Karlsruhe Institute of Technology

Intelligent Sensor-Actuator-Systems

RSSI-Based Localization of mobile Agents with Bayesian Neural Networks

Bachelor/Master Thesis
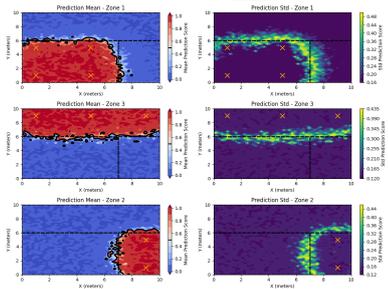
Indoor localization in warehouse environments remains a significant challenge. The absence of GNSS signals, frequent signal obstruction by high-bay racking, and constantly changing stock levels create a highly dynamic and "noisy" electromagnetic environment. For safety-critical applications—such as preventing collisions between autonomous forklifts and pedestrians—robust and reliable localization is essential. Bluetooth Low Energy (BLE) provides a cost-effective infrastructure for this, utilizing Received Signal Strength Indicator (RSSI) fingerprinting. However, RSSI signals are notoriously volatile; extracting precise position data requires sophisticated probabilistic modeling to account for this inherent uncertainty.

What to do

- Probabilistic Modeling: Deepen your understanding of Bayesian Neural Networks (BNNs) and how they capture epistemic and aleatoric uncertainty.
- System Integration: Develop a framework to use BNNs either as a learned measurement equation (mapping position to expected RSSI) within a filter (e.g., Particle or Kalman Filter) or as a direct regressor for coordinates.
- Implementation in Python: Build the training pipeline and inference engine.
- Evaluation: Benchmark the BNN approach against traditional deterministic models using real-world warehouse datasets, focusing on both accuracy and the reliability of the predicted uncertainty bounds.

Requirements
Students in Computer Science, Robotics, Electrical Engineering, Mechatronics or related. You should have a good idea of probability theory and machine learning. Experience in scientific programming in Python is welcome. Strong self-motivation, endurance and mathematical problem solving skills are expected.

Emphasis:

Theoretical Study	
Software Implementation	
Hardware Implementation	

We offer:

- excellent support and advice
- highend infrastructure
- contact to industry and research partners

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Language:

German or English