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Fault-Detection and Self-Stabilization Protocol for Wireless Sensor Networks

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Abstract : Sensor devices are prone to errors and sudden node failures, which are difficult to detect in a timely manner when deployed in real-time, hazardous, large-scale harsh environments and in medical emergencies. Therefore, the loss of data can be life-threatening when the sensed phenomenon is not disseminated due to sudden node failure, battery depletion or temporary malfunctioning. We introduce a set of partial differential equations for localizing faults, similar to Green's and Maxwell's equations used in Electrostatics and Electromagnetism. We introduce a node organization and clustering scheme for self-stabilizing sensor networks. Green's theorem is applied to regions where the curve is closed and continuously differentiable to ensure network connectivity. Experimental results show that the proposed GTFD (Green's Theorem fault-detection and Self-stabilization) protocol not only detects faulty nodes but also accurately generates network stability graphs where urgent intervention is required for dynamically self-stabilizing the network.

Keywords : Green's Theorem, self-stabilization, fault-localization, RSSI, WSN, clustering
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