Life Game Orchestra as an Interactive Music Composition System Translating Cellular Patterns of Automata into Musical Scales

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Abstract

We developed a system called Life Game Orchestra that generates music by translating cellular patterns of Conway's Game of Life into musical scales. A performer can compose music by controlling varying cell patterns and sounds with visual and auditory fun. A performer assigns the elements of tone to two-dimensional cell patterns in the matrix of the Game of Life. Our system searches defined cell patterns in the varying matrix dynamically. If the patterns are matched, corresponding tones are generated. A performer can make cells in the matrix by moving in front of a camera and interactively influencing the generation of music. The progress of the Game of Life is controlled with a clock defined by the performer to configure the groove of the music. By running multiple matrices with different pattern mapping, clock timing, and instruments, we can perform an ensemble. The Life Game Orchestra is a fusion system of the design of a performer and the emergence of cellular automata as a complex system.

Keywords: Conway's Game of Life, Cellular automata, Cell pattern, scale, Interactive composition, performance.

1. Introduction

Various music composition trials using cellular automata have been studied, for example, by applying cell states to pitch, duration, timbre, etc. [1,2]. Recently, as Internet technology advances, we can find such composition systems developed on websites such as WolframTones [3], CAMUS [4], and glitchDS [5].

In this paper, we propose a music composition system using cellular automata known as Conway's Game of Life. We note that the Game of Life works by local state transition rules but is macroscopically recognized as sets of two-dimensional cell patterns. Additionally, the Game of Life is interesting for observers because of the typical moving cell patterns such as blinkers and gliders. Consequently, we used small cell patterns in the matrix as the trigger for tone generation, enabling a performer to compose musical elements such as scales, harmony, timing, instruments, etc. Therefore, we achieved the fusion of the emergence seen in the Game of Life and intentional music composition by performers. Our system is called Life Game Orchestra, which is shown on our website [6].

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2. Method

2.1 System Overview

Our system is configured on a PC, camera, speaker, screen, projector, and Max/MSP/Jitter software (see Figure 1). We used the jit.conway object of Jitter, which calculates Conway's Game of Life. In advance, a performer sets music composition parameters such as the mapping of cell patterns on a scale and beat timing. After setting, the performer moves or dances in front of a camera capturing his/her motion to send the data to a PC. Next, motion data are transformed into cells and added to the progressing matrix of the Game of Life. The cells progress under the state transition rules of the Game of Life. Specific cell patterns are translated into the tone in the mapped scale and music is generated.

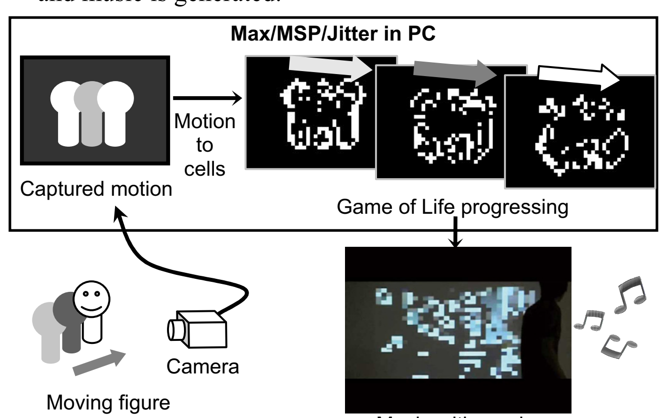

Figure 1. System configuration.

2.2 Mapping of Cell Patterns on a Scale

In the Game of Life, we frequently observe various moving cell patterns, which interfere with one another, expanding or shrinking chaotically and repeatedly. The state transition of the Game of Life is a deterministic model under local rules; however, it has an unpredictable and emergent property. Using cell patterns for music composition, visual emergent information is converted into music. In our system, we map some cell patterns on a musical scale. The system retrieves specified cell patterns in the current matrix. If cell patterns are matched, allocated tones are sounded. Unmapped patterns do not generate any sound.

