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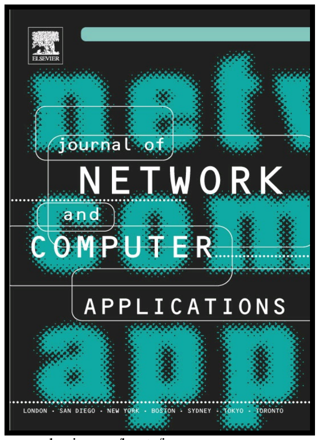

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Operator Calculus Approach for Route Optimizing and Enhancing Wireless Sensor Network

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***Abstract*—Route optimization is one of important feature in wireless sensor networks in order to enhancing the life time of WSNs. Since Centrality is one of the greatest challenges in computing and estimating the important node metrics of a structural graph, it is necessary to calculate and determine the importance of a node in a network. This paper proposes an alternative way to optimizing the route problems which is based on multi-constrained optimal path (MCOP) and operator calculus approach. A novel routing protocol called Path Operator Calculus Centrality (POCC) is proposed as a new method to determine the main path which contains high centrality nodes in a wireless sensor network deployment. The estimation of centrality is using the operator calculus approach based on network topology which provides optimal paths for each source node to base station. Some constraints such as energy level and bit error rate (BER) of node are considered to define the path centrality in this approach. The simulation evaluation shows improved performance in terms of energy consumption and network lifetime.**

***Keywords*—Wireless Sensor Network, Multi-constrained Optimal Path, Centrality, Path Centrality, Operator Calculus.**

I. Introduction

One of the important aspects in wireless sensor networks (WSNs) is routing protocol. Contrary to traditional ad hoc networks, routing in WSNs is more challenging due to their inherent characteristics. First, resources are very constrained in terms of energy supply, capability and transmission bandwidth. Second, it is hard to design a global scheme as Internet Protocol (IP). In addition, IP cannot be applied to WSNs since address updating in a large-scale and dynamic WSN may result in very heavy overhead. Third, it is hard for routing to manage with unpredictable and frequent topology changes due to the limited resources, particularly in a mobile sensor environment. Fourth, data aggregation by sensor nodes generally creates in a high probability of data redundancy, which should be considered by routing protocols. Fifth, most applications of WSNs need the only communication scheme of many-to-one, for example from multiple sources to one particular sink, rather than multicast or peer to peer. Finally, in time-constrained applications of WSNs, data transmissions should be achieved within a certain period of time. However, energy preservation is more important than quality of service (QoS) in all sensor nodes are constrained with energy which is directly related to network lifetime.

Selection of cluster heads (CHs) based on optimal probability for load distribution of energy within sensor nodes is proposed in homogeneous clustering protocol called Low Energy Adaptive Cluster Hierarchy (LEACH) [1]. Furthermore, conception of hierarchical and multi-hop clustering disseminates energy load more evenly. It is noticed that localized schemes work well when compared with centralized algorithm in clustering based approaches. On the basis of energy distribution among sensor nodes, WSNs are categorised into homogeneous and heterogeneous networks. Some clustering routing protocols such as LEACH [1], Power-Efficient Gathering in Sensor Information System (PEGASIS) [2], and Hybrid Energy-Efficient Distributed Clustering (HEED) [3] are designed for homogeneous networks. Whereas, stable Election Protocol (SEP) [4] and Distributed Energy-Efficient Clustering (DEEC) [5], Learning Automata-based Energy Efficient Heterogeneous Selective Clustering (LA-EEHSC) [6] deal with heterogeneous networks. Geographic and Energy Aware Routing (GEAR) [7] routes a packet towards targeted region through geographical information and energy awareness of nodes. For such process either their exist a closer neighbor or all neighbor are farther away from destination. For closer neighbors from the destination, GEAR picks a next-hope node among all neighbors closer to the destination.

In WSNs, data are transmitted in multihop scheme where the sensor node forwards the collected information to another node which is closer to the destination, in this case the base station (BS). There are numbers of data dissemination algorithms and routing protocols which are designed to transport the sensed data to the base station (BS) with minimum energy consumption. However, the growing interest in real time applications such as reporting imaging data in hostile area, disaster monitoring and intrusion detection necessitates the appearance of other new and more significant requirements. These requirements comprehend guaranteeing certain network bandwidth, end-to-end delay and delivery ratio. Although, the severe constraints of the wireless sensor network (WSN) produce great issues and challenges that hinder supporting these QoS requirements. These constraints are supporting multiple classes of traffic, delay energy trade-offs, reliability vs. redundancy, multipath routing constraints, and network congestion [8].