TNE090 Wireless Sensor Networks

Course Information

Intended learning outcomes

This course intends to provide knowledge of wireless sensor network communication and sensor data processing. This course also presents hands-on experience of designing wireless sensor network remote monitoring and control system.

- Understand system requirements and applications in wireless sensor network
- Explain different protocols in wireless sensor network
- Design wireless remote monitoring and control systems
- Understand principles behind sensor data processing

Course content

- Wireless sensor network system design
- Basics of wireless communications
- PHY and MAC layer protocols
- Statistical signal processing and machine learning algorithms

Teaching and working methods

Lectures, labs and project work. Labs and project work are mandatory and will be presented orally and in writing.

Examination

PRA1: Project work with oral and written report, U,3,4,5, 3 credits

LAB1: Laboratory work, U,G, 3 credits

Prerequisites:

C-programming, basic electronic circuit theory.

Organization:

Lectures, labs and project work. Labs and project work are mandatory and will be presented orally and in writing.

Detailed course content and lectures:

- Sensor networks: Challenges and applications
- Fundamentals of wireless networks
    - OSI model
- Basics of wireless communications
    - BER, capacity, modulation
    - OFDM and spread spectrum systems
    - MIMO
- Medium Access Control (MAC) protocols and routing algorithms
- Case study: 802.15.4 standard and smart grids
- Sensor fusion: statistical methods
    - Estimation and Kalman filtering
    - Detection
- Machine learning:
    - Classification, regression, clustering
    - Basics of deep learning

References: (Available online via LiU library) Selected chapters from:

- Fischione C., *An Introduction to Wireless Sensor Networks*. Online.
- Dargie W, Poellabauer C. *Fundamentals of Wireless Sensor Networks. Theory and Practice*. Wiley; 2010.
- Akyildiz IF, Vuran MC. *Wireless Sensor Networks*. Wiley; 2010.
- Goldsmith, A. *Wireless Communications*. Cambridge University Press; 2005.
- Kay SM. *Fundamentals of Statistical Signal Processing*. Prentice Hall
- Hastie T, Tibshirani R, Friedman J. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Springer.
- "IEEE Standard for Low-Rate Wireless Networks," *IEEE Std 802.15.4-2020,* July 2020.
- Tanenbaum AS, Wetherall D. *Computer Networks*. 5th ed., Pearson; 2011.

Labs:

- Matlab based lab assignments
- Simulation of wireless fading channels, BER performance, OFDM, CDMA, MIMO communications
- Implementing basic sensor fusion algorithms

Projects:

- Two parts
- Part 1: Case study of protocols and advanced aspects of WSNs
- Part 2: Implementation of sensor data processing algorithms