Emerging cooperation evaluated evolutionary game theory, experiment with simulation and application

ムハンマド, アーサン, ハビブ

氏　　名　：　MD. AHSAN HABIB
  Name

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論 文 内 容 の 要 旨

Thesis Summary

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The entitled of my thesis is," Emerging cooperation evaluated evolutionary game theory, experiment with simulation and application" in which I have been constantly concerned on numerous environmental changes or problems that have been recognized as issues of the global perspective. So, the environmental issues can be modelled to optimize by predicting the game aspect. Precisely, it can be said that the environmental issues can be modelled as chicken type game which reveals the several real-world problems based on evolutionary game. The evolutionary game theory (EGT), the most widely known standard structural framework to exhibit a large amount of human behavioral diversity, has turned into prominent structures in environment and social issues to survive and prosper. There have been left several issues which implies the less amount of the fundamental knowledge in the entire field of evolutionary game theory. So, what I thought to start my PhD study was that I should check the different issues regarding evolutionary game theory, that is what my PhD thesis dedicates. In my PhD study, I would like to evaluate several challenges which are currently observed in the real field of evolutionary game theory by presuming the 2×2 game template that is 2 players and 2 strategy game and the thesis　deals with highlighting only 2×2 game which is the most prominent and most fundamental template in the field of evolutionary game theory regarding several unclear problems to simplify according to my terminology.

There are several approaches for down-to-earth issues touching with each of the chapters. Let me explain about what the each of the chapter dedicates in my thesis paper. According to the thesis, chapter 1 reveals that the historical context of motivation is needed to look through the study. There are some fundamental concepts of game theory with evolutionary, and behavioral dynamics, as well.

As I said, I have been concerned on 2×2 game and chapter 2, focuses on symmetric 2×2 game with the universal concept of dilemma strength that was explored by the Professor Tanimoto's script in many years ago. The universal dilemma strength can be defined by consulting the hard process of the mathematics.

But still, it can be said that the less amount of the prove that the real human beings behave if he or she is exposed to simplify the 2×2 symmetrical game situations. So, this chapter designs the field survey, say, the experiment to explore what each of the real human beings behave to 2×2 symmetric game situations. That means, what I design was that obtaining some hard evidence from the real human beings behaving with respect to the universal concept of dilemma strength and dilemma class suggesting from the theoretical point of view. That's the chapter 2 deals with.

The chapter 3, turns to bit different thing as compared to chapter 2 deals with, relies on MAS (multiagent simulation) approach. I was concerned on what is called network reciprocity that is one of the five (i.e. kin selection, direct reciprocity, indirect reciprocity, network reciprocity and group selection) fundamental protocols proposed by the Professor Martin Nowak, to emerge the cooperation in the prisoner's dilemma game. For the last several decades, there had been numerous works that proposing new mechanism of enhancing network reciprocity by taking the MAS approach, and this time I was concentrated the same subject in that sense which was bit different than the previous many numerous works had been reported. What chapter 3 reveals that unlike the previous study, the conformity mechanism is able to promote cooperation in network reciprocity mechanism context, and this would dedicate to enrich the idea of template to enhance the network reciprocity.

In chapter 4, comes to also different from previous two chapters; chapter 2 and chapter 3, which concerns on realistic scenario based on 2×2 game in terms of the classical game theory. To chapter 4, tries to extend the applications of EGT in certain fields in real sense, but unlike the previous those two chapters (i.e. chapter 2nd and 3rd), chapter 4 concerns on asymmetric 2×2 (2 players & 2 strategy) game. As I said, because of the realistic application model build in chapter 4, premises two asymmetric players appeared as power generator system; one of the power generator who is interested in sustainable power generation system like PV, wind turbine system and so forth, whereas another player is introduced as the conventional power generator relying on fossil fuel, coal and so forth. But anyway, I tried to build realistic asymmetric 2×2 game what precisely analyzed by considering mathematical analysis concerning on equilibrium condition.

Finally, chapter 5 is the summary of the results obtained throughout this work, that shows some novel achievements in the field of game theoretical approach. Apart from this, recommendation and future work has been outlined here and some mathematical formulations with analysis are included in the appendix.