Reliable Virtual Sensing for Wireless Sensor Networks

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Several “energy-hungry” sensors such as gas detectors, radar, and cameras have excessive energy dissipation. Virtual sensing is a technique which “breaks the downward spiral” between energy expenditure and events-miss probabilities. The idea is to deactivate main sensors and utilize a set of energy-friendly HW & SW components instead. However, reliability of such systems composed of virtual and real sensors should be as high as possible.

In this article, a novel approach is proposed to improve the virtual sensing reliability. An ontology on sensor-environment relationships is utilized to automatically generate rules before deployment to switch between real and virtual sensors. We illustrate the general approach by a case study: we show how reliable virtual sensing reduces the energy consumption and event-miss probabilities of object tracking applications. Seismic sensors and a dynamic time-warping algorithm shape the virtual object tracking sensor. We validate the precision of such virtual sensors over several experiments.

A series of experiments with a network of TelosB sensor nodes show that virtual sensors have much less energy consumption than a Doppler µ-radar (real) sensor. Finally, we evaluate event-miss probabilities and lifetime extension by using the WSNet simulator.

This is a joint-work with Mohamed Abdelaal, Prof. Dr.-Ing. Oliver Theel, and Prof. Dr. Daniela Nicklas