Notre Dame Electrical Engineering

Renewable Energy Aggregation: A Coalitional Game Approach

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Abstract:

Aggregation of renewable energy resources has significant potential to reduce the cost of variability for renewable integration in a power grid. In this work, we focus on developing aggregation strategies using cooperative game theory. We consider two problems. In the first problem, renewable energy producers form a coalition to jointly bid in the two-settlement electricity market. We propose a contract that produces non-empty core and thus stability for the game of realized profit. Next the benevolent aggregator designs a strategy that improves their long-term profitability maintaining the short-term stability goals. In the second problem, we investigate the possibility of forming coalitions among consumers having rooftop photovoltaic solar cells under various incentive programs such as feed-in tariff, net metering, net purchase and sale. For net metering, and net purchase and sale, we develop a pricing condition under which the cooperative games have non-empty cores. In both the problems, we develop cost allocation rules that are based on the cost causation principle. Thus, our strategies strongly promote aggregation of renewable energy.

Biography:

Pratyush Chakraborty received the B.E. degree in electrical engineering from Jadavpur University, India, in 2006. From 2006 to 2009, he worked in the Industrial Solution and Services Division in Siemens Limited, Kolkata, India. He received the M.Tech. degree in electrical engineering from Indian Institute of Technology, Bombay, India in 2011, the M.S. and PhD. Degrees in electrical and computer engineering from the University of Florida in 2013 and 2016 respectively. From January 2017 to May 2018, he was a Postdoctoral Research Scholar at the University of California, Berkeley. From June 2018, he is a Postdoctoral Fellow at Northwestern University, Illinois. His research interests include game theory, distributed control, and optimization of power system with deep renewable penetration.