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REPORT

By a member of the dissertation committee of the dissertation of Sun Ping on the theme: “Game-theoretical Models of Network Formation with Asymmetric Players”, submitted in conformity with requirements for the degree of Candidate (PhD) of Physico-Mathematical Sciences in Speciality 1.2.3 — Theoretical Informatics, Cybernetics.

The dissertation of Sun Ping is dedicated to the analysis of network formation games with asymmetric players, random disturbances and possibly partial information. The dissertation studies both noncooperative as well as cooperative game frameworks. This is a very contemporary and important topic as many modern technological, economical and sociological systems (e.g., online social networks or telecommunication systems or economic systems) can be adequately described by network models. Furthermore, in most real situations the players have asymmetric characteristics and the random disturbances often constitute a significant part of the system dynamics.

The dissertation of Sun Ping consists of four technical chapters as well as of Introduction, Conclusions and Bibliography. In the Introduction, the candidate carefully described the motivation of the work, the main contributions of the thesis and the main methodologies. The state of the art of the domain is very carefully described.

Chapter 1 introduces the first network formation model with asymmetries as well as some basic notions used throughout the dissertation. Specifically, Sun Ping introduces a very interesting network formation model with the players partitioned into ordered groups. The players’ benefits can be both discounted and undiscounted with respect to the shortest paths and the players’ costs depend on the difference in group labels. This is a very natural approach to introduce asymmetry in the players’ set. Sun Ping provides several characterizations of the stable network configurations.



In Chapter 2 Sun Ping takes a more dynamic point of view on the network formation process. Specifically, at discrete time steps a pair of players is selected at random and the players update the link status based on their mutual benefits and costs. Importantly, in this modification, the players do not know initially the indices of the groups of the other players. Thus, this modification represents a game with partial information. For this model, the candidate investigates the time to stable network, the heterogeneity gap and the size gap.

In Chapter 3 the candidate investigates the network formation processes in the framework of cooperative games. Sun Ping study the CIS-value and the core as the cooperative solution concepts. For subgame consistency problem, an imputation distribution procedure is elaborated to avoid the players' deviations from the cooperative trajectory. What makes the contributions of this chapter particularly original is the presence of two random disturbances: random game duration and random realization of link formation. The sufficient condition for the strongly subgame consistent core is also obtained.

Finally, in Chapter 4, Sun Ping studies a non-cooperative two-stage game where the Nature undertakes the role of a random factor and there is a leader who proposes a joint network structure. The model is analyzed using the technique of the games on trees. It is interesting that in this model a new notion of the stable partially Bayesian equilibrium is proposed, which is more selective than the Nash equilibrium.

The results of the thesis have been presented in important conferences on games (such as Game Theory and Management) and in high-level journals (such as Automation and Remote Control, Dynamic Games and Applications, and Mathematics), indexed by Scopus and Web of Science.

For all the above reasons, I conclude that the dissertation of Sun Ping on the theme "Game-theoretical Models of Network Formation with Asymmetric Players" meets the requirements established by Order No. 11181/1 of 19 November 2021, "On the procedure for awarding academic degrees at Saint Petersburg State University", and Sun Ping deserves the award of the degree of Candidate (PhD) of Physico-Mathematical Sciences in the Speciality 1.2.3 — Theoretical Informatics, Cybernetics. Clauses 9 and 11 of the aforementioned Order by the author of the thesis is not broken.

Member of the Dissertation Council,
Konstantin Avrachenkov,
Doctor of Philosophy (PhD),
Habilitation à Diriger des Recherches (HDR),
Director of Research at Inria,
22 March 2023.

A handwritten signature in blue ink, appearing to be "K. Avrachenkov".