Forschungspraxis

# Experimental Evaluation of Remote State Estimation in WSN

Thanks to the ease of deployment and low cost, Wireless Sensor Networks (WSN) is a good candidate technology for many applications. In the context of industrial applications, WSN provides the necessary communication infrastructure for sensors and actuators to wirelessly operate in closed-loop control systems called Networked Control Systems (NCSs).

In state-of-the-art NCSs, a remote state estimator calculates the Minimum Mean Square Error (MMSE) estimate of the system's state, which is then used by the controller to compute the actuation command. WSN devices, however, are subject to packet loss due to the low-power communication technology and external disturbances. This effect severely degrades the quality of estimation and can lead to the instability of the system under control. For this reason, an MMSE estimator operating over lossy WSN must take the stochastic packet loss into account [1,2].

In this work:

- An industrial wireless sensor network will be deployed using Zolertia Re-Motes and the Contiki-NG firmware.
- A measurement-based model of the WSN channel quality will be derived and included in the MMSE filter model.
- The quality of estimation of the MMSE filter will be evaluated and compared to [1].

This work will consist of the significant amount of programming for embedded devices, and for a large part also of processing the measurements data.

[1] Soleymani, Touraj, et al. "Covariance-based transmission power control for estimation over wireless sensor networks." 2018 European Control Conference (ECC). IEEE, 2018.

[2] Zoppi, Samuele, et al. "Transmission Power Control for Remote State Estimation in Industrial Wireless Sensor Networks." arXiv preprint arXiv:1907.07018 (2019).

## Prerequisites

- Strong C and Python programming skills.
- Good knowledge of wireless systems and protocols (WSN).
- Basic knowledge of LTI control systems.
- Experience with python data processing tool is beneficial.
- Experience with embedded systems is beneficial but not required.

## Advisors

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