Vol.24, MIT press (2014). (to be published.)