

# Augmented Reality Interface for Electronic Music Performance

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## ABSTRACT

Starting from the days of the Musical Telegraph, the first electronic instrument, the majority of synthesizers today are still equipped with keyboards, often using the traditional layout of acoustic pianos. The question that many researchers attempt to answer is that of improvement. In this paper we present an Augmented Groove, a novel musical instrument that attempts to depart from traditional approaches to musical performance, i.e. use keyboards, dials or simulated traditional musical controllers. It allows novices to play electronic musical compositions, interactively remixing and modulating their elements, by manipulating simple physical objects.

## 1. INTRODUCTION

With every technological leap musicians and engineers have been creating new ways to make and play music. This quest has resulted in today's electronic musical instruments, e.g. sound samplers and synthesizers, which opened unprecedented opportunities for musical expression and creativity. Firstly, they allow musicians to synthesize virtually any sound even those that can not be produced naturally, expanding their musical vocabulary. Secondly, musicians can create a composition without just having to use traditional instruments. Today's electronic musical compositions are assembled out of hundreds of looped samples and MIDI sequences, modulated with filters, then sequenced and played back from a computer (Rule, 1999). Therefore, the proficiency in traditional musical instruments is no longer a necessary prerequisite for creative musical expression.



Figure 1: Two users are playing music in Augmented Groove: the insert shows the view on the projector screen

While the way music is *made* has changed significantly, the way it is *played* has not. Most of the synthesizers are still equipped with piano keyboards and arrays of buttons and dials. These controllers are neither easy nor enjoyable to use especially for the novice. Currently, we are not aware of any effective musical controllers that would allow the novice to control electronic music as performance, the only option being is simple playback after composition.

This paper presents an Augmented Groove – a musical controller that allows a novice to interactively and collaboratively perform electronic music. We define performance of electronic music as the ability to interactively *remix and modulate elements of musical compositions* created by the composer. The resulted controller is easy and enjoyable to use for novices.

## 2. RELATED WORK

Recently there has been a significant growth of interest in alternative musical interfaces and controllers (comprehensive surveys in Cutler, Robair, and Bean, 2000; Paradiso, 1997). While some of the new controllers borrow from traditional ways to play music, such as simulating wind instruments or tracking a conductor’s baton waved by the user, others completely depart from traditional approaches in search for new methods of artistic expression. Electromagnetic fields, digital pens, touch sensors, data gloves, body posture, soft toys, streaming water and other techniques have been used to interactively control musical performances. Many of these interfaces, e.g. the Digital Baton (Marrin and Paradiso, 1997), allow control of global musical parameters, such as tempo, which inhibits refined musical control, such as adjusting or modulation of single elements of the composition.. At the same time other interfaces, provide control at a too refined level, e.g. control of individual note progression, which makes them as difficult to use as traditional instruments. Finally, many of controllers, e.g. Dance Space , are not designed to be precise and repeatable, focusing instead on “computer-supported improvisation”.

## 3. AUGMENTED GROOVE

In Augmented Groove the musical performance is constructed from a collection of short looped musical phrases, or loops, each carefully composed to fit others so they can be interactively re-mixed. For each individual loop or group of loops a composer can assign filters and effects, to allow the user the ability to modulate musical elements, the range of these modulations, however, is set by the composer to ensure a high quality of performance. Hence, this model targets mostly modern electronic music, which tends to be composed in a very similar fashion (Rule, 1999).

