

Rasping Music: Remodeling Early Minimalist Music through Mechatronic Sound-Sculpture

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ABSTRACT

This paper presents Rasping Music: an audiovisual composition in which one of the early instances of Minimalist composition, that is Steve Reich's Clapping Music, is remodeled and transcribed for a set of four mechatronic sound-sculptures, designed and developed by the first author. After a brief overview of the Minimalist movement and its musical depiction, the sound-sculptures are introduced and the Minimalist ideas behind their design are noted. Then, following a discussion on Steve Reich's pulse-based compositions, the compositional strategies and techniques in the realization of Rasping Music are presented in detail.

1. INTRODUCTION

According to Edward Strickland, “in its simplest definition, Minimalism is a style distinguished by severity of means, clarity of form, and simplicity of structure and texture” [1]. The term was initially applied to a movement in visual arts in which the artist’s tendency, as Kenneth Baker argues, was to “present as art things that are – or were when first exhibited – indistinguishable ... from raw materials or found objects, that is, minimally differentiated from mere non-art stuff” [2]. In the words of Keith Potter, Minimalist art “experimented with the limits of art by asking how many of the elements traditionally associated with it could be taken away to leave something which could still be considered art” [3]. Strickland argues that Minimalism is a form of art that “makes its statement with limited resources”, is “prone to stasis”, and “resistant to development” [1]. In this way, he states that in a musical context, Minimalism is manifested as repetitive modules, static harmonies, drones, and silences. In his article “What is Minimalism Really About?”, Tom Johnson’s immediate response to this question is: “it has a lot to do with repetition” [4]. Summarizing Johnson’s article, Potter cites “repetition”, “tiny variations”, “hyper clarity”, and “making music less dramatic” as chief attributes of Minimal music [3]. Although repetition is a “basic structural components of all forms of classical music”, as Strickland remarks, in Minimal music, it is implemented in an “overt and imme-

diately audible” manner, and is the predominant structural principle [1]. According to Potter, “by selecting some of the oldest and most familiar building blocks of music, and subjecting them to the radical scrutiny afforded by remorseless repetition, [Minimalism] takes on the challenge of revitalizing the most hackneyed and debased musical currency available” [3].

This Minimalist line of thought instigated the design of a mechatronic sound-sculpture entitled *Rasper*, in which a noisy electromechanical apparatus is transformed into a medium for sonic expression, primarily through rhythmic regulation. The next section introduces *Rasper* and discusses some of its key design features. Then, following a brief overview of the pivotal role of rhythmic pulse in the music of Steve Reich in Section 3, Section 4 introduces *Rasping Music*: an audiovisual composition inspired by Reich’s *Clapping Music* composed for four units of *Rasper*.

2. RASPER



Figure 1. Four units of *Rasper*

Designed and developed by the first author, *Rasper* is a mechatronic sound-sculpture, created in an effort to highlight the potential aesthetics of some mundane aural and visual phenomena characterizing urban technological life. In this sound-sculpture, electromechanical components such as DC motors and actuators are removed from their everyday context, in which they are tools to help run our machines and their sound is just an unwanted byproduct, and used as a

source for sonic expression. Using microcontroller programming, their sonic output is regulated rhythmically and timbrally, and therefore, brought back to the domain of aural attention. Contrary to their everyday location (i.e. hidden inside the machines), *Rasper* presents them in transparent sculpture forms, in a fully visible, bare, and reductionist manner, with minimal modification. Fluorescent lighting is used here, not only to highlight the bodily existence of the mechatronic components, but also as an aesthetic element itself, widely considered, as it is, dull and uninteresting.

2.1 Sound-generating Mechanism

The sound-generating unit of *Rasper* is comprised of a DC motor with a 3D-printed disk attached to it, and a push solenoid with a piece of spring steel mounted on its shaft. When the solenoid pushes out and the sharp edge of the spring steel with the rotating disk, the vibration and surface friction between the two components creates the “rasping” sound. The figure below illustrates the sound-generating unit.



