A COEVOLUTIONARY SYSTEM FOR STRATEGY DEVELOPMENT IN POKER GAMES

JUN-ICHI KUSHIDA[1], IORI NAKAOKA[2], KATSUARI KAMEI[2]
NORIYUKI TANIGUCHI[3] AND YUKINOBU HOSHINO[4]

[1]Graduate School of Science and Engineering
[2]College of Information Science and Engineering
Ritsumeikan University
1-1-1 Noji-higashi, Kusatsu, Shiga 525-8577, Japan
kushida@spice.ci.ritsumei.ac.jp; { nakaoka; kamei }@spice.ci.ritsumei.ac.jp

[3]Advanced Telecommunications Research Institute International
2-2-2 Hikaridai, Seika-cho, Soraku-gun, Kyoto 619-0288, Japan

[4]Department of Electronic and Photonic Systems Engineering
Kochi University of Technology
Tosayamada-cho, Kochi, 782-8502, Japan

ABSTRACT. *In two player games like professional chess and shogi in the real world, the players play against each other repeatedly while changing their strategies and striving for mastery. The relation between these players can be ascribed to competitive coevolution represented by predator-prey or parasite-host. In this paper, we propose conditions for players to realize the reciprocal development of their strategies in two player games. We construct a co-evolutionary system that reciprocally develops players' strategies. The game environment is the seven card stud poker, which is one of the complex real world games of imperfect information. In our system, the players decide their actions based on self-learning by Classifier Systems and then make the strategies more sophisticated. We analyze dynamics of the evolution of the player's strategies and show the learning process of reciprocating skills of players.*
Keywords: Two player game   Coevolution, Classifier system, Poker game

1. **Introduction.** Coevolution is a situation in which two different species co-evolve each other. Typical examples are the relation between a predator and a prey, and a parasite and a host [1]. In this situation, the species evolves to surpass the opponent. In competitive coevolution, species must keep evolving to win the struggle for survival. Consequently, species that stop evolving become extinct [2, 3]. This mechanism of coevolution has shown successful results in developments of GA and GP [4]-[14]. Floreano showed successful coevolution of prey and predator robots using a competitive coevolutionary GA [2, 3]. Hillis used co-evolution as an engineering tool to develop the sorting networks [15].

In coevolution, a continuous increase in complexity of individual strategies is required. But each individual tends to find the simplest strategy that can win against current opponents [16]. Therefore, individuals may incite over-specialization [17, 18], and the relation of individuals may fall into a limited cycle that rediscovers the same class of strategies over and over or the mastery of some individual may be fixed by arrested evolution of other individuals [1, 3, 17].

On the other hand, in two player games such as professional Chess and Shogi in the real world, players play against each other repeatedly while changing their strategies and strive for mastery. These players' relations can be ascribed to competitive coevolution.