Abstract

Among the research area of linguistic evolution, cultural evolution is especially important for us to form languages. Even if the human is said to have obtained the language ability biologically, we cannot use any language by birth. There are several study about cultural evolution to research how language is constructed through generations. Among which, we focus on the generation of computer-tractable language. In this thesis, we investigate the self-organization of meaning through ambiguous communication because we cannot understand the speaker's intention every time completely. We can guess the intention of utterance together with body actions and a situation when they utter. On the other hand, what the listener has guessed may not be the exactly same one as the original intention. The so-called meaning only exists in our mind because we do not know what the meaning is. Our approach is to construct meanings, in our definition, from syntax learning.

We have investigated the effect of the symmetry bias on the language evolution, which decides the meaning in an ambiguous environment. For this task, we constructed a Meaning Selection Iterated Learning Model (MSILM) based on the Simon Kirby's Iterated Learning Model (ILM), and simulated with three strategies: Perfect Matching Symmetry Bias (PMSB), Imperfect Matching Symmetry Bias (IMSB), and Random strategy. As a result of applying IMSB, the language of the agent evolved into more compositional one, and the agent acquired a more expressive and similar language to the parent's one than that with the Random strategy agent. On the other hand, as a result of applying PMSB, the language of the agent did not evolve well, the agent acquired a less expressive and different language to the parent's one than that with Random strategy agent. Our experimental results showed that the effect of IMSB accelerated linguistic evolution to obtain more compositional one, whereas PMSB disturbs linguistic evolution.

As a target of syntax-based meaning composition, we consider music scores. We assume that the rules of music progression are in a subclass of context-free language, and we let computers find them autonomously. We employ the ILM, and ask if the computer can find a music knowledge that is common to us, and also if the computers can compose music independently of our music knowledge. In this research, we have shown an example set of rules found in the 25 études of Burgmüller regarding a symbol as a set of notes on one beat. Although many of categories in the tree seem redundant and futile, some of them reflect probable progressions, which well match with our human intuition. This experiment has several virtues compared with other grammar-based formalism for music. One is that we do not need to provide a dictionary beforehand. The other is that we can exclude the human-biased intuition, which had hindered the definition of creativity.

Key Words: **Linguistic Evolution; Machine Learning; Symmetry Bias; Agent-based model; Grammar acquisition; Iterated Learning Model; Music Analysis; Self-organization**