Efficient Equilibria in a Public Goods Game

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Abstract—The “best-shot” public goods game is a network game, defined on a social network. As in most strategic games, it contains a structured tradeoff between stability and efficiency. The present study considers a multi-agent system, in which each agent represents a player in the “best-shot” game. It is demonstrated that any Pure-strategy Nash Equilibrium (PNE) of the “best-shot” game is Pareto efficient and that best-response dynamics converge into a PNE within a linear number of steps. It is also shown that the game is a potential game. The potential function can be utilized for the search of PNEs with certain social properties. In order to improve efficiency beyond the limited set of stable states, a mechanism of side payments is proposed. We prove that by using side payments an outcome that maximizes social welfare can be stabilized. A distributed protocol based on asymmetric distributed constraints optimization, which enables the search for efficient outcomes, is proposed. Finally, an extensive experimental evaluation compares the actual social welfare in outcomes achieved by different search paradigms for common social networks structures.