Figure 2. *Rasper*: sound-generating unit

2.2 System overview

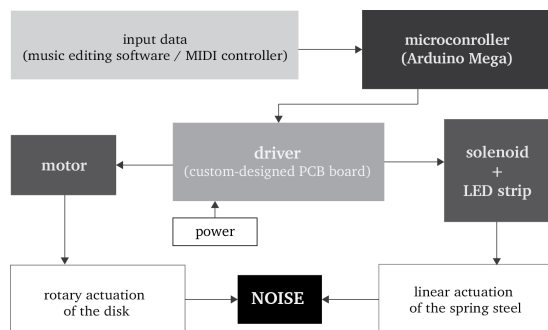


Figure 3. *Rasper*: system overview

As detailed in Figure 3, *Rasper* is driven using a custom-designed driver board and the communication is accomplished using MIDI messages. Two separate MIDI messages are required to drive the instrument, one corresponding to the motor, and one to the solenoid. For the solenoid inputs, a MIDI note-on pushes the solenoid out and creates the contact between the spring steel and the disk, and for the motor inputs, the MIDI velocity value of the corresponding MIDI message is used to control the speed of rotation. In this manner, the rhythmic behavior of the sonic output is determined by the solenoid input, whereas motor inputs are used

to modulate the timbre of the resulting sound. The light element is an LED strip, and is driven using the same signal that drives the solenoid. Therefore, synchronous bursts of light accompany every single aural pulse and rhythmic pattern, tightening the audiovisual expressivity of the output.

Rasper's use of mechatronics and microcontroller programming makes it perfectly capable of creating recurring motions and pulse-based patterns. In fact, the rhythmic regulation is the primary factor through which the noise of the mechanical components is modified in relation to their everyday state. Regardless of the instrument's Minimalistic aesthetic in terms of design, this minimally sonic alteration (that is at heart of its sonic output) calls for its employment in a Minimalist compositional setting. With this in mind, the significant role of pulse in the Minimalist music of Reich, made his work of special interest for this context, inspiring the structure of the first piece composed for *Rasper*. For more information on *Rasper* see [5], and for more photos and video documentation visit <http://www.m-h-z.net/rasper>.

3. REICH, PULSE MUSIC, AND PHASING

La Monte Young, Terry Riley, Philip Glass, and Steve Reich are widely known as the founding fathers of Minimal music. Regardless of the complexity and richness difference between their early and recent works, Potter points out that all four composers have been “continuing to activate their music with the crucial ingredient of repetition – or in Young’s case, more often sustained sounds” [3]. According to Michael Nyman, “Riley’s major achievement has been the installation of regular pulse into experimental music” [6]. Reliance on repetition is, however, even more significant in Reich’s work. In fact, in an interview with Nyman, Reich stated that he preferred the term ‘pulse music’ to Minimal music [7]. As Potter notes “pulse-dominated percussion-based music had in fact fascinated him since he was a child” [3]. Repetition, according to Nyman, “is a local device by which Reich realizes his concept of ‘music as a gradual process’”.

In his article ‘Music as a Gradual Process’, Reich expresses his intentions on creating a piece of music that is “literally” a process [8]. His early tape works such as *It’s Gonna Rain* and *Come Out* that are entirely based on phasing effects, explicitly manifest his approach:

In the process of trying to line up two identical tape loops in some particular relationship, I discovered that the most interesting music of all was made by simply lining the loops up in unison, and letting them slowly shift out of phase with each other. As I listened to this gradual phase shifting process I began to realize that it was an extraordinary form of musical structure [8].

As Potter explains, “Reich’s discovery of phasing in fact has much in common with Cageian musical practice ... [in that it has] its roots in the observation of a process happening independently of its composer’s conscious control” [3].

However, as Reich argues himself, Cage’s processes were solely compositional and not audible, whereas for him, being able to “hear the process throughout the sounding music” is key [8].

Rhythmic repetition underscores all of Reich’s works since *It’s Gonna Rain*. Starting with *Its Gonna Rain*, the use of the gradual phase shifting process continued “in every piece from 1965 through *Drumming* in 1971, with the exception of *Four Organs*” and was finally ended in late 1971 with *Clapping Music* [8]. Mentioning the pivotal role of hand clapping in a typical African ensemble, Potter refers to this piece as one of the instances of the African music influence in Reich’s work.

