

Master Thesis Project

# Predictive Triggering for Multi-agent Systems

## Intelligent Resource Allocation in Distributed Control of Multi-agent Systems

Multi-agent systems are composed of multiple intelligent agents acting and inter-acting autonomously in a complex environment. Applications include, but are not limited to, multi-robot systems, autonomous driving or quadcopter swarms flying in formation. In all three settings, it would be beneficial for the agents to communicate. In the case of multiple robots working together and the swarm of quadcopters, sharing information is important for coordination. In autonomous driving, communication between the vehicles allows for adaptive traffic control, which may lead to reduced fuel consumption and fewer traffic jams.

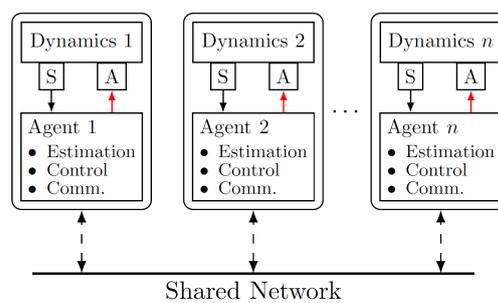
If information has to be exchanged over a common, typically wireless, network, communication becomes a shared and limited resource. Especially in settings with many agents, the bandwidth typically does not support simultaneous communication of all agents. Therefore communication has to be limited to the necessary instants and resources have to be allocated in a reasonable way.

The need for resource efficiency has led to an increasing interest in event-based control algorithms since the beginning of the century. In event-based control, information is exchanged if certain events occur (e.g. a control error growing too large). In most of these algorithms, however, the agents decide *instantaneously* if they need to communicate, thus freed resources cannot be reallocated. In this project, we aim for algorithms that can predict future communication demands and, in this way, allow the communication system to reconfigure and allocate the limited resources to the agents which need to transmit information. At the same time, we want to guarantee good control performance.

We are looking for outstanding students who are eager to do their Master thesis on a challenging research project in the area of distributed control. The project involves fundamental theoretical developments in the area of networked and distributed control, and can also be extended to experimental validation on real-world platforms.



[[https://www.its.dot.gov/communications/its\\_images.htm](https://www.its.dot.gov/communications/its_images.htm)]



MPI for Intelligent Systems, Intelligent Control Systems (<http://trimpe.is.tuebingen.mpg.de>)

The project will be carried out at the Max Planck Institute for Intelligent Systems (MPI-IS) in Stuttgart/Tübingen. The MPI-IS is a young, highly dynamic, and internationally oriented research institution with close ties to several national and international partners (e.g. University of Stuttgart, ETH Zürich, University of Southern California, KTH Stockholm). This project is open to students from any institution. Accommodation at the institute's guest house may be available for the duration of the project, and the MPI can support travel to international conferences if the project leads to such publications.

**Prerequisites:** High motivation and excellent theoretical skills. Programming experience (e.g. Python or Matlab).

**Contact:** Do not hesitate to contact us if you are interested in this project. When applying, please include your CV, grade transcript, and optionally other documents helpful to evaluate your background.

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