Analysys of Drum Score Using Iterated Learning Model

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With the advance of information science and the use of music data, research related to music, such as automatic generation of music, composition support, and analysis of music, has been performed using information science technology. Furthermore, it is pointed out that music takes a form very similar to a language, such as recognition using ears and being described as a symbol on a musical score, and music and language evolved from the same origin. We also know that the brain functions used for music and language overlap. From these similarities, it is thought that music has a grammar like language. Therefore, analysis of music using a technique cultivated in a language has been attempted. However, unlike language, music has a vague meaning and is difficult to formalize, so it is difficult to implement by computer. In addition, when a statistical natural language processing method is used, a large amount of music data is required. Therefore, it is necessary to try to analyze music from the essence of human language processing. In this study, we analyze the music score using the method of evolutionary linguistics.

Evolutionary linguistics is a study aimed at elucidating human thoughts and properties by pursuing the origin and evolution of human language from two aspects, biological evolution and cultural evolution. Noam Chomsky defined language as a human-specific biological trait and defined the mechanism as a generative grammar. The purpose is to understand the human brain and thoughts from language analysis. In addition, Chomsky proposed that universal grammars exist, with human beings having a natural language acquisition device. Only a limited number of sentences can be learned during childhood to acquire language. Therefore, Simon Kirby asserted that even without assuming a special device for acquiring language, infants acquire generative grammar by performing generalized learning with little linguistic knowledge. And, computer simulations using an iterated learning model showed that a language without a structure has synthesizing and recursive processes, indicating the possibility of cultural evolution of the language. In this research, based on this Kirby's Iterated Learning Model, a model for analyzing music scores is created.

Kirby's Iterated Learning Model is a computer simulation of verbal communication composed of two types of agents, parent and child. The parent agent generates a character string from its own language knowledge and passes the character string and the meaning of the character string to the child agent. The child agent acquires a grammar from the stored linguistic knowledge by performing generalization learning. Then, the child agent that has acquired the grammar becomes a new parent agent and passes the character string to the new child agent. By repeatedly learning this process over several generations, linguistic knowledge with high expressiveness is acquired.

Previous research has attempted to discover the structure of music based on Kirby's Iterated Learning Model. A symbol sequence is created from a musical score, and learning is performed using an iterated learning model. As a result of an experiment of music score analysis using Burg Müller 25 Etüden, it was possible to observe a part of the cadence rule and the progression from dissonance to consonance, but there is still a problem in finding the grammatical rules of music.

The problems of previous studies are that they assume too much meaning similar to language for music and symbolize music scores. Previous study, piano scores are used for musical scores. In the piano score, two staves, the right hand (main melody) and the left hand (accompaniment), are arranged at the top and bottom, and progress simultaneously. When symbolizing this score, the order of notes included in the range of one beat is not considered. And when the number of left-hand notes is smaller than the number of right-hand notes, the left-hand notes are equally allocated and symbolized. Therefore, in this study, symbolization is performed while maintaining the order of notes. In addition, the piano score is very complicated and unsuitable for the analysis of the score because the progress of the accompaniment and the main melody must be considered. Therefore, this time, the drum score was adopted as the music score. Drum score is simpler than piano score and has a musical rhythm structure such as 8 beats, so it can be said that it is suitable for discovering the structure of music. In this research, instead of labeled context-free grammar what Kirby's iterative learning model and the previously used, we constructed it to acquire rules of context-free grammar, created initial production rules from drum score, and generated symbols from production rules. We generated a sequence and tried to find drum grammar rules using iterated learning model. This model does not use musical knowledge and is a model for learning grammar from a common part of a symbol sequence.

As a result of the experiment, the grammar rules converged in earlier generations compared to previous studies. Then, the obtained grammar rules were converted to Chomsky normal form and converted to Greibach normal form, and the result was a regular grammar. It is suggested that the generated grammar obtained from the drum score may have only the same restrictions as regular grammar.

In this study, Iterated Learning Model learned drum score in units divided into bars. For this reason, rhythm instruments such as drums cannot be said to have regular grammar. In the future, it is necessary to devise a model for learning grammar without specifying the budget unit. Also, this time, we could only collect 9 drum scores, so it was an experiment with few sentences. Therefore, it is a future work to collect and analyze more score data.