Bachelor's Thesis

« Managing Transmission Power through Reinforcement Learning to Avoid Self-interference. »

Background

Over the last few years, wireless networks have become increasingly popular in industrial applications due to their flexibility and cost-efficiency. Therefore, the IEEE 802.15.4 standard has been extended by several sub-standards to increase reliability and scalability in these applications. One of these sub-standards is the *Deterministic and Synchronous Multi-channel Extension* (DSME). It provides TDMA-based channel access and a distributed 3-way handshake for slot allocation. An open-source implementation of DSME, called openDSME[1], is currently developed at the Institute of Telematics. It is capable of running on various hardware platforms as well as in the discrete event simulator OMNeT++[2].

In DSME, a single channel is used during the *contention access period* (CAP). Here, nodes communicate using CSMA/CA to allocate exclusive transmission slots during the *contention free period* (CFP). A collision occurs if two nodes or more try to send a packet at the same time, resulting in lost packets. Thereby, the used transmission power is dictated by the underlying real-time operating system. Usually, the maximum transmission power is chosen which, however, is mostly not appropriate. If nodes reduced their transmission power, the channel could be accessed by multiple nodes at the same time through spatial reuse.

To make this work, nodes have to estimate the required transmission power for communication with each neighbor. This can be done through *reinforcement learning* (RL). A learning agent first selects random transmission powers for communication and gradually learns which power is appropriate for every neighbor. The key is finding appropriate rewards for the RL algorithm.

Goal of the work

The goal of this thesis is to design an RL algorithm to predict the required transmission power for communication with every neighbor. Different algorithms should be discussed and an appropriate algorithm should be selected and implemented. Results should be obtained from network simulation and hardware experiments. For this, solid knowledge of C++ is required and basic knowledge about communication networks should be present. Experience with RL and network simulators is not required but beneficial.

[1] http://opendsme.org/
[2] https://omnetpp.org/

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