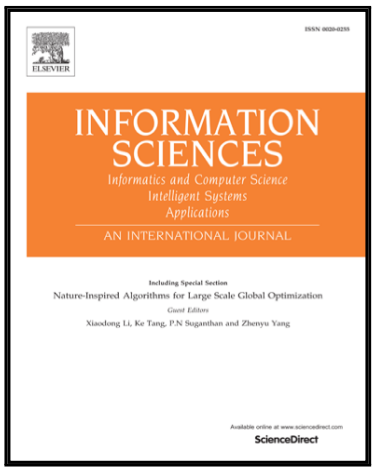

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An exact approach to extend network lifetime in a general class of wireless sensor networks

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Abstract

This paper provides a general framework to model and optimize lifetime maximization problems in wireless sensor networks with sensors having specialized capabilities like the ability to adjust their sensing range, change their directions, etc. In order to identify the set of tasks that a sensor carries out, the concept of *role* is introduced. These roles include sensor direction, sensing range, communication mode and combinations of these. The purpose is to identify schedules, represented as the allocation of roles to the sensors and a time interval for assumming such roles, while covering targets and transmitting signals to the base station. To do so, a large scale linear programming model is proposed and solved through an exact approach based on column generation, which is complemented with a branch-and-cut procedure used to address the pricing subproblem. The proposed approach is tested on an extensive set of randomly generated instances used to evaluate its performance. Computational results show the potential of the proposed approach for medium-large size instances for which it is possible to compute either the optimal or good quality solutions in short computational times.

Keywords: Wireless Sensor Networks, Directional sensors, Adjustable Sensing Ranges, Multiple target coverage, Column Generation

1. Introduction

Wireless Sensor Networks (WSN) are a set of recently introduced promising technologies that are used with the purpose of facilitating the collection of data from natural or built environments. WSN are made of small devices called sensors (or sensor nodes) that operate on a non-rechargeable battery. The sensors have sensing capabilities and are deployed to monitor or control some phenomena and transmit the retrieved data to the final user through multi-hop wireless communications (*i.e.* using other nodes as relays) [34, 35]. In recent days, WSN are found in an enormous number of applications covering industrial settings, environmental monitoring, forest fire detection, human health control, security surveillance and some applications where the use of traditional wired networks is either too complex or impractical [30, 43].

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