ETH
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Institut für Technische Informatik
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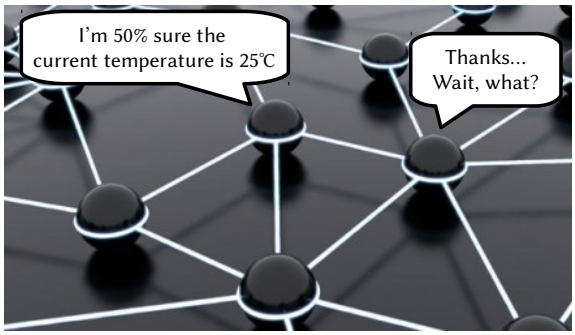
Semester Thesis:

Uncertainty in Collaborative Sensor Network Calibration

Motivation and Informal Description: Distributed sensor networks consisting of large numbers of inexpensive sensors have become popular means to observe the environment. For instance, in the OpenSense[1] project multiple low-cost air pollution sensors are installed on top of trams to measure the air quality throughout the entire city of Zurich.



Providing reliable data quality is a key factor in these sensing deployments. Unfortunately, low-cost sensors often lack sufficient accuracy due to serious error sources[2]. In order to improve the data quality of existing and future sensor networks, active research efforts are devoted to counteract these limitations with appropriate *sensor calibration* methods. One particular way to calibrate sensors in a network is called *collaborative calibration*. It relies on the principle that accurate, or freshly calibrated sensors, transfer their calibrated measurements to other sensors. The receiving sensor then uses these measurements to adapt, i.e. calibrate, its own measurements.

Task: In this thesis we want to extend the idea of collaborative calibration by not only transferring calibrated measurements but also *corresponding uncertainty metrics* to other sensors. These uncertainty metrics help to assess the reliability of the measurements. For instance, a sensor may also provide a range within it believes the true measurement lies. The narrower the range, the more certain the sensor is about its measurement. Further, these uncertainty metrics can also be used to improve the collaborative calibration process, e.g. by filtering measurements with high uncertainty before they are used to calibrate a sensor.

This thesis will involve the following rough tasks:

- Familiarize yourself with related work, in particular sensor network calibration and theoretical basics of uncertainty metrics.
- Develop and implement methods to *(i)* generate uncertainties for sensor measurements and *(ii)* integrate those into collaborative calibration methods to optimize their performance.
- Test and evaluate your approach on real data using different OpenSense air quality sensor datasets.

Requirements: Basic knowledge and interest in theoretical and practical aspects of algorithms and numerical methods. Previous experience with MATLAB or python (or the numerical tool of your choice) is advantageous.

Interested? Please have a look at http://www.tec.ethz.ch/research.html and contact us for more details!

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[1] https://gitlab.ethz.ch/tec/public/opensense
[2] http://people.ee.ethz.ch/~bmaag/files/maag18survey.pdf