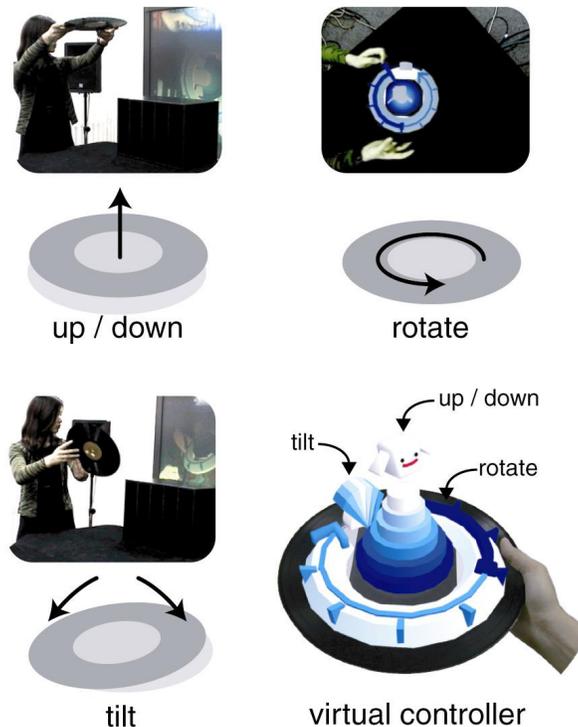


Figure 2: Gestural musical interface in Augmented Groove

During performance<sup>1</sup> the user plays music by physically manipulating simple LP records outfitted with a fiducial markers (Figure 1, 3) and tracked by an overhead camera (Billighurst, Poupyrev, Kato, and May, 2000; Kato and Billighurst, 1999). To start the phrase playing the user simply flips the record so that the overhead camera can identify its fiducial marker. The system then start playing the corresponding musical sequence. The user can modulate the musical sequence by translating the record up and down, and by rotating and tilting it (Figure 2). The 3D motions of the record are mapped to corresponding modulations, e.g. pitch, distortion, amplitude, filter cut-off frequency, delay mix, etc. More control gestures as well as more complex mappings can be easily added for experienced users. Since the system tracks and recognizes several records at the same time, performers can play several musical phrases simultaneously and collaboratively (Figure 1). Thus, records serve both as physical *musical containers*, grouping together elements of composition, and *tangible 3D controllers*, that allow to interactive modulation, mix and fading between musical phrases.

Augmented Groove is a mixed reality (MR) interface: 3D virtual controllers are overlaid on top of the records providing the user with instant feedback on the state and progression of musical performance. For each control dimension a corresponding graphical element changes depending on the value of the control (Figure 2). For example, as the user raises the record a pyramid in the middle of the overlaid virtual controller (Figure 2) also goes up and when the musical control reaches its limit a small animated character pops up cuing the user. Although virtual controls are not absolutely necessary to control music since the user can hear musical changes, they are important cue for novice users, explaining the interface, visualizing the performance and making the system easier and more enjoyable.

#### 4. INITIAL USER FEEDBACK

Evaluating musical instruments in controlled user studies is difficult (Roads, 1995) because it strongly depends on a user personal preferences. We informally assessed Augmented Groove by collecting informal user feedback during a demonstration at the SIGGRAPH 2000 Emerging Technologies exhibition<sup>1</sup> (Poupyrev, Berry, Kurumisawa, Nakao, Billighurst, et al., 2000) which allowed visitors to play musical compositions, using three records, i.e. elements of three tracks could be mixed and modulated at the same time (Figure 3).



Figure 3: A Siggraph visitor playing Augmented Groove

We observed that Augmented Groove was enjoyable to use and that visitors were able to effectively control musical performance. Even with three records, there was a large range of possible musical variations, providing room for creativity and exploration: “I can play with this for hours,” noted several visitors and a number returned several times with friends and colleagues. We noted that without *any* instructions, visitors had difficulty understanding the interface, however a short explanation was usually sufficient for a user to be able to effectively control a musical

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<sup>1</sup> Video figures are available at <http://www.mic.atr.co.jp/sspace/> or <http://www.csl.sony.co.jp/~poup/research/agroove/>

performance. Overall, Augmented Groove was highly rated by visitors as fun, enjoyable and creative. The biggest complaint was latency of computer vision tracking system.

## 5. CONCLUSIONS AND FUTURE WORK

Augmented Groove is a simple, unobtrusive MR interface that allows users to interactively control and modulate electronic musical performance. Although we focused on providing a novice user with an enjoyable and easy to use tool, we have been developing it with a professional electronic musical performer in mind. In future, we are planning to re-design the interface for real musical performances. Technical and interface issues will be addressed, such as lag, physical designs of records, new complex mappings and dynamic gestures.

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