Clapping Music was written for two pairs of hands of two performers, one of which clapped a basic rhythmic pattern repeatedly, as the other shifted the downbeat to the succeeding beat after a number of repeats. On this piece he writes:

The basic difference between these sudden changes [in *Clapping Music*] and the gradual changes of phase in other pieces is that when phasing one can hear the same pattern moving away from itself with the down-beats of both parts separating further and further apart, while the sudden changes here create the sensation of a series of variations of two different patterns with their downbeats coinciding. In *Clapping Music* it can be difficult to hear that the second performer is in fact always playing the same original pattern as the first performer, though starting in different places” [8].

As Potter remarks, “even in a simple piece such as this, audibility of process is relegated in favor of its broader rhythmic consequences” [3]. The reliance on rhythmic repetition and the high degree of variety and complexity derived from a basic unit achieved in *Clapping Music*, in addition to its non-existing melodic material and minimal involvement of timbral change, made it an inspiring model for a new piece composed for *Rasper*.

4. RASPING MUSIC



Figure 4. *Rasing Music*: debut realization at Sonic Arts and Engineering Expo (October 2013).

Rasing Music is a composition based on phasing rhythms. Similar to Reich’s work, the entire piece is a process in which various potentials of a simple rhythmic unit are ex-

plored and experienced by applying it to four *Raspers*, by shifting the downbeat of one at a time. The rhythmic competence of *Rasper* in addition to its programmability, make it perfectly capable of following any desirable rhythmic pattern and shifting the downbeat flawlessly whenever required. Nevertheless, despite the wide rhythmic capabilities of the instrument, the initial rhythmic units written for this piece are intentionally composed as simple and basic 4/4 patterns. This is done in an attempt to comply with the Minimalist ideology influencing the composition, in which sophisticated results are achieved gradually through a process that is a rigorous exhaustion of the minimal compositional material employed by the composer.

The piece is comprised of three sections, each starting with a different rhythmic unit as the initial pattern. Four *Raspers* have been used in order to achieve a wider variety of interlocking patterns. During each section, all four *Raspers* start with the same rhythmic pattern and after every four bars of repetition the downbeat of one of them is shifted forward, except for one, which keeps the original downbeat throughout each section. In each section, shifting downbeats and the morphing of the interlocking patterns continue to the point that the downbeat of one of the three phasing *Raspers* is switched back to the original position. Then, as the instrument keeping the original downbeat starts following the next rhythmic unit, the other three also move to the new section one at a time, every four measures. Figure 5 demonstrates the initial rhythmic unit of each section in order of appearance in the piece.

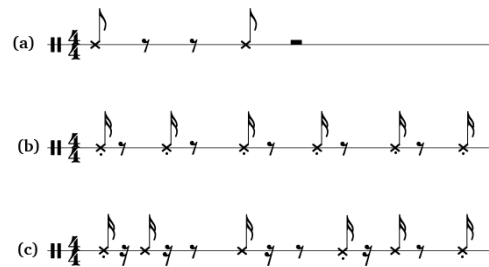


Figure 5. *Rasing Music*: rhythmic units

As can be seen in this figure, the degree of rhythmic complexity increases with each succeeding section. The first section starts with the very simple pattern, in order to make it easier for the audience to notice the phasing process. After four measures of all instruments repeating this pattern, the phase shifting is accomplished according to the following steps that are implemented every four measures (see Figure 6):

1. The downbeat of one *Rasper* is shifted forward by an 8th note.
2. The downbeat of the second *Rasper* is shifted by another 8th note in relation to the last step.
3. The downbeat of the third *Rasper* is shifted by another 8th note in relation to the last step.
4. The downbeat of the first *Rasper* is shifted again by an 8th note in relation to the last step.

As the fourth *Rasper* holds on to the original downbeat, this algorithm continues until one of the *Raspers* has cycled through the whole bar and reached the original downbeat again. This way, a variety of different interlocking rhythms that are all derived from the original pattern are experienced, as the piece moves into the second section.

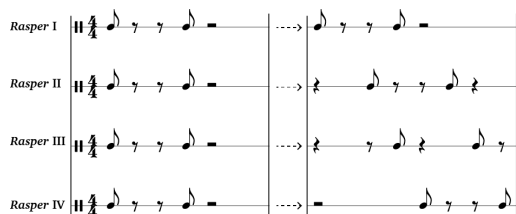


Figure 6. Development of Section One

The development of the second section is based on the same criteria as the first section and the only difference is the relatively more complex rhythmic unit. In the third section however, the phasing is accomplished by shifting the downbeats by a 16th note instead of an 8th note. This opens up the chance for creating more interlocking and morphing patterns and raises the rhythmic complexity of the work as the piece moves towards the end. By the end of section three, all *Raspers* move back to the beginning of the section one, one at a time, and once in-sync, repeat the initial pattern for four measures and finally end on the same simple and synchronized rhythmic state in which the piece started.

