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Resource allocation in networks via coalitional games

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Citation

Shams, F. (2016, September 21). *Resource allocation in networks via coalitional games*. Retrieved from <https://hdl.handle.net/1887/45667>

Version: Not Applicable (or Unknown)

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Issue Date: 2016-09-21

Abstract

Next-generation wireless and power distribution networks will lead to higher energy consumption and waste. However, the advent of new smart devices opens the possibility of devising cooperative policies for improving their energy efficiency.

The main goal of this dissertation is to manage resource allocation in network engineering problems and to introduce efficient cooperative algorithms to obtain high performance, ensuring fairness and stability. Specifically, this dissertation introduces new approaches for resource allocation in Orthogonal Frequency Division Multiple Access (OFDMA) wireless networks and in smart power grids by casting the problems to the coalitional game framework and by providing a constructive iterative algorithm based on dynamic learning theory.

In OFDMA wireless networks each terminal is assigned to a set of subcarriers. The problem is to find the optimal amount of power transmission over each subcarrier as to achieve the device's demanded data rate exactly. The power distribution is obtained by a dynamic learning algorithm based upon Markov modeling. Simulation results show that the average number of operations of the proposed iterative algorithm are much lower than $K \cdot N$, where K is the number of mobile terminals and N is the number of subcarriers.

In smart power grids, we consider the problem of power trading coordination among micro-grids, e.g., wind turbines and solar panels. To minimize the amount of dissipated power during generation and transfer, we introduce an algorithm which allows the micro-grids to autonomously cooperate and self-organize into a set of coalitions. Our evaluation shows that the new approach enables micro-grids to coordinate for power trading and dissipate only 10% of the power which would be otherwise dissipated by traditional power distribution networks.