EVOLUTION OF STRATEGIES IN NOISY LEADER GAME*

EIZO AKIYAMA†

Graduate School of Systems and Information Engineering, University of Tsukuba, Tennodai 1-1-1, Tsukuba, Ibaraki 305-8573, Japan
(TEL +81-29-853-5550; email: eizo@sk.tsukuba.ac.jp)

We investigated the evolutionary phenomena observed in noisy leader game. The analyses show that, unlike the case without noise, there appears evolutionary process toward such a strategy that try to differentiate and fix her role, either leader or follower, from the opponent.

Survived strategies after 100 thousand generations share the following three common policies among simulation runs: (1) Do not give your way before the opponent does once you have consecutively failed coordinating your action with the opponent's. (2) If you remember you have gone through the experience of a leader, behave aggressively. (3) If you have not had an experience as a leader, and if the opponent has always been aggressive and has experienced the role of leader more than one, follow her.

Extended Abstract

Table 1. Payoff matrix of the game of leader:
In each cell, left and right figures show the points for the row player (player 1) and the column player (player 2) respectively.

	C	D
C	(1, 1)	(3, 5)
D	(5, 3)	(0, 0)

The game of leader, whose payoff matrix is given in Table 1, is one of the non-trivial games in the classification of two-player two-strategy (2x2) games by Rapoport [1]. In this game, if a player chooses D (Daring) and the other C (Careful), coordination between the players gets realized, where the former becomes the "leader" and gets the highest score while the latter becomes the follower and gets the second best score. However if both are become daring (D), we see the worst result.

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There are several studies on the evolutionary phenomena in such 2x2 games. For example, Crowley [2] investigated the evolution of strategies in 2x2 games using classifier systems with memory length 2 (considering the memory of previous actions of both the focal and the opponent players'). Tanimoto and Sagara successfully parameterized all 2x2 games and investigated the effect of game structures on their evolutionary phenomena with agents having memory length 2.

Note that in the payoff matrix in Table 1 the sum of the payoffs for (C,D) and (D, C) is larger than twice the score for (C,C). Browning and Colman showed that, for such games, Alternating Reciprocity where both players choices alternately change with time (i.e. (C,D)→(D,C)→ (C,D)→(D,C)….) is observed as a result of evolution. They used genetic algorithms with memory length 6.

Because we cannot avoid errors or mistakes in the real world, it's important to consider introduction of player's mistakes (noise) in decision into the models. For example, there are many studies on noisy prisoner's dilemma.

In this paper, we focus on the **repeated noisy leader's game** where **memory length of the players can change** with generations, and investigate evolutionary phenomena using the simulation framework presented by K. Lindgren (1991) [5].

There are mainly two types of evolutionary phenomena in this game: memory length in the first type (Figure 1-(a)) oscillate between around 4 and 5 while that in the second type does not go over 4 (Figure 1-(b))

Survived strategies after 100 thousand generations share three common policies over simulation runs: (1) Do not give your way before the opponent does once you have consecutively failed coordinating your action with the opponent's. (2) If you remember you have gone through the experience of a leader, behave aggressively. (3) If you have not had an experience as a leader, and if the opponent has always been aggressive and has experienced the role of leader more than once, follow her.

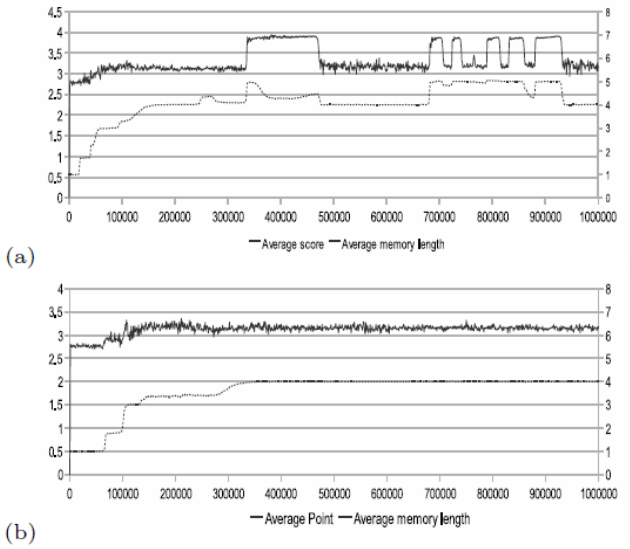

Figure 1. Two typical types of results about average point and average memory length that change with generations. Solid line shows average payoff over the population in each of the generation, while dotted line shows the average memory length. Vertical axis in the left-hand side measures average payoff while in the right-hand side measures average memory length in each of the generation.

References

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