Echoic Defiance of Gravity

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Echoic Defiance of Gravity is an audiovisual live performance utilizing a virtual instrument based on bouncing ball simulations. The system maps the balls' motion within boxes to MIDI events, influencing both visuals and sound in real time. Each box corresponds to a musical note, and note triggers are determined by the ball's collisions, combining fixed tonal elements with stochastic behavior. Performers can adjust parameters like gravity during performance, affecting both domains. The work explores simulation-based algorithmic composition and aims to highlight the instrument's expressive range through various configurations.

Additional Key Words and Phrases: MIDI event remapper, algorithmic composition, echo, delay, visual music, audiovisual instrument, cross-modal experience, simulation, ball simulation, particle simulation, gravity

1 Program Notes

Echoic Defiance of Gravity is a visual music piece featuring *Bouncy Echo*—a virtual "audiovisual" instrument based on a computer simulation of the motion of bouncing balls, showcasing its potential as a versatile, expressive tool for real-time music performance. Here, the simulation not only governs the motion of the balls in the visual domain but also determines the musical outcome of the piece in the auditory domain, thereby providing a unique cross-modal experience for both the audience and the performer.

In addition to the fact that this piece may invoke intriguing discussions in terms of simulation-based algorithmic composition, it is especially noteworthy that it is a unique amalgamation of a fixed, deterministic set of musical notes and partly uncertain, indeterministic follow-ups generated by computer simulation in the visual domain. Although the exact time and the frequency of occurrence of musical events are chance-based and effectively random, they are perfectly relevant to the motion of the ball presented simultaneously.

Regarding the musical organization of the piece, the artists focus on exploring a wide range of parameter combinations, keep evaluating the musical versatility of the system employed, and hope to bring more unique outcomes to the stage at the conference than those featured in the accompanying video.

2 Project Description

As briefly mentioned above, *Echoic Defiance of Gravity* features a virtual audiovisual instrument powered by computer simulation of a simple everyday phenomenon. More specifically, it utilizes *Bouncy Echo*, a MIDI event remapper based on the result of a set of multiple independent simulations of a bouncing ball inside a "box" (i.e., a two-dimensional rectangle).

Figure 1 shows the screenshot of *Bouncy Echo* in its initial condition. Here, each box corresponds to a musical note. While the current setup consists of 36 boxes that cover three octaves of musical notes, i.e., from C2 (lower left corner) to B4 (upper right corner), the overall layout and the individual note assignments can be easily reconfigured,

As the performer triggers the motion of each ball in a box in real time via MIDI Note On messages, every subsequent bounce of the ball determines the characteristics of the onset of the corresponding musical note. Eventually, the Note On messages are transmitted to the sound source (e.g., virtual instruments running on Apple Logic or Ableton Live) via MIDI connections. The performer can also modify selected parameters for the simulation of the bouncing balls during the performance in real-time, including the existence/amount of (virtual) gravity, to modify not only the visual result of the simulation but also its musical outcome.

In addition, regarding the simulation, *Bouncy Echo* controls not only the balls but also the size of the boxes that contain the balls. Figure 2 and Figure 3 present more screenshots of *Bouncy Echo* in action during the performance.

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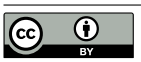

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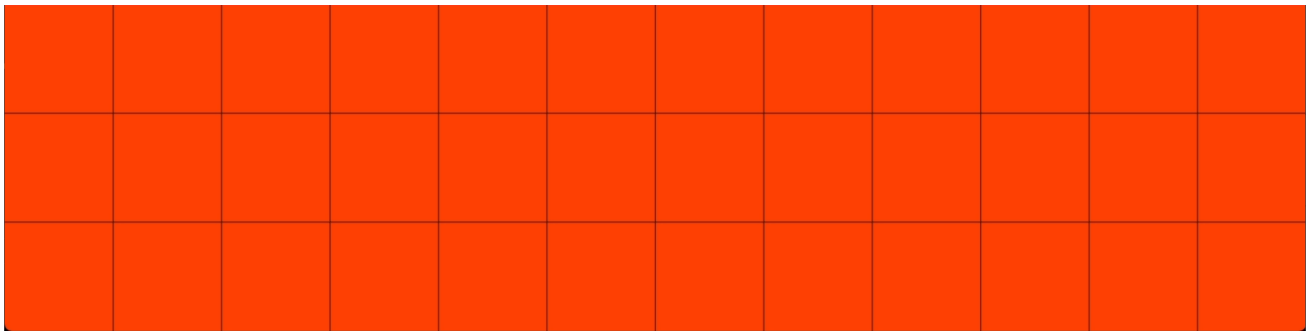

Fig. 1. A screenshot of the *Bouncy Echo* in the initial condition.

