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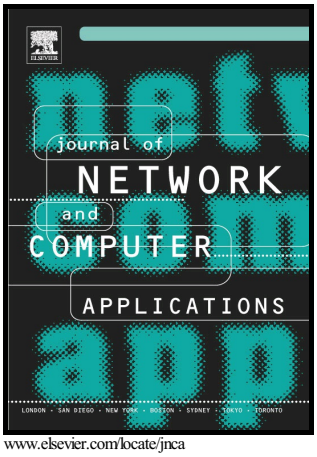

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A dynamic programming framework for the Wireless Sensor Network Configuration Problem

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Abstract

This work studies the problem of network configuration for Wireless Sensor Networks (WSN), consisting of two interdependent problems: sensor placement and topology control, by taking into consideration both the traffic load and the transmission range assignment. The design objectives are i) reducing the overall energy consumption and ii) ensuring node energy consumption fairness between the sensors. First, the problem of placing the sensors in the optimal positions is studied and then a power control scheme is put in place to manage the topology of the network. For both the two sub-problems, we first consider the one dimensional (or linear) network case and next the two-dimensional case. The two sub-problems are considered within a unifying mathematical framework based on dynamic programming, in order to guarantee the optimality of the solution. The method can easily be adapted to solve the problem for discrete values of transmission range. The method presented in this work shows a low computational complexity in comparison to other methods, and, due to its implementation simplicity, it may be of great help to network designers in the planning phase of WSN deployment.

Keywords: WSN, Dynamic programming, Sensor Placement, Network configuration;

1. Introduction

Wireless Sensor Networks (WSN) is a disruptive technology with potentially a wide range spectrum of applications such as remote health surveillance, precision agriculture, air and water pollution detection and containment, home automation, supply chain monitoring, etc. [1]. WSN development is the culmination of recent advances in microelectromechanical systems (MEMS) and wireless communication technologies. A typical WSN is composed of a set of tiny motes that sense the environment and transmit sensed information, hop-by-hop, to a processing workstation through the Base Station (BS). A simple WSN is presented in Fig. 1. Each mote comprises sensors, a processing unit, memory, radio transceiver and a battery.

Faced with stringent constraints that affect energy, bandwidth and memory use among others,

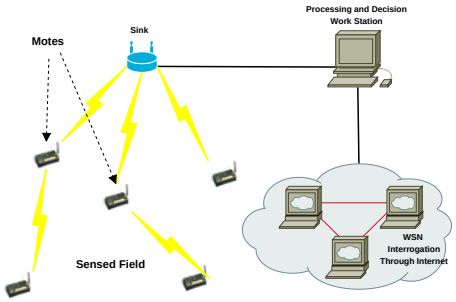

Fig. 1. Wireless sensor network

WSN technology needs to be carefully managed in order to meet the requirements of applications. Optimization techniques and strategies are applied at the physical, access control, network and application layers to improve their performance. A primary concern in WSN is the energy constraint. A carefully designed network can be a very effective means to conserve energy and therefore extend the lifetime of the network.

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