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A Cognitive Approach to Link Optimization Utilized in Wireless Sensor Networks*

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Abstract: In *Wireless Sensor Networks*, a minimal transmitting radius r , titled as CTR (Critical Transmitting Range),is functioned to meet the demand of network connectivity and to ensure the network robustness in most cases. Nevertheless, the entire energy consumption of the whole network increases due to the unique pre-set of the radiating radius for all the nodes.

Cognitive Intelligence is incorporated to make the self-organize more efficiently. The algorithm of GTL(Game-theoretical Total Link) in this paper uses *Game Theory* to set the energy range of each node , thus to make nodes control their energy consumption flexibly according to the topological changing. Via the experiments, it obtains that at least 20% energy would e saved compared to the classical algorithm of CTR, referenced to Figure 1.

Compared to CTR, GTL is able to save more energy without loss of connectivity and robustness. By modeling a payoff function, $Payoff = 1 - \alpha \times r + \beta(n - k)$, all nodes choose various radiating radius to change the their coverage area periodically and intelligently. Through repeated games, the whole network will eventually get a Nash Equilibrium, which is the optimal solution.

Both GTL and CTR algorithms are simulated within the background of a random generated Wireless Sensor Networks . In Figure 2, deeper darken area indicate more coverage coincidence and further hint more energy waste correspondingly ,thus , the S/N ratio (Signal to Noise ratio) will decrease when more coverage circle overlap. Therefore, CTR algorithm performances great waste of energy due to the coverage overlapping.

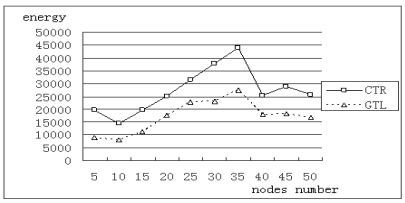

Figure 1 Energy Consumption CTR & GTL

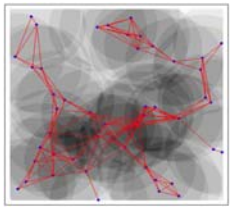

Figure 2 CTR

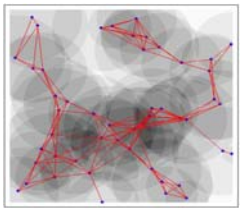

Figure 3 GTL

Figure 3 shows the result of GTL algorithm after playing the game. For the purpose of energy saving, most nodes decrease their energy level after repeated game on the premise of that all nodes keep in connection.

Being with cycled sleeping strategy or composed of mobile nodes , most networks are dynamically structured in topology. Hereby, the experiments with sleeping strategy ,which are also conducted in this paper, show that sleeping nodes transfer more work to other living nodes, then probably make extra energy waste. Consequently, GTL might be used to balance the energy oscillation.

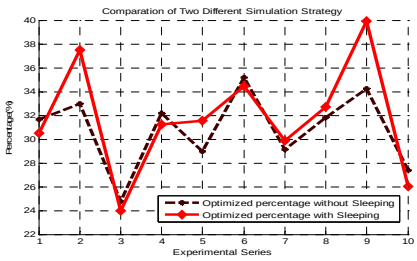

Figure 4 energy consumption of sleeping and non-sleeping strategy

Keywords: *Wireless Sensor Networks, Topology Control, Game Theory*

Abstract only

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