List of open MSc topics (each one is independent on the others)

Please note that these are <u>unfunded</u> topics, unless in exceptional cases. The student's benefit would be to complete his/her MSc thesis on a topic of high relevance in today's wireless world and to get hands-on expertise on a project work. Some of the topics may involve measurements and crowd data processing. The earliest time they can be started (in terms of supervision) is 22nd of Jan 2018

AREA2: GNSS

1. **<u>Spoofing detection and localization via TDOA, AOA and FDOA methods in aviation (for high-altitude vehicles)</u>.**
   The analysis will comprise at least the followings:
   - literature overview,
   - Matlab implementation of 2 TDOA, AOA and FDOA detection and interference localization techniques
   - comparison between various algorithms

   Learning outcomes/Benefit for the student: student will gain significant knowledge about GNSS and impairments mitigation; he/she will also develop his/her analytical and programming skills in Matlab.
   Needed skills: good Matlab knowledge, digital communication background, preferably some knowledge about satellite navigation

2. **<u>Jamming detection and localization via DRSS, VTDOA, AOA and VFDOA methods in aviation (for high-altitude vehicles)</u>.**
   The analysis will comprise at least the followings:
   - literature overview,
   - Matlab implementation of 2 detection and interference localization techniques
   - comparison between various algorithms

   Learning outcomes/Benefit for the student: student will gain significant knowledge about GNSS and impairments mitigation; he/she will also develop his/her analytical and programming skills in Matlab.
   Needed skills: good Matlab knowledge, digital communication background, preferably some knowledge about satellite navigation

AREA3: Localization for industrial internet applications

3. **<u>3D indoor localization of a moving machine for reliable multi-connectivity applications</u> .**
   The analysis will comprise at least the followings:
   - literature overview of Industrial internet and indoor applications
   - analysis and software implementation of AOA-based 3D positioning in two scenarios: cm-wave and mm-wave communications

- impact of machine velocity & number of available edge access notes on the positioning estimates
- location-based reliability measures investigation

Learning outcomes/Benefit for the student: student will gain significant knowledge about industrial internet and 3D positioning; he/she will also develop his/her analytical and programming skills in Matlab.

Needed skills: good Matlab knowledge, digital communication & signal processing background

AREA4: 5G

4. **<u>Study the potential of 5G communication as low-cost alternatives of aviation operation for the grount-to-air control segment</u>**

The analysis will comprise at least the followings:

- literature overview: investigate to what extent the cellular systems (from 3G to 5G) can complement the existing aviation data links, by making use of dynamic spectrum sharing, location–based beamforming and mmWave spectrum
- Matlab implementation of basic mmWave beamforming transmitter-receiver chain for the ground-to-air control segment
- analysis based on literature and simulation results focusing on throughput as performance criterion

Learning outcomes/Benefit for the student: student will gain significant knowledge about communication needs in aviation traffic control; he/she will also develop his/her analytical and programming skills in Matlab and 5G domain.

Needed skills: good Matlab knowledge, digital communication background, preferably some knowledge about satellite navigation and/or communications needed in aviation

5. **<u>Study the potential of 5G navigation as a supplement to GNSS positioning</u>**

The analysis will comprise at least the followings:

- literature overview: investigate how to hybridize 5G positioning with GNSS
- Matlab implementation of a basic hybrid navigation solution 5G-GNSS
- analysis based on literature and simulation results focusing on positioning and tracking accuracies as performance criteria

Learning outcomes/Benefit for the student: student will gain significant knowledge about navigation needs in aviation traffic control; he/she will also develop his/her analytical and programming skills in Matlab and 5G domain.

Needed skills: good Matlab knowledge, digital communication background, preferably some knowledge about satellite navigation and/or communications needed in aviation

6. **Expand the multi-floor Matlab indoor simulator** that we have now for RSS-based positioning to support also AOA and TOA-based positioning, as well as hybrid RSS-AOA-TOA positioning

The analysis will comprise at least the followings:

-understanding our current Matlab simulator

- literature overview on AOA and TOA positioning estimates
- expanding of our current simulator to support AOA and TOA and hybrid positioning estimation
- analysis based simulation results focusing on positioning and tracking accuracies as performance criteria

Learning outcomes/Benefit for the student: student will gain significant knowledge about indoor positioning; he/she will also develop his/her analytical and programming skills in Matlab and future wireless communications.

Needed skills: good Matlab knowledge, digital communication background.

7. **Implement a channel model for aviation and test its throughput with a basic LTE/OFDM signal configuration .**

The analysis will comprise at least the followings:

- literature overview of wireless channel models used in aviation and of LTE standard
- Matlab implementation of a channel model for aviation (student choice based on his/her literature search)
- Matlab implementation of an LTE transmitter-receiver chain (existing open-source models from Matlabexchange page can be used)
- Testing the throughput over the created channel with different parameters

Learning outcomes/Benefit for the student: student will gain significant knowledge about aviation domain and communication links in aviation; he/she will also develop his/her analytical and programming skills in Matlab.

Needed skills: good Matlab knowledge, digital communication & signal processing background

Requirements and grading

- **grade 1:** moderate understanding of the challenge, basic literature survey and basic software implementation with at least some partial results ready
- **grade 2:** moderate understanding of the challenge, moderate literature survey, working software implementation and simulation-based or measurement-based results according to the initial objectives
- **grade 3:** very good understanding of the challenge and state-of-the-art, good and extensive literature survey, a working software implementation, simulation-based or measurement-based results according to the initial objectives, and comparative analysis of your results with the state-of-the-art results, ability to work independently to some extent
- **grade 4:** very good understanding of the challenge and state-of-the-art, very good and extensive literature survey with a lot of individual and independent work (i.e., not only going through the provided papers, but searching related work by yourself), a working and well-written/well-documented software implementation, possibly with a Graphical User Interface (GUI), full and detailed simulation-based or measurement-based results (new results compared to the initial objectives highly desired), comparative analysis of your results with the state-of-the-art results, analytical thinking in analyzing and interpreting the results, fast progress of the thesis work (target time: less than 6 months from the thesis start), innovativeness in the research (e.g., new algorithms, coming with new ideas based on the read papers, new implementational approaches, etc.)

- **grade 5:** excellent understanding of the challenge and state-of-the-art, excellent and extensive literature survey with a lot of individual and independent work (i.e., not only going through the provided papers, but searching related work by yourself), excellent level in English technical writing, a working and well-written and well-documented software implementation, possibly with a Graphical User Interface (GUI), simulation-based or measurement-based results, deep comparative analysis of your results with the state-of-the-art results, analytical thinking in analyzing and interpreting the results, fast progress of the thesis work (target time: less than 4 months from the thesis start), innovativeness in the research (e.g., new algorithms, coming with new ideas based on the read papers, new implementational approach, etc.) and one submitted publication based on your thesis work

Note: At TUT, the min. number of MSc thesis pages: 42 pages (without references & lists of tables and figures); no upper limit, but preferably no more than 100 pages