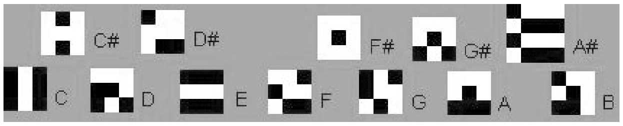

Figure 2. Examples of mapping of cell patterns on scales. Each mapping is designed for the C major.

The generated music depends on the mapping strategy, which is developed under the music composition skill of the performer. The combination of multiple tones produces consonance, dissonance, scales, modes, chords, and harmonies. A simple cell pattern, meanwhile, is easily generated, and a complex cell pattern is not. For example, we can design the mapped scale according to the occurrence ratio of cell patterns (see Figure 2). In this case, two patterns of blinkers are mapped on C and E, which are notes of the major third interval on C, and four patterns of gliders are mapped on D, F, G, and B, which are notes of the chord of G seventh. As a result, generated music has a tonality of C major. Consequently, the generated music is influenced by the progress of the Game of Life and the strategy of the performer, who is also the composer.

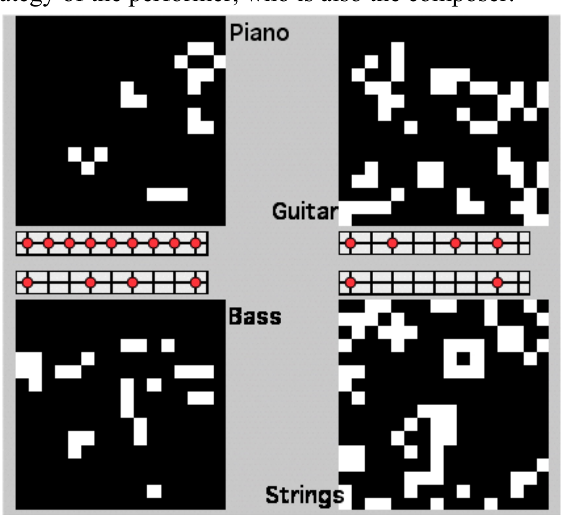

Figure 3. Four-part ensemble of Life Game Orchestra.

2.3 Ensemble of multiple parts

We can perform an ensemble by running multiple matrices simultaneously. Each matrix as an instrumental part has its own scale mapping and instrument (see Figure 3). The clock for the progress of the Game of Life is controlled by the matrixcontrol object of Max/MSP, which is shown as latticed rectangles with small circles in Figure 3. The horizontal direction means time and the small circles indicate the progress time of the matrix under the specified clock, which causes the formation of a rhythmical groove.

In an ensemble, we should select the instrument for each matrix in consideration of the occurrence ratio of cell patterns and the characteristics of the rhythm pattern. For instance, a part with a quick beat is suitable for percussive instruments such as the timpani and marimba, and another with a long duration time is suitable for bowing strings or for wind instruments such as the violin or clarinet. However, a performer can design freely the combination of instruments in the ensemble using his/her own concept. Moreover, instruments, noises, environmental sounds, and other sampling data are useful for unique composition.

3. Performance

As one of our concepts, everyone can enjoy a performance using an intuitive and simple interface. Therefore, in our system, a performer only physically moves before the camera for the performance, and enjoys the generated music with the auditory sense and projected movie of the Game of Life visually. Additionally, it means that a performer can interactively affect the music generation of the Game of Life, which has achieved interactive music composition. If a performer has a great knowledge of music composition, he/she can achieve highly refined music by designing the mapping of cell patterns. Meanwhile, if not, the performer can perform interesting music by physical motion with a setting designed in advance by any other composer.

4. Conclusion

In our system, we can generate a melody maintaining tonality by the mapping of simple cell patterns on harmonized tones. This generated music is synchronized with the progress of the Game of Life as well as with the emergence of cellular automata, music composition, and interactive performance.

We will develop other mapping methods for various musical elements besides scales because the mapping of cell patterns has interesting potential for music. Moreover, we will improve it visually using colored cells related to tones.

References

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