Multimodal and Redundant Peer to Peer communication for Robots in Noisy Environments

↗ Area | 📡 Infrastructure and Connectivity

Introduction

📢 Since decades automation of industrial processes increases the yield of production in many different branches and fields. After the third industrial revolution robots were broadly put in place. However, the amount of exchanged data was decent and often possible in a wired physical layer. Recently, the 4th industrial revolution as well as mobile robots are on the rise. This brings two practical implications w.r.t. the requirements for the communication stack of data. First, wires are often not an option anymore and thus wireless data communication becomes necessary. Secondly, the robots become more flexible and collect increasing amounts of data. Particularly, the problem at hand looks at a new generation of collaborative mobile robots which work together to perform tasks in the physical world. This can reach from handling materials to performing production steps collaboratively. The real challenge begins as soon as a fleet size increases to dozens or hundreds of robots which all use wireless technology, as the noise and interference degrades the quality of service for the wireless communication. New technologies like 5G have sufficient technical specs for many industrial cases, though they require licensing, additional infrastructure, as well as experts for setup and configuration. For this reason, this work explicitly excludes the usage of 5G and searches for alternatives which require less expertise, setup, and configuration per site.

Who is Filics?

🤖 Filics is a deep tech startup based in Munich, developing an Autonomous Mobile Robot (AMR) for logistics industry in a multidisciplinary, rapidly growing team. The product is a unit of two mobile robots, which work together to execute transport tasks for EUR pallets.

Problem description

🔥 In the case at hand, the focus lies on robots which need to exchange actor commands in real-time to be able to perform a transportation task collaboratively. The communication layer needs to be able to exchange up to 1Mbit with latencies within the real-time boundaries of the tasks between the involved mobile robots. Especially jitter is harmful whenever control loops are involved and thus makes the main concern of this work. Secondly, safety and robustness concerns need to be addressed as mobile robots operate in areas mixed with humans and any harm to humans needs to be reliably prevented.

Content

- Introduction to low latency, low jitter and high reliability wireless communication
- Find out the constraints for bandwidth, topology, latency and jitter
- Develop the OSI-Layers, topology, and protocol of the communication concept on a theoretical basis
- Develop the hardware concept for an appropriate communication system
- Develop the software concept for an appropriate communication systems
- Implement the system on a hardware and software level
- Measure the performance of the work with real robot prototypes in predefined tests. Preferably, up to the point of failure.
- Document the work

Aims of the thesis

🎯 Research, implement and evaluate a wireless communication module that enables mobile robots to collaboratively perform real-time critical tasks in noisy environments.