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Master's Thesis

Industrial Low-power Wireless Environment Monitoring with Machine Learning

One of the many promises of 5G is that it will enable novel applications for vertical industries like manufacturing and logistics. An overview of the foreseen use cases and corresponding requirements to the communication system can be found in the technical report TR 22.804 by 3GPP. In this context, Germany's spectrum authority BNetzA is aiming to support the adoption of 5G in vertical industries by making available the frequency band 3.7-3.8 GHz for so-called private 5G networks. In such private networks, landowners (of a factory, harbor, airport, etc.) can either set up and operate their own infrastructure on-premise or outsource these tasks to a third-party, e.g., a mobile network operator.

As communication networks in the industrial domain have stringent Quality-of-Service requirements w.r.t. latency, reliability, etc., the objective of this work is to develop a software and hardware platform for monitoring such parameters in wireless networks, e.g., in order to document the reliable operation and integrity in a private network. Because of the emergence of advanced computing platforms and the widespread availability of data through the Internet, the field of machine learning has received lots of attention from the research community. Particularly, large progress has been made in the field of deep learning, where the approach to solving problems has shifted from creating accurate models to gathering lots of measurements. The aim of this work is also to identify and use machine learning methods where appropriate, in order to solve the above-mentioned task.

The following approach is envisioned:

- Develop a hardware platform for recording wireless signals (e.g., based on off-the-shelf software-defined-radios)
- Collect traces of wireless signals in a private network
- Develop and evaluate a method to construct a radio environment map based on suitable wireless metrics (e.g., signal strength), using modern machine learning approaches where appropriate
- Consider wireless standards agnostic as well as wireless standards specific metrics
- Investigate the use of mobile sensor nodes vs. fixed sensor nodes

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