Proposals for master thesis projects, Spring 2024

Thesis project title	Short description
Path Planning for UAVs on Cellular Networks (Supervisors: Fernando dos Santos Barbosa)	The main goal is to develop a path planning algorithm for unmanned aerial vehicles (UAVs) that accounts for the challenges and risks encountered when operating over a city, which might include network connectivity, distribution of people, weather, battery consumption and risk of accidents. We envision using a mix of novel machine-learning and AI tools together with traditional planning algorithms, such as RRT and A* to address this problem.
Safe Reinforcement Learning with Control Barrier Functions (Supervisors: Adam Miksits, Fernando dos Santos Barbosa)	When training and deploying reinforcement learning (RL) agents for real robots, it is essential to ensure safety. Ericsson Research has recently studied shielding and trust region policies to achieve safety on both a simulated and a real robot. To bridge the gap between simulation and reality, we also used domain randomization during RL training. This thesis will try other methods, such as control barrier functions, to achieve safety during training and deployment, and compare the methods with respect to safety and other performance metrics.
Discrete-time Control Barrier Functions for Safe Navigation of Networked Mobile Robots (Supervisors: Adam Miksits, Fernando dos Santos Barbosa)	To improve robot flexibility and reduce costs, control algorithms are being moved from the robot to the edge/cloud. In this case, it is important to ensure robot safety despite possible network interruptions. This thesis project will investigate how discrete-time control barrier functions could be used to achieve safety guarantees under network outages.
Visual Servoing with Compressed Images (Supervisors: David Umsonst, Andre Mateus, Jose Pedro)	Visual Servoing is a popular control algorithm that uses images as sensor inputs to move robots to a desired pose. In this thesis, we want to investigate how the control performance changes when visual servoing is offloaded to a remote server and compressed images are used to determine the control commands.
Manipulation-on-the-Move over the Network (Supervisors: Mina Ferizbegovic, Roberto Castro Sundin, David Umsonst)	In this thesis, we investigate a smooth package delivery problem consisting of two robots - a mobile robot delivering a package to a robotic manipulator. We want the manipulator to

	smoothly pick up the package, while the mobile robot drives by. For that, we would like to extend existing Manipulation-on-the-Move algorithms to a networked control setup and compare it to our inhouse developed algorithms.
Multi-rate Control over the Network (Supervisors: Fernando dos Santos Barbosa, David Umsonst)	Control algorithms can often be divided into high-, mid- and low-level controllers, where the low-level runs at very high frequency, and mid- and high-level controllers at lower frequencies. In this thesis, we will investigate the effects of distributing these layers among device, edge and cloud, over the network. The main goal of this thesis is to determine if safety and tracking performance can still be guaranteed when the network suffers outages.
Network-aware 3D scene graph representation (Supervisors: Alejandra Hernandez Silva, Clara Gomez Blazquez, Jose Araujo)	3D scene graphs offer a powerful way to represent the environment through a hierarchical layered structure that collects varied information such as objects, rooms, 3D structures, etc., valuable to allow robots/devices to perceive, plan, and interact intelligently in the real world. In this project, we will integrate network information into a 3D scene graph representation and exploit this new information to improve robotic tasks such as path planning to best adapt to network conditions.
Leveraging room information for enhanced loop closure detection (Supervisors: Alejandra Hernandez Silva, Clara Gomez)	Semantic understanding of the environment is a fundamental requirement for robotic systems and XR glasses. 3D scene graphs constitute a hierarchical representation of the surroundings that integrates geometric and semantic information at multiple levels of abstraction. 3D scene graphs are becoming an essential component of Simultaneous Localization and Mapping (SLAM) systems. This thesis aims to integrate semantic room information into a 3D scene graph and take advantage of this new information in the SLAM loop-closure detection strategy to reduce localization errors.