The patterns are programmed in Ableton Live and in the form of MIDI clips, and phase shifting is accomplished by adjusting the Start Markers of the clips. MIDI velocity values of 127 are sent to the solenoids to create the pulses. In order to narrow down the focus on the phasing process, motor speeds are kept constant by applying MIDI velocity values of 100 to the motors throughout the entire piece.

Rasping Music has been realized both as installation and performance. In the installation setting, the piece cycles back when it reaches the end of the third section. As a performance, the piece has been performed at the Wellington City Gallery as part of the Sound Full festival, and the Adam Concert Room in the Composer Competition 2014, winning the 3rd composition prize of the competition. As an installation, the piece was premiered at the Sonic Arts and Engineering Expo in October 2013 at Victoria University. It was also featured in Wellington Lux 2014 international festival as a ten-day long exhibition in Wellington city public space¹.

5. CONCLUSION

Minimalist music shares two major common features with the ideas behind creation of *Rasper*. On one hand, “its focus on sensations based on the direct perception of object forces [its audience] to a radical reconsideration of those objects”

¹ Video documentation of *Rasping Music* available at: <http://vimeo.com/114283575> and <http://vimeo.com/91393656>.

[3]. Where the object is a physical *sound-object*, *Rasper*’s focus on the trivial noises of urban technological life and its effort to aestheticize them represents an analogous approach. Second, the rigorous structural incorporation of repetition in Minimal music can be interpreted as an equivalent of the reliance on the pulse-based rhythmic structure in *Rasper*’s sonic output. With this in mind, *Rasping Music* uses modern technologies to remodel a classic Minimalist composition, and in doing so, it adheres to the minimalist guidelines both ethically and aesthetically.

The Minimalist approach in *Rasping Music* can be in fact compared to the one employed in works that over the decade have been identified with Microsound, Glitch, or Minimal-click. Since the final years of the previous century and with the advancement in digital technologies, the number musicians and artists who focus on the sonic artifacts of the digital realm as their primary sound-palette has grown. In a substantial number of these works, basic sonic byproducts of digital technologies (i.e. clicks, cuts, and glitches) are recycled and aestheticized using minimalist formal and structural elements. With this in mind, and considering the recent developments in the areas of kinetic sound art and mechatronic sound-sculpture, *Rasping Music* build-upon a minimalist scaffold in highlighting the potential aesthetics of technological sonic byproducts of the physical realm, where the *glitch* is created physically and mechanically.

The evolution of music is comparable to the multiplication of machines.

—Luigi Russolo

6. REFERENCES

- [1] E. Strickland, *Minimalism: Origins*, 2nd edition. Bloomington: Indiana University Press, 2000.
- [2] K. Baker, *Minimalism: Art of Circumstance*, 1st edition. New York: Abbeville Press, 1988.
- [3] K. Potter, *Four Musical Minimalists: La Monte Young, Terry Riley, Steve Reich, Philip Glass*, 1st edition. Cambridge, UK; New York: Cambridge University Press, 2002.
- [4] T. Johnson, *The Voice of New Music: New York City, 1972-1982: A Collection of Articles Originally Published in the Village Voice by Tom Johnson*. Eindhoven, Netherlands: Het Apollohuis, 1989.
- [5] M. H. Zareei, D. A. Carnegie, and A. Kapur, “Rasper: a Mechatronic Noise-intoner,” in *Proceedings of the International Conference on New Interfaces for Musical Expression (NIME)*, London, UK, 2014, pp. 473–478.
- [6] M. Nyman, *Experimental Music: Cage and Beyond*, 2nd edition. Cambridge; New York: Cambridge University Press, 1999.
- [7] M. Nyman, H. Davis, and R. Orton, “Steve Reich: an Interview with Michael Nyman,” *The Musical Times*, no. 112/1537, pp. 229–231, Mar-1971.
- [8] S. Reich, *Steve Reich: Writings About Music*. Halifax; New York: Art Metropole, 1974.