Master Thesis -
Energy Efficient Positioning in Industrial Environments Using Machine Learning

Ericsson Research
Ericsson Research develops new communication solutions and standards. The organization has the responsibility to provide Ericsson with world-class system concepts, technology innovations, and methodologies. The rapidly increasing demands for mobile broadband access in combination with needs for new technology and solutions for the digitalization of industries and societies creates challenging and exciting opportunities for our organization. Building on our experience from real network operations, profound knowledge about existing standards, and forward-looking research, we invent and master advanced concepts and solutions that shape today’s and tomorrow’s mobile radio communication.

Background
Traditionally, positioning is a service added to an existing radio network deployment, for example to enable positioning of emergency calls. There is an interest in precise positioning as part of connectivity and communication services to industrial internet of things (IIoT). 5G can enable digitalization in industry use cases while ensuring robustness, interoperability and long-term support. There are numerous activities in standardization and in industry interest organizations to analyze and consolidate requirements from these use cases. Some use cases can comply with crude accuracy requirements, while other use cases require positioning accuracies in decimeters and very high availability.

Radio network deployment involves placement of base stations, antenna height/direction/tilt, need of transport network between base stations and other network nodes, user distribution/behavior/services and much more. In addition to transmission and reception of radio signals for communication, base stations also transmit radio signals that are specifically designed for positioning. Such additional radio signal transmission demands energy surplus at the base stations.

The ambition with this master thesis is to analyze energy consumption surplus at the base stations when they transmit radio signals for positioning and to come up with a strategy that optimizes transmission of positioning radio signals from the base stations in terms of energy efficiency while at the same time do not reduce the achievable positioning accuracy as compared to the case with no energy consumption constraints.

Thesis Description
The following steps are envisioned as part of the thesis work:

- Study theoretical positioning performance analyses in literature for a selected set of positioning solutions.
- Define an industry scenario in a simulation model.

Contact Persons
Samuel Axelsson  
+46 73 8093049  
samuel.axelsson@ericsson.com

Deep Shrestha  
+46 72 5931453  
dee.shrestha@ericsson.com
• Evaluate achievable positioning accuracy when there is no bound in terms of energy consumption while transmitting radio signals from base stations for positioning.

• Evaluate energy consumed at the base stations while transmitting radio signals for positioning.

• Propose strategies to achieve energy efficient transmission of radio signals for positioning with an achievable positioning accuracy on par with the case when there is no bound on the energy consumption at the base stations.

Radio signals that are transmitted by the base stations are called positioning reference signal (PRS) in radio access technology (RAT) based positioning methods. The user equipment (UE) listens to PRSs transmitted by as many base stations as possible to achieve a decent positioning accuracy. While the PRS transmission (in addition to communication signal transmission) results in energy consumption surplus at the base station, not all PRSs received by the UE enhances the achievable positioning accuracy. In this regard, depending on the employed positioning method, it becomes utmost important to understand the balance between energy consumption by the base stations when they transmit PRS and the achievable positioning accuracy.

Energy efficient PRS transmission strategy for a decent positioning accuracy may be realized based on some parametric methods. However, when the number of UEs that needs to be localized increases the parametric methods are not very efficient. With a skilled student in the ML art, we can then move towards a more ML oriented approach that can be very interesting with the ambition to address general PRS transmission strategy that balances energy consumption and the achievable positioning accuracy given a fixed deployment of base stations.

The thesis will be concluded with a result presentation for the Ericsson research team.

Qualifications
This project aims at students in computer science, computer engineering, electrical engineering or similar. Background in wireless communication is preferred.

Extent
1-2 students, 30hp each

Location
Ericsson AB Mjärdevi, Linköping

Preferred Starting Date
Spring 2021

Keywords
5G, positioning, Matlab, machine learning

Contact Persons
Samuel Axelsson
+46 73 8093049
samuel.axelsson@ericsson.com

Deep Shrestha
+46 72 5931453
dee.shrestha@ericsson.com