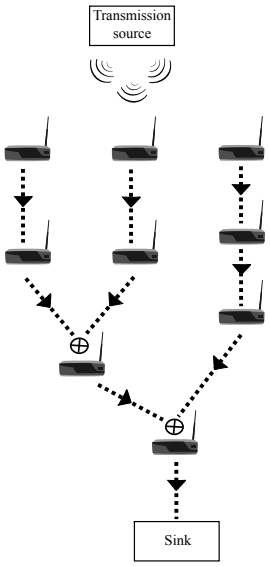
Master's Thesis

Energy-Efficient Data Collection in Distributed WSNs

Using Wireless Sensor Networks (WSNs) for data collection is a common interest for many applications such as wild life monitoring or acoustic environments. For such applications, our network architecture is a distributed WSN, where multiple nodes can act as a distributed antenna receiver so that data is collected at a central node, to apply diversity combining for an improved reception [1].
One of the main challenges, especially for large networks, is collecting the sensed signals from multiple sensor nodes at a sink node. On one hand, it is possible that the sensed signals from a single source node are too weak for further data processing. On the other hand, collecting all data streams from multiple nodes (for the same activity) will result in a network stress; packet losses and lower life time.
In the literature, several algorithms have been proposed that offer efficient data collection such as clustering [2] and tree-based [3]. These approaches mainly rely on collecting the sensed signals on one or more nodes, combining them, and forwarding only the combined information to a sink/gateway node. They, however, ignore the fact that data may be processed along the path, resulting in different data rate.



Expected Solution

Goals of the thesis

The aim of this thesis is to jointly select the combining nodes and find a route between the source and sink nodes, along which the signals are combined. In the thesis, candidate will be given a centralized solution that can find an optimal data collection path. Then, the objective is to develop a distributed solution and integrate power allocation for wireless transmissions, so that data is collected as fast as possible.

Possible milestones to reach include: Literature review of data collection protocols; implementation of a distributed protocol and incorporation of power allocation; evaluation of system reliability and energy efficiency; and performance comparison with state of the art and centralized approach.

Required skills (or willing to learn)

Python/C++ and networking basics.

In-cooperation

This thesis is being offered (and will be conducted) in cooperation with the Computer Networks group (Prof. Karl).

[1] M. Nabeel, B. Bloessl, and F. Dressler, "Efficient Receive Diversity in Distributed Sensor Networks using Selective Sample Forwarding," *IEEE Transactions on Green Communications and Networking*, vol. 2, no. 2, pp. 336–345, Jun. 2018. DOI: 10.1109/TGCN.2017.2780196.

[2] L. Xu, R. Collier, and G. M. P. O'Hare, "A Survey of Clustering Techniques in WSNs and Consideration of the Challenges of Applying Such to 5G IoT Scenarios," *IEEE Internet of Things Journal*, vol. 4, no. 5, pp. 1229–1249, Oct. 2017. DOI: 10.1109/JIOT.2017.2726014.

[3] O. Gnawali, R. Fonseca, K. Jamieson, M. Kazandjieva, D. Moss, and P. Levis, "CTP: An Efficient, Robust, and Reliable Collection Tree Protocol for Wireless Sensor Networks," *ACM Transactions on Sensor Networks*, vol. 10, pp. 1–49, Dec. 2013. DOI: 10.1145/2529988.

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