Performance Analysis of Voting Algorithms in Wireless Sensor Networks

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Wireless sensor networks (WSN) are often deployed in a field in order to monitor the physical and environmental conditions. Some areas where WSNs are used include *Environmental applications* like (e.g., forest fire detection and flood detection), *Military applications* (e.g., target tracking and battlefield surveillance), and *Health applications* (e.g., disease prevention). A major concern in large WSNs is the overall reliability in the presence of some faulty sensors (also referred to as nodes). To achieve reliability, some applications take advantage of fault tolerance techniques. One such technique is achieving consensus (agreement) among nodes to accomplish a common goal. The consensus among nodes may not be exact, in which the final values, one held by each node, are approximately the same. Reaching consensus is a simple task if all nodes behave dutifully, even if each node carries a different value. However, it becomes challenging in the presence of faulty nodes. The process of reaching agreement is called *Global Convergence* (GC). This research addresses the GC problem where each node is able of communication only with its immediate neighbors. This forms a network of communication that is a Partially Connected Network (PCN).

To achieve GC, the nodes experience a repeated pattern of collecting values from their neighbors, applying a convergent voting algorithm to the collected values, and broadcasting the voted values to their neighbors. Each such pattern is called a round. The voting algorithm assists in decreasing the differences in the opinions of the nodes until convergence is achieved. A voting algorithm is convergent if the final values stay within the range of the initial values held by non-fault nodes. The main objective of this study is to experiment with different convergent voting algorithms and evaluate their performance on achieving GC in terms of number of rounds, the rate of convergence, and various network topologies. This study will be conducted under the assumptions of PCN, presence of faults with various severity, and asynchronous communication systems in which each node keeps track of its own round independent of the other nodes' processing speeding and timing. The performance evaluation is done through simulation and data are collected for various user input. The simulator is designed in such a way that the user can analyze the network at runtime by updating the network, e.g., adding, removing, or moving the sensors.