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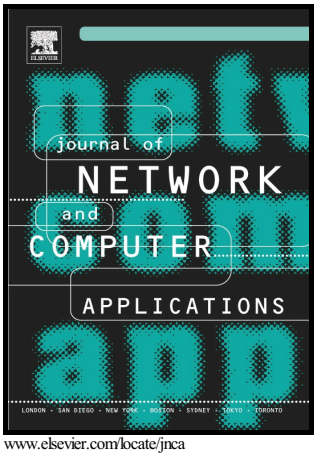

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Distributed Topology Construction Algorithm to Improve Link Quality and Energy Efficiency for Wireless Sensor Networks

Xiaochen Hao[a*], Weijing Liu[a], Ning Yao[a], Dehua Geng[a], Xida Li[b]

[a]School of electrical engineering, Yanshan University, Qinhuangdao 066004, China

[b]Institute of Information Science and Engineering, Yanshan University, Qinhuangdao 066004, China

haoxiaochen@ysu.edu.cn

xiaodou7356@126.com

893724041@qq.com

978439871@qq.com

43187327@qq.com

*Corresponding author.

Abstract

The evaluation of link quality plays a vital role in designing the upper level protocol in wireless sensor networks. The high rate of packet loss occurs when data is transmitting on the poor quality link, thus resulting in data retransmission and energy waste. Motivated with the aforementioned problem, we present the link weight model to address the problem of poor link quality and high energy consumption. This model regards the node's transmitting power as an adjustment factor. It fuses the link quality parameter and nodes' energy parameter to mathematically formulate the above problem for decreasing the interference and making the network energy balanced. Then exploiting the method of function derivation, we validate the analytical solution of the link weight. On the basis of this model, a distributed topology construction algorithm to improve link quality and energy efficiency is proposed. Finally several simulation experiments are conducted to evaluate the performance of this algorithm and validate its theoretical properties. Theoretical analyses and simulation results show that this algorithm can enhance the link steadiness, decrease the interference and prolong the network's lifetime.

Key words: wireless sensor networks; link quality; energy consumption; link weight

1. Introduction

In wireless sensor networks (WSNs), considerable research has gone into topology control algorithms (Bahi et al., 2014; Chu and Sethu, 2014). The goal of topology control is to dynamically change the nodes' transmitting range in order to maintain the network connectivity (Paolo S, 2005). Thus the topology control algorithms can decrease energy consumption and prolong the time of network connectivity. In topology control, the quality of the links used decides many higher layer protocols' performance. The poor link quality may cause high energy consumption and the dynamic change of packet loss. If we choose these poor quality links to communicate, the accuracy of packet reception will decrease, and the node energy consumption will increase. Maybe it will happen that the low energy nodes can't undertake more transmission task or will prematurely die because of the increasing energy consumption. Or even, these nodes will lead to energy holes in the surrounding area(Salarian et al., 2014; Olariu and Stojmenovic, 2006; Watfa et al., 2014), thus causing network disconnection or network collapse. For this reason, it is an indispensable content on how to improve the link quality and effectively exploit the sensor nodes' energy in WSNs.

Adjacent figure can describe the network topology structure, and it has decisive effect on network