On Optimal Scheduling of Collaborative Mobile Chargers in Wireless Sensor Networks

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ABSTRACT

The limited battery capacity of sensor nodes has become the biggest impediment to wireless sensor networks (WSNs) applications over the years. Recent breakthroughs in wireless energy transfer based on rechargeable lithium batteries provide a promising application of mobile vehicles. These mobile vehicles act as mobile chargers to transfer energy wirelessly to static sensors in an efficient way. In this talk, we discuss some of our recent results on several charging and coverage problems involving multiple mobile chargers. In collaborative mobile charging, a fixed charging location, called base station (BS), provides source of energy to mobile chargers, which in turn are allowed to recharge each other while collaboratively charge static sensors. The objective is to ensure sensor coverage while maximizing the ratio of the amount of payload energy (used to charge sensors) to overhead energy (used to move mobile chargers from one location to another), such that none of the sensors will run out of battery. Here, sensor coverage spans both dimensions of time and space. We first consider the uniform case, where all sensors consume energy at the same rate, and propose an optimal scheduling scheme that can cover a one-dimensional (1-D) WSN with infinite length. Then, we present several greedy scheduling solutions to 1-D WSNs with non-uniform sensors and 2-D WSNs, both of which are NP-hard. Finally, we study another variation, in which all mobile chargers have batteries of unlimited capacity without resorting to a BS for recharging. The objective is then to deploy and schedule a minimum number of mobile chargers that can cover all sensors. Again, we provide an optimal solution to this problem in a 1-D WSN with uniform sensors and several greedy solutions with competitive approximation ratios to the problem setting of 1-D WSNs with non-uniform sensors and 2-D WSNs, respectively.

Categories and Subject Descriptors

C.2.1 [**Network Architecture and Design**]: Wireless communication, Network topology; G.2.2 [**Graph Theory**]: Network problems, Graph algorithms

General Terms

Design, Performance

Keywords

Collaborative mobile charging, coverage across time and space, wireless energy transfer, wireless sensor networks (WSNs).

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