An Energy-Efficient Self-Organizing Global Extremity Reporting Scheme for Sensor Networks

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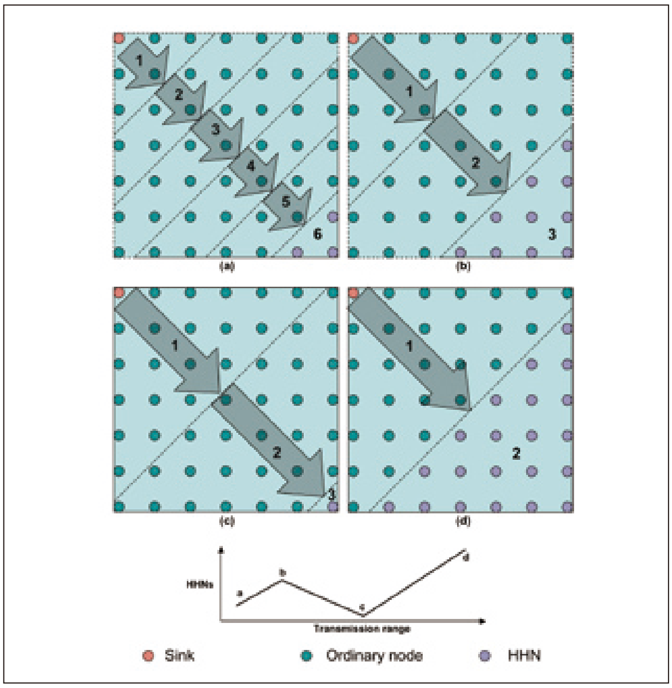

The general goal of a wireless sensor network consisting of battery-powered wireless sensor nodes is efficiently and reliably retrieving sensed information in the network by using the least amount of network resources and energy as possible. When we consider applications which periodically collect extreme values, such as maximum or minimum temperature in the monitored region, starting message transmission from the edge of network toward the sink, i.e. a center of information collection, is the most efficient and effective. More specifically, nodes furthest from the sink, called *highest hopcount nodes* (HHNs), first broadcast messages containing sensed value at regular intervals. For saving energy and bandwidth, a neighbor node closer to the sink forwards a message only if either of the received value or its sensed value is larger than values contained in messages forwarded by neighbor nodes of the same distance from the sink.

Since HHN is relative definition, the number of HHNs changes in accordance with the transmission range of radio signals. When the transmission range is small, radio signals emitted by a node are received by only a few nodes in the proximity. In Fig. (a), a red node at the upper-left corner of the square region is the sink and five nodes in the triangular area indicated by "1" are at the hopcount distance of 1 for receiving radio signals of sink. The number of nodes in area 2, which are in the transmission range of nodes with hopcount 1, is also small. Consequently, the number of HHNs in the furthest area numbered 6 becomes small as illustrated in Fig. (a). As the transmission range increases, the number of HHNs first increases for having more nodes in the transmission range as in Fig. (b) and then decreases for the border effect as in Fig. (c). The further increase in the transmission range results in division of the region into two and sudden increase in the number of HHNs as shown in Fig. (d). After this point, the number of HHNs gradually decreases again.

The scheme can reduce the energy consumption by more than 30% and can be incorporated with a routing mechanism and a sleep scheduling algorithm for further energy-efficient periodic monitoring.

Transverse Field Effects on DNA-Sized Particle Dynamics

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Next-generation DNA Sequencers need major technical advances to provide low cost and high speed demand, which are in demand in genome research. Characterizing the genetic components of disease at low cost and high speed will make application of genetic information to medical diagnostics and treatment possible. Such a sequencer might also be useful for evaluating food safety, investigating crime, and to provide identification for security purposes. However, the high cost and low speed of current DNA sequencing constitute serious barriers to these applications. A promising theoretical approach to ultra-fast DNA sequence read out is to scan a transverse electrical current across an individual DNA molecule while it translocates through a nanopore. Experimental validation of the feasibility of this sequencing mechanism requires two closely spaced nanoelectrodes with the gap size precisely adjusted to the DNA diameter. The transverse electrical current in a sub-picoampere range, which is already low, would increase exponentially with decrease in DNA-electrode tunneling distance. We report a novel experimental platform for single-molecule DNA sequencing. Our system incorporates a microfluidic channel into the *self-break junctions* that we have recently developed. We applied this system to the electrical characterization of single DNA-sized particle dynamics in the channel. The capability of fine-tuning the electrode gap size allowed electrical detection of the individual particles flowing through the nanogaps. We find that the particle translocation slows down as a consequence of the transverse electric field-induced electrode-particle interactions. The present results suggest this transverse electric field control is capable of characterizing DNA translocations through a nanopore.