

# Robust controller synthesis for cyber physical systems

## Master Thesis Proposal

Department of Electrical Engineering (E2), Automation

### Background

Cyber physical systems are often used for safety-critical applications, so it is of great importance to provide formal guarantees of correctness. This project is concerned with the automatic *synthesis* of controllers that are *correct by construction*. Such synthesis typically requires techniques to reduce or partition the continuous and infinite state space. One partitioning technique currently under investigation for this purpose is called *stutter bisimulation*. Stutter bisimulation is known to work for verification, but synthesis is so far only supported when there is no disturbance in the system. The objective of this research is to extend the existing work and develop partitioning techniques that work for the synthesis of cyber physical systems where disturbance is present.

### Objectives

The overall aim of this project is to investigate the methods to construct a robust controller for a system partitioned using stutter bisimulation or similar abstraction methods. The project involves the following tasks:

- Gaining an understanding of the verification and synthesis of cyber physical systems.
- Investigating how disturbance can be modelled and handled when synthesising using stutter bisimulation.
- Implementing robust controller synthesis using the TuLiP software, which is developed at Berkeley University.

### Further Information

The project is intended for two persons, and it is in collaboration with the University of Waikato in New Zealand.

**Prerequisites:** This thesis is suitable for two students with background in system control, computer science, or similar. Good mathematical and programming skills in Python, and knowledge of linear temporal logics are meritorious.

**Intended outcomes:** The students will gain competence about cyber physical systems and the concepts of software that is correct by construction. They will also gain experience with using and developing TuLiP.

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