



## Master thesis project: Distributed Intelligence for Safe and Explainable Human-Robot Collaborative Operations

### Ericsson Overview

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We are truly a global company, operating across borders in over 180 countries, offering a diverse, performance-driven culture and an innovative and engaging environment. As an Ericsson employee, you will have freedom to think big and the support to turn ideas into achievements. Continuous learning and growth opportunities allow you to acquire the knowledge and skills necessary to progress and reach your career goals. We invite you to join our team.

### Position summary

In an automated warehouse where autonomous robots load trucks with products while sharing the same environment with humans, a proper safety analysis is performed to avoid the hazardous situations without compromising the productivity. We have a basic safety analysis mechanism using image processing for object identification and risk assessment and mitigation (using fuzzy logic, RL approaches) to provide safety. The tasks of this thesis will be to extend the safety model: (1) adding safety from communication perspective i.e. among robots and between the robot and the edge / cloud; (2) performing highly-computational processing in edge / cloud; (3) looking into the Explainability of the used AI (XAI) techniques for Trustworthiness perspective; (4) model compression to run complex deep learning architectures in devices with limited hardware.

The high-level task is to perform safety analysis and image processing in the cloud and locally at the attached hardware and comparing both with respect to safety, performance, energy usage in human-robot collaborative use case.

**This thesis is suitable for 2-3 students. The thesis would involve the following steps (can be adjusted to research interest of the candidate(s)):**

- Literature review, identifying relevant concepts and algorithms for safety analysis and image processing involving communication between robot and the cloud.
- Propose a suitable edge/cloud -based and D2D communication for collaborative robots.
- Model and implement the technique for different scenarios of the selected use case.
- Use real robots for testing the software for the presented use case.
- Performance evaluation for edge/cloud-based and D2D scenarios.
- Performance evaluation for explainable AI.

### Qualifications

We are looking for 1-2 open-minded students who seek a challenging research work with the freedom to propose and develop your own ideas. To be successful in this thesis work the candidate(s) would need the following:

- MSc studies in Computer Science, Electrical and Computer Engineering or similar area.
- Excellent programming skills in C/C++, or Python or Java or Matlab.
- Good knowledge of concepts in machine learning (e.g. deep learning), robotics, ROS, etc.
- Experiences with machine learning libraries Tensor flow, Keras, PyTorch, sci-kit learn etc.
- Knowledge of safety analysis techniques, XAI, communication protocols and technologies (edge/cloud, D2D) is a bonus.
- Like to build end to end prototypes and concepts.
- Be fluent in English.