Editorial: Game Theory for Networks

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1 Editorial

Game theory has been recently become a useful tool for modeling and studying various networks. The past decade has witnessed a huge explosion of interest in issues that intersect networks and game theory. With the rapid growth of data traffic, from any kind of devices and networks, game theory is requiring more intelligent transformation. Game theory is called to play a key role in design of new generation networks that are distributed, self-organizing, cooperative, and intelligent.

This special issue consists of seven selected papers for network game theory and applications such as contents sponsoring, service provisioning, resource allocation in next generation mobile networks, and smart grids.

The first article titled “Time-Consistent Solutions for Two-Stage Network Games with Pairwise Interactions” studied a two-stage network game with a special type of pairwise interactions between players. For a particular type of a network, a simplified formula for the Shapley value based on a constructed characteristic function is derived. Time inconsistency of the Shapley value and the core in the two-stage game with pairwise interactions was demonstrated, and a time-consistent imputation distribution procedure based stage payments were introduced to overcome the time inconsistency problem.

The next article with title “Pricing and Revenue Sharing Between ISPs Under Content Sponsoring” studied the interpricing among Internet service providers that jointly deliver the sponsored data from content provider to end user. Authors derived

the best response of the end user, the content provider, and the Internet service providers, and analyzed their implications for the sponsoring strategy of the content provider. Authors also investigated the interactions between strategic end user, content provider, and two interconnected Internet service providers through a sequential Stackelberg game, and concluded that cooperation between the Internet service providers improves the total payoff of the Internet service providers and leads to a higher social welfare.

The third article titled “Duopoly Provision of Services Based on Wireless Sensor-Supplied Data: A Differential Game Model” analyzed the provision of services based on wireless sensor data in dynamic manner. In the scenario, two competing service providers deploy their own wireless sensor networks in order to collect the data and provide services to final users. The service providers compete in prices dynamically in order to maximize their profits, while the behavior of the users is modeled using a discrete choice model. In particular, the changes in the population of users are analyzed through an evolutionary game and the Logit dynamic, while the dynamic competition in prices is studied using a differential game. The article concluded that the dynamic pricing competition is economically feasible for the service providers, and the dynamic solution converges to the static solution of the scenario.

The fourth article titled “New Method of Energy Efficient Subcarrier Allocation Based on Evolutionary Game Theory” proposed an energy efficient subcarrier allocation method using evolutionary game in cognitive radio networks with filter bank multicarrier modulation technology. Since the adjacent subcarriers don’t need to be orthogonal to each other in filter bank multicarrier, authors applied evolutionary game theory to optimize the subcarrier allocation problem. Authors introduced a channel state matrix to show the quality of subcarriers and designed the subcarrier allocation algorithm using evolutionary game.

In the next article titled “Low-Complexity Channel Estimation and Cooperative Channel Allocation in Millimeter-Wave Small Cell Networks” proposed a virtual channel representation channel estimation method using out-of-band spatial information to reduce training overheads for high-speed mobile communication networks. Since the throughput performance degrades in multi-cell scenarios, authors also proposed a cooperative channel allocation method based on coalitional game framework, which enhances throughput performance in mm-wave small cell networks.

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The fifth article titled “Demand Response Management in Smart Grid Networks: A Two-Stage Game-Theoretic Learning-Based Approach” considered the combined problem of power company selection and demand response management in a smart grid network consisting of multiple power companies and multiple customers by adopting a reinforcement learning and game-theoretic technique. The demand response management problem is formulated as a two-stage game-theoretic optimization framework and the result of the two-stage game inputs to the learning system to build knowledge and to conclude to the optimal power company selection.

The last article titled “Charging Control of Electronic Vehicles in Smart Grid: A Stackelberg Differential Game Based Approach” proposed the charging control problems of the electrical vehicles in smart grid, where electricity transactions exist between the aggregation and the electrical vehicles. Authors applied the Stackelberg differential game to formulate the charging and discharging interactions between the aggregation and the electrical vehicles, where the dynamic behavior of the energy levels of the aggregation and the electrical vehicles are formulated as a differential game, and the charging and discharging interactions between the aggregation and the electrical vehicles are formulated as a Stackelberg game.

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Ju Bin Song received the Ph.D. degree from the Department of Electronic and Electrical Engineering, University College London (UCL), London, U.K., in 2001, and the B.Sc. and M.Sc. degrees in 1987 and 1989, respectively. From 1992 to 1997, he was a Senior Researcher in the Electronics and Telecommunications Research Institute (ETRI), South Korea. He was a Research Fellow in the Department of Electronic and Electrical Engineering at UCL in

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