Melody Slot Machine III for Automatic Fingering Saxophone using Servomotors

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Abstract

Melody Slot Machine is a dial with the staves of music displayed on an iPad, which can be rotated to change the melody variations. The melody variations are generated on the basis of the AI-based melody-morphing method and can be partially switched to another variation without any significant change in the overall melody structure and with no musical breakdown. The microcomputer on the Automatic Fingering Saxophone receives the MIDI note from Melody Slot Machine and moves the servomotor so that the fingering corresponds to the note number.

1 Melody Slot Machine

Melody Slot Machine is a dial with the staves of music displayed on an iPad, which can be rotated to change the melody variations (Fig. 1). The melody variations are generated using a melody-morphing method [4] on the basis of the Generative Theory of Tonal Music (GTTM) (Fig. 2) [6]. The GTTM is used to analyze the musical structure to obtain a time-span tree. The melody variations in Melody Slot Machine can be partially switched to another variation without any significant change in the overall structure of the time-span tree and with no musical breakdown.

(a) Slot dial   (b) Pepper's ghost display

Figure 1: Melody Slot Machine

Previous time-span-tree analyzers [3] exhibited low performance because they analyzed in a bottom up manner using only local information. We have thus constructed deepGTTM, which introduces AI into GTTM analysis and dramatically improves the performance of time-span-tree analysis [5]. The GTTM is a compilation of musical knowledge gained from composer's experience. Thus, we have shown that a composer's musical knowledge can be learned using a deep neural network.

The original Melody Slot Machine was built in 2018 for introducing a melody-generation method based on GTTM, with a marimba piece composed by Mizuki Kobayashi and vocal and soprano saxophone piece composed by Kyoko Otagawa. The marimba piece was generated using a GTTM-based morphing method with two pieces as input: Horn Concerto No. 1 by Mozart and "La Gioconda" Dance of the Hours by Ponchieli. In the vocal and soprano saxophone piece, however, the melody
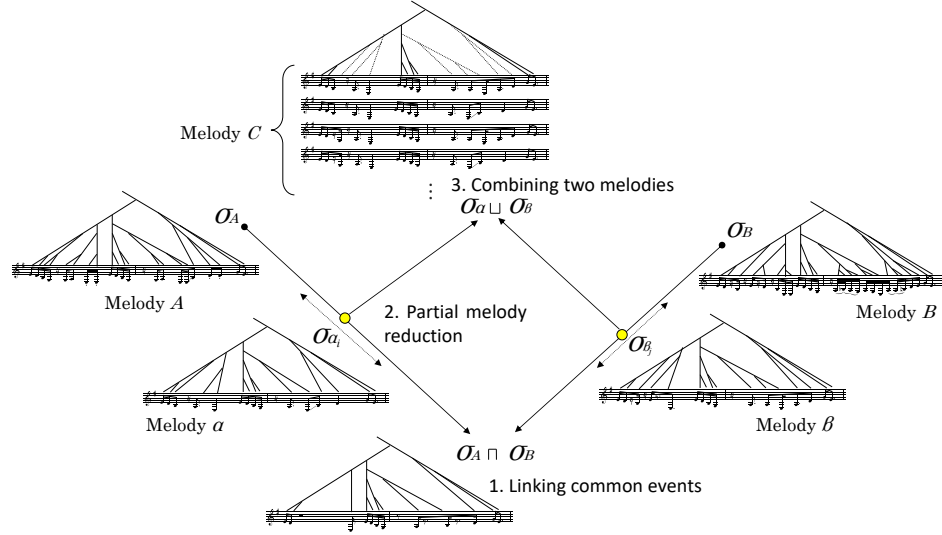
Figure 2: Melody-morphing method

for the vocal part is a morphed melody using La Campanella composed by Liszt, while the soprano saxophone part is a morphed melody composed by Otagawa. In our exhibit at NeurIPS 2019 Demonstrations, we used the marimba piece [1].

Melody Slot Machine II, built in 2023, used a vocal and soprano saxophone piece [2]. Two iPads were used to control each melody of vocal and soprano saxophone, and AI was used to detect the direction of the user's head on the basis of the facial image acquired with the iPad's front camera, and the volume of the part facing the direction of the head was increased. This makes it easier for even music novices to hear the melody of the part they are operating.

Melody Slot Machine III uses a microcomputer and servomotor attached to the saxophone to automatically perform the fingering of melodies with varying variations. The microcomputer receives the MIDI note on signal output from Melody Slot Machine III, and moves the servomotor so that the fingering corresponds to the note number. The keys of saxophone and servomotors are connected by wires. When the servomotor is moved and a wire is pulled, the key moves and the tone hole closes.

2 Automatic Fingering Saxophone

Automatic Fingering Saxophone uses a microcomputer and servomotor attached to a saxophone to automatically execute the fingering of melodies with various variations. The microcomputer receives the MIDI note on signal output from Melody Slot Machine and moves the servomotor so that the fingering corresponds to the note number (Fig. 3).
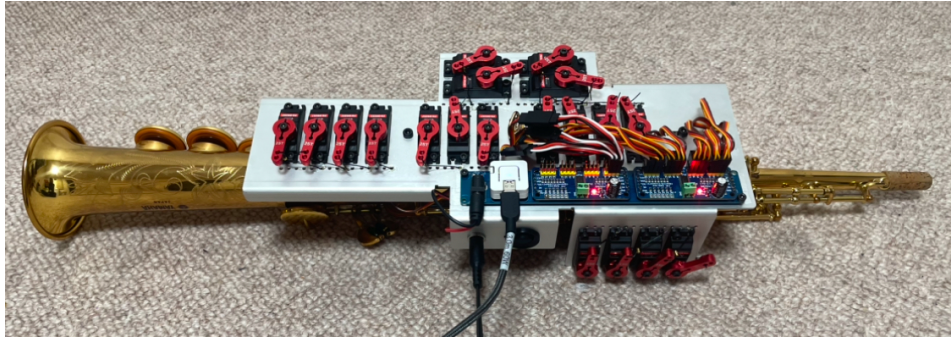

Figure 3: Soprano saxophone with servomorters

The keys of the saxophone and servomotors are connected with wires. When the servomotor is moved and a wire is pulled, the key moves and the tone hole closes. Automatic Fingering Saxophone can finger faster and more accurately than even the most experienced saxophonist.

There are pianos on the market that play automatically, but they are all automated [7]. In contrast, Automatic Fingering Saxophone aims to reduce the burden on the performer by automating some of the movements necessary for performance.

3   Melody Slot Machine with Automatic Fingering Saxophone

Melody Slot Machine with Automatic Fingering Saxophone challenges human composers and performers through AI and robotics technology. The inclusion of humans also emphasizes their importance. For example, humans selecting the dials of Melody Slot Machine adds an element of amusement and improvisation to a piece of music. Automatic Fingering Saxophone's servomotors are fast and precise, but it is the performer's blowing and tonguing that give the tone its expression. We hope that the Melody Slot Machine with Automatic Fingering Saxophone will give you an idea of how AI and robot technologies and humans can better communicate with each other.

4   Conclusion

This paper describes the Melody Slot Machine with Automatic Fingering Saxophone, which allows even music novices to control combination of melodies and performances. The melody variations used in Melody Slot Machine use a structure based on GTTM, so that even if the variations are changed, the overall structure is maintained and the pieces does not break up. Automatic Fingering Saxophone controls 19 servomotors with a microcomputer based on MIDI signals received from Melody Slot Machine to excute fingerings automatically. We will increase opportunities to perform with theMelody Slot Machine with Automatic Fingering Saxophonein the future and make improvements if any problems are found.

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