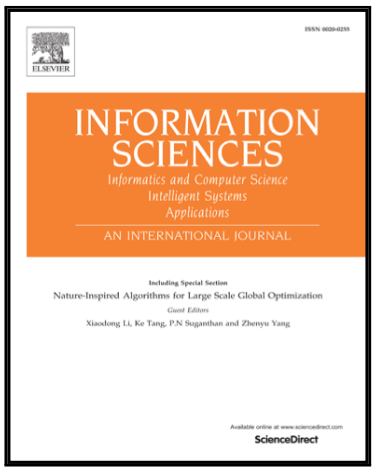

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Heuristics for Lifetime Maximization in Camera Sensor Networks

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Abstract

Due to increasing threat perception and cheap availability of multimedia technologies, camera sensor networks are becoming more and more popular these days. Camera sensor networks pose some unique challenges in addition to the usual difficulties associated with any directional sensor network. This paper addresses the problem of maximizing the network lifetime in camera sensor networks under the full and the partial target coverage models. In the full target coverage model, all the targets are assumed to be covered during the entire lifetime, whereas in the partial target coverage model, targets are supposed to have weights according to their importance, and only a fraction of targets with sum of weights above a certain threshold need to be covered during the entire lifetime. Three heuristics are presented for this problem. The first heuristic is an improved version of an already existing heuristic. Other two heuristics are based on column generation and utilize a linear programming solver to solve the master problem, whereas a genetic algorithm is used to solve the $\mathcal{NP}$-hard subproblem. Computational results show the effectiveness of our proposed heuristics.

Keywords: Camera sensor network, Genetic algorithm, Heuristic, Network lifetime maximization problem

1. Introduction

The use of Wireless sensor networks (WSNs) has increased manifolds and now encompass a wide range of civil and military applications. Particularly, they are being used to collect various kinds of data in remote or hostile environments such as fire monitoring in forests, seismological activity monitoring in oceans, volcanic activity monitoring, battlefield surveillance etc. Precise placement of sensors is not possible in such environments due to the risks involved. Hence, sensors are deployed randomly in such environments. As an atonement for this random deployment, more number of sensors are usually deployed than what is actually needed. Because of this over deployment, some targets are within the sensing range of more than one sensor, i.e., some targets are covered by more than one sensor. This redundancy in target coverage increases the fault tolerance of the overall system as in case of fault in one of the sensor covering a redundantly covered target, another sensor can cover this target.

Each sensor operates on a battery whose energy storage capacity is limited. Since replacement of batteries in a remote or hostile environment is either impossible or extremely difficult, how to utilize the resources at hand in an efficient manner is always a prime concern while designing WSNs for such environments. A commonly

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