# The role of mechanical reproduction in music at the age of personal fabrication: cutting record - a record without (or with) prior acoustic information

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**Abstract**

In this presentation, we would like to examine the role of mechanical reproduction in music at the age of personal fabrication by taking an example from our recent project "cutting record - a record without (or with) prior acoustic information". In 1923, László Moholy-Nagy, master at the bauhaus, proposed to produce a record without prior acoustic information. After nine decades, we realized the idea with a help of standard vector graphics software (e.g. Adobe Illustrator) and cutting machines (e.g. laser cutter, paper cutter). Instead of using a stylus and a vibration from recorded sound, we generate a graphical waveform as a computational vector line, and engrave the form as a continuous groove on a surface of diverse materials including paper, acrylic, and wood. The result literally is not a record because of its lack of original sound, however it could be played as a monophonic record in the same manner as its ancestor with a standard record player. Our practice combines the current personal fabrication tools and the mature audio technologies to provide a way to think the new and the old in parallel lines, examining the role of reproduction in music from a range of fields including composition, sound synthesis, and turntablism.

**Keywords**

personal fabrication, mechanical reproduction, record, cutting machines, laser cutter, vector graphics, music, sound synthesis, turntablism, Moholy-Nagy

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INTRODUCTION
In this presentation, we would like to examine the role of mechanical reproduction in music at the age of personal fabrication by taking an example from our recent project "cutting record - a record without (or with) prior acoustic information".

,ÄúI 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 Ritchriftreihen (etched grooves).,Äù [Moholy-Nagy, 1923]

In 1923, LaÃÅszloÃÅ Moholy-Nagy, master at the bauhaus, proposed to produce a record without prior acoustic information. In the essay, he has listed four possibilities of the record that reshape our previous thoughts of music,

1: A generalized instrument which renders all former instruments.

2: The development of a new mechanical harmony in which one can examine the graphic signs and relate their proportions to a rule.

3: The composer himself can create his composition, ready for reproduction, on the record.

4: The introduction of this system during musical performances to allow independence from large-scale orchestral enterprises.

At the moment, it was just a provocative idea, however, after nine decades, we realized the idea with a help of standard vector graphics software (e.g. Adobe Illustrator) and cutting machines (e.g. laser cutter, paper cutter). Instead of using a stylus and a vibration from recorded sound, we generate a graphical waveform as a computational vector line, and engrave the form as a continuous groove on a surface of diverse materials includes paper, acrylic, and wood. The result literally is not a record because of its lack of original sound, however it could be played as a monophonic record in a same manner as its ancestor with a standard record player. In following section, we will describe our achievements according to the four possibilities.

ACHIEVEMENTS
1: A generalized instrument
In addition to the record without prior acoustic information (i.e. lack of original sound), we also develop a way to produce a record with prior acoustic information [Jo, 2013a]. By converting a digital audio data into a vector graphic form and transform the form into a locked groove (i.e. concentric circle) or a spiral groove by codes (we use Sound eXchange, gnuplot, and processing for the purpose), we could reach to produce universal sounds. Theoretically, any digitized audio stream could be rendered in a form of record though we have a limitation for the sampling frequency of the original data

because of the spatial resolution of cutting machines (i.e. roughly, 8000Hz for laser cutter, 2000Hz for paper cutter). A detailed technical description is available in another paper [Jo, Ando, 2013]

2: The development of a new mechanical harmony
A reconfigurable record could be made by splitting a circle into a collection of arcs by laser cutter. We have etched a different graphical form (i.e. different sound) in each arc. People could arrange the order of the arcs on a record player like a puzzle [Fig. puzzle.png]. Each graphical arrangement results in a unique beat and groove like a step sequencer.

3: The composer himself can create his composition
We have lots of selection in vector graphics software from proprietary (e.g. Adobe Illustrator) to open source (e.g. Inkscape). In hardware, still a laser cutter would be a costly tool, the alternative, a paper cutter is relatively cheaper than the laser (around 1:100). These conditions offer a possibility to produce her/his own music by their hands with a few help (e.g. instructions) of professional. We have conducted a workshop with undergraduate level design students (cutting record workshop, sadi: samsung art and design institute, July, 2013). In the workshop, most of them have a skill to use a standard vector graphics software (i.e. Adobe Illustrator), however, few of them have an experience and knowledge in cutting machines and analog record. Through the workshop, we offer a step-by-step instruction for a making process [Jo, 2013b], and provide paper cutters and record players for their use. With the environment, every of the students could produce her/his own paper record within 2 hours.  At the last of the workshop, we also have a DJ party to play with their music in back to back style.

4: The introduction of this system during musical performances.
We present a making process of the record in a form of performance (http://www.youtube.com/watch?v=vbCLe06P7j0). At the performance, we firstly show a set of actions to draw a waveform with vector graphic software, and then cut the waveform with a paper cutter. After that, we play the result with a record player and record the sound with an audio editing software (i.e. Audacity). The recorded sound is converted into a graphical form and reproduced from the paper cutter. At the last of the performance, we play a record with prior acoustic information from a record without prior acoustic information. We're not sure if our presentation correctly fit which Moholy-Nagy predicted or not, however, the introduction of our way shows another style of laptop music (instead of live coding) for the audience.

SUSPICION
Our practice combines the current personal fabrication tools (i.e. vector graphics software, cutting machines) and the mature audio technologies (i.e. analog record) to provide a way to think the new and the old in parallel lines [Huhtamo, Parikka, 2011]. With the outcome, we could suspect the role of "reproduction" in music from a range of fields.

Jacques Attali predicts that music will become a network of composition where people actively participate in music-as-process [Attali, 1985]. As a successor of repetition, representation, and sacrifice, people will perform music for their own pleasure. "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". This statement clearly correlates with the consequence of our workshop where people create and perform their own record (i.e. music) for themselves. At the workshop, people attach greater importance to create something that they've never create before in the manner of what Boden proposed

as psychological creativity (p-creativity) [Boden, 1991], and the general quality (e.g. sampling frequency, S/N: signal-noise ratio) is of secondary importance.

From a point of sound synthesis [Roads, 1996], our approach shows another way to generate the base of additive synthesis (i.e. sine wave) without a help of electric circuit. When we have a vectorized smooth zigzag form along to a circle [Fig. zigzag.jpg], the result could be played as a sine wave. If we have 100 zigzags in a locked groove, we could have 55Hz sine wave in 33rpm and 75Hz in 45rpm (number of zigzag / (60sec / rpm)).

In addition to turntablism [Snapper, 2004], our approach of puzzled record acting as a step sequencer provides a further opportunity for a record player in the role of instrument for musical performance.
By cutting a groove into a collection of arcs with different sound, and switching the order of arcs through a performance with several turntables, we might could reach alternative style of DJ music like the cheap bass/drum machine (i.e. TB- 303/TR-808) caused the birth of Techno music, and the over quality turntable produced Hip-hop [Blashill, 2002].

In the last century, ‚ÄúWe would become practiced in selecting what we wanted to hear, but not practiced in producing stuff for others to hear,Äù [Lessig, 2008]. With our practice, we would like to examine how could we (FabLab, personal fabrication, etc.) change the music by reviving people to do not just ‚Äúlisten‚Äù music but also ‚Äúcut‚Äù their own music.

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