Collaborative Data Management for Wireless Sensor Networks

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Abstract
Collaboration among individual nodes in wireless sensor networks can facilitate distributed, energy-efficient data collection, processing and transmission. My research concerns the design and testing of efficient, robust and scalable adaptive algorithms for collaborative data management in static and mobile wireless sensor networks.

Keywords
Wireless sensor networks, data management, adaptability, mobility

Problem Statement and Research Question
Providing fine-grained observations of real-world phenomena is a common requirement for many sensor network applications. However, continuously reporting accurate data represents a significant communication overhead (thus increased energy consumption) for sensor nodes. In order to preserve network resources it is thus necessary to limit the amount of data to be sent, while at the same time maintaining the accuracy of the delivered data to fulfill the given application requirements. The main focus of my research lies in designing and evaluating collaborative data collection, processing and transmission frameworks based on

adaptive algorithms that minimize network resource usage (i.e., energy) while preserving data accuracy.

Approach and Methodology

A performance analysis of classical adaptive algorithms for data reduction in wireless sensor networks constitutes the starting point of this work. Improvements upon these algorithms are then needed to get rid of unreliable wireless communication and to enable resilience to changing network configuration. Finally, the role of node mobility for collaborative data management will be investigated as an opportunity for further optimization. The theoretical evaluation of the algorithms will be accompanied by various prototypes on real test-beds.

Related Work

Several different approaches for data management in wireless sensor networks have already been proposed. An interesting methodology and extensive experimental results are presented in [1], where data reduction is obtained through a prediction scheme based on classical Kalman filter theory. In [2] a global spatio-temporal probabilistic model for network-wide sensor data is derived from past observations and used to estimate the current response of the network to a given query. In both these approaches collaboration among nodes is limited to the classical client-server model. In [3] Howard et al. show how sensor nodes can share locally collected data and cooperate in order to reach autonomously an optimal network configuration. Even if thematically not directly connected to [1] and [2], this work offers interesting ideas on how to exploit node mobility to increase global network performances.

Potential Cooperation

This work would benefit from cooperation with researcher from the field of autonomous robotic systems and learning algorithms.

References

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