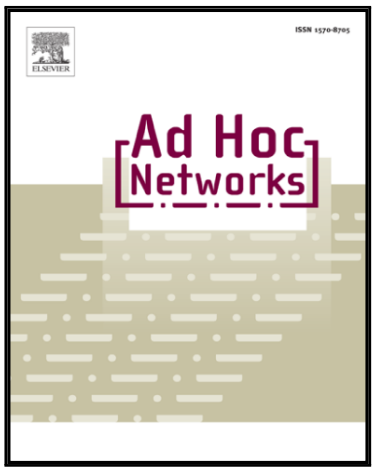

Topology control game algorithm based on Markov lifetime prediction model for wireless sensor network

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Topology control game algorithm based on Markov lifetime prediction model for wireless sensor network

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Abstract Since the wireless sensor network (WSN) consists of large number of sensors with limited energy resource, how to prolong the network lifetime is an inherent problem in wireless sensor network topology control. Motivated with this problem, we present a novel Markov lifetime prediction model (MLPM) for each single node to forecast their lifetime from a mode transition perspective. MLPM realizes the real-time prediction of node lifetime until the node died. Besides, on the basis of this model, this paper proposes TCAMLPM, a distributed topology control game algorithm for WSN which ensures the algorithm to converge to Nash Equilibrium by making use of the best response strategy. With TCAMLPM, energy conservation is accomplished by adjusting transmitting power of the nodes. The comparison results of our algorithm with the other algorithm that also aims at maximizing the network lifetime show that TCAMLPM not only extends the network lifetime, but also performs better in guaranteeing the network connectivity and robustness.

Keywords: wireless sensor network; topology control; Markov lifetime prediction model; game theory[1]

1 Introduction

Wireless sensor network (WSN) consisting of numerous tiny sensor nodes is a self-organizing communication network with multi-hop feature and it integrates sensing technology, embedded computing technology, and distributed information processing technology [1]. In WSN, sensor nodes can communicate with each other over wireless channels to monitor, perceive and collect various kinds of on-site information [2]. Today WSNs are used to support a wide variety of applications, such as industrial process monitoring and control, machine health monitoring, environment monitoring. Since sensors typically operate on batteries and the equipped batteries are difficult or expensive to recharge or replace because it is always deployed in tunnels, oceans, volcanoes, or other dangerous and difficult-to-reach places, energy conservation of the sensor nodes is a key issue for extending the network lifetime which is a major concern for network designers.

Topology control is an effective method to maintain network connectivity while reducing energy consumption and improving network lifetime of the battery operated WSN [3]. The objectives of topology control generally include the quality of network coverage and connectivity, robustness, reliability, and scalability. But maximizing the network lifetime is always one of the most important objectives for designers to consider. Up to now, various topology control approaches have been proposed to construct energy-efficiently connected topologies. Reference [4] proposes a heuristic topology control algorithm for wireless sensor networks with mobile sink. In this algorithm, they try to balance the energy of all the nodes by reducing transmission powers for the nodes having less residual energy and reducing the amount of relayed data for such nodes having heavier loads. So that the lifetime of all these nodes is extended and the experimental results show that the network lifetime of this algorithm is prolonged more than 15% compared with other algorithms. Reference [5] mainly considers the impact of link quality on the topology for decreasing the interference and prolonging the network lifetime. These two papers prolong the network lifetime from the perspective of increasing energy balance and reducing link interference respectively. However, optimizing the performance from one hand alone is not able to maximize

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