For our location in **Gratkorn/Austria..** we are looking for a

Master Thesis: Carrier Phase-Based Ranging for Smart Car Access Systems (m/f/d)

NXP Semiconductors enables secure connections and infrastructure for a smarter world, advancing solutions that make lives easier, better and safer. As the world leader in secure connectivity solutions for embedded applications, we are driving innovation in the secure connected vehicle, end-to-end security & privacy and smart connected solutions markets.

Scope:
Modern cars are equipped with a passive keyless entry & start (PKES) system which allows users to access and start the car without actively using the key fob. Existing systems use a combination of two technologies: a low-frequency (LF) magnetic field to determine the location of the fob (ranging), and an ultra-high radio frequency (UHF/RF) link to establish communication between fob and car. Because LF magnetic fields remain largely undisturbed by environmental factors including human body effects, the fob location can be accurately determined by measuring the received field strength (RSSI).
Given the ubiquity of smart devices (phones, watches, etc.) there is a shift towards smart car access systems, with LF/UHF being replaced by existing RF technologies. Due to its wide availability in smart devices, Bluetooth is one of the potential RF technologies for a PKES system where it will be used for both ranging and communication between device and car. In addition to using RSSI and time of flight, ranging information can be obtained from phase shifts induced at multiple carrier frequencies.
In this master thesis you will investigate algorithms for carrier phase-based ranging and assess their applicability to smart car access using Bluetooth.

Objectives:

- Review literature on carrier phase-based ranging algorithms (MUSIC, ESPRIT, maximum likelihood, sparse Bayesian learning, …)
- Develop and implement algorithms in Matlab using existing RF transceiver model and compare algorithm complexity
- Evaluate impact of different channel models and transceiver imperfections (IQ phase/gain imbalance, phase noise) on ranging performance
- Perform measurements in a real-world car access scenario using Bluetooth devices and evaluate algorithm performance on measurement data

Your Profile:

- Master student in electrical engineering, software engineering, or similar studies
- Interest in development and Matlab implementation of signal processing algorithms
- Basic knowledge in Matlab programming
- Eager to interact with an international team of system, hardware, and software engineers

For the successful completion of the Master Thesis you will receive a remuneration of a one-time payment of EUR 5.150, - gross. Additional you will get a bonus of EUR 2.000, - gross if you receive an excellent grade “Sehr gut” for your Thesis.

NXP Talent Acquisition Team
Stefan Repija