

Public Abstract

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Graduation Term: Fall

Graduation Year: 2006

Title: Adaptive Clustering and Transmission Range Adjustment for Topology Control in Wireless Sensor Networks

A wireless sensor network (WSN) is characterized by a limited energy supply and a large number of nodes. Topology control (TC) as one of the main ways to control energy consumption in WSNs has been the focus of a considerable body of research. Network topology control is about the management of network topology to support network-wide requirements. Topology control algorithms can be divided into *transmission-power-based* algorithms and *duty-cycle-based* algorithms according to their energy saving approaches.

The contributions of the dissertation include a two-level topology control strategy, a distributed connected dominating set construction algorithm (DSP-CDS), an energy consumption analysis model to solve the optimal transmission range problem in clustered WSNs, and a distributed traffic-adaptive clustering algorithm (RDSP-CDS) for non-uniform traffic networks.

The *duty-cycle-based* and *transmission-power-based* approaches have different network conditions for them to perform well. By dynamically integrating the two approaches, I have developed a two-level topology control strategy to achieve further energy saving.

In topology control, clustering as a very promising energy saving technique can be used with either a *transmission-power-based* algorithm or a *duty-cycle-based* algorithm. Connected dominating set (CDS) is a special cluster structure where the cluster heads form a connected network without using gateways. I have designed a distributed algorithm, DSP-CDS, for constructing CDS. DSP-CDS converges quickly in a single phase.

Motivated by the effects of clustering and transmission range on energy consumption, I have developed an energy consumption model for clustered WSNs and use it to solve the optimal transmission range problem. This model provides us an insight into the energy consumption behavior in clustered wireless sensor networks and the relationship among major factors.

Observing that traffic load often has unpredictable changes after deployment and has great impact on the optimal transmission range, I have designed a traffic-adaptive clustering algorithm, RDSP-CDS, by utilizing the energy consumption analysis. RDSP-CDS incorporates adaptive

transmission range adjustment into the DSP-CDS algorithm. RDSP-CDS is suitable for dynamic network topologies due to transmission range changes, node mobility, and/or node failure.