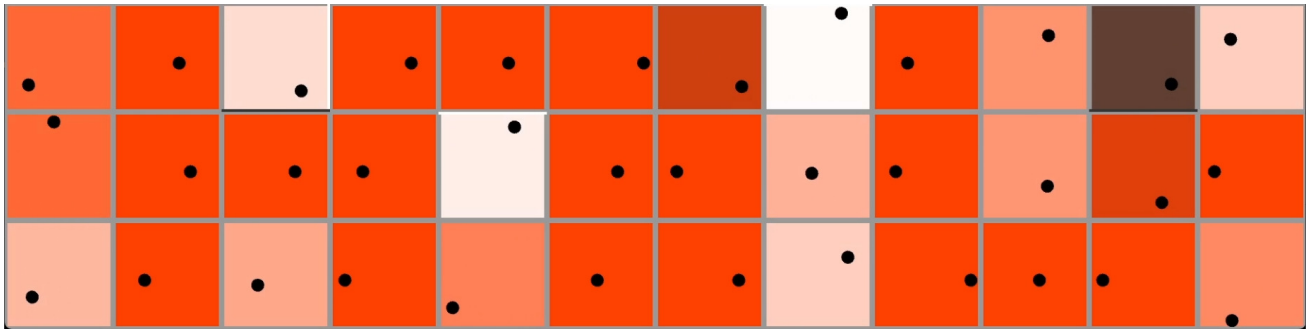

Fig. 2. A screenshot of the *Bouncy Echo* with bouncing balls.

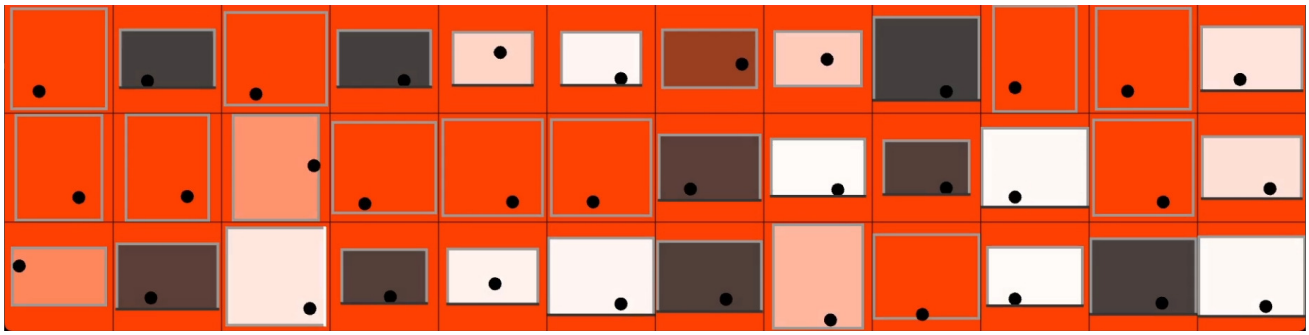

Fig. 3. A screenshot of the *Bouncy Echo* with the boxes changing in size.

3 Technical Notes

The system for *Echoic Defiance of Gravity* consists of the following:

- visual display: a TV or a video projector with a (wall-projected) screen, supporting at least full-HD resolution (i.e., 1920 x 1080).
- sound output: an audio system to support stereo output (via two 1/4" TRS plugs)
- a MIDI keyboard for on-stage performance — prepared by the performer
- a computer (Macintosh laptop) and an audio interface for media processing — prepared by the performer

As an audiovisual piece, *Echoic Defiance of Gravity* requires a video display, as well as an audio system with stereo output. Otherwise, its overall venue requirement is highly flexible.

4 Ethical Standards / Acknowledgements

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