

Master's thesis proposal:

Automatic code generation for self-supervising control systems using Modia

Modia (<https://github.com/ModiaSim/Modia.jl>) is an experimental domain-specific extension of the Julia programming language (<https://julialang.org>) for modeling and simulation of complex physical systems. Using Modia it is easy to model and simulate a feedback control system consisting of a continuous-time plant and a discrete-time controller.

The goal of the thesis is to extend the Modia language with a few new constructs for plant and controller supervision and to facilitate automatic code generation of a self-supervising real-time control system. By including a simulation model of the plant in the runtime system, the control system will be able to supervise itself and raise an alarm or go to a safe state if the real plant states deviate too much from the simulated states. The runtime system could also collect information about the plant and use it to automatically recalibrate the simulation model and the controller. The final system will be demonstrated on one or several plants in the lab.

The thesis is a collaboration between the Automatic Control and Computer Science departments at LTH and is intended for two students. One student will be registered at each department.

- The two students will be jointly responsible for designing the new language constructs and the runtime system, including its internal logic.
- The Computer Science student will be responsible for implementing the language extensions in Modia and for the code generation in Julia.
- The Automatic Control student will be responsible for implementing the runtime system interfacing with the process and the real-time simulation of the process.

Prerequisites:

- The Automatic Control student should have taken FRTN01 Real-Time Systems.
- The Computer Science student should have taken EDAN65 Compilers.

Planned start date: January 2020

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