Master's Thesis

JOHANNES KEPLER UNIVERSITÄT LINZ

BRINGING THE DESIGN OF FEEDBACK CONTROL LAWS RIGHT INTO THE DISTRIBUTED CONTROL SOFTWARE

In cooperation with the University of Oldenburg

Current Situation

Machines and robots require specially designed control algorithms, which are usually developed in MATLAB/Simulink. These algorithms are first perfected using simulations and then transferred to the control software of the actual machine. For distributed control systems, such software is often available in the IEC 61499 language. Examples of such algorithms are either AI-based, for example using reinforcement learning, or they are classic controllers such as PID, LQR (Linear Quadratic Regulator), LQG (Linear Quadratic Gaussian Control), MPC (Model Predictive Controller). On the actual machine, these algorithms have the task of continuously adjusting the deviation between the desired and actual behavior based on measured values.

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Background

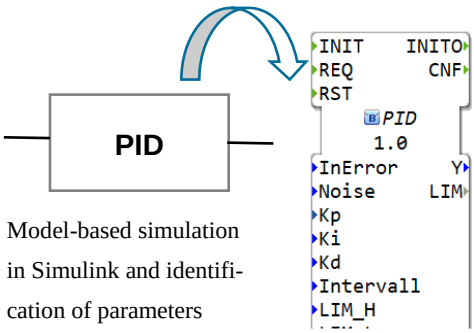
IEC 61499 is an event and block-based language. The standard was developed specifically for programmable logic controllers (PLCs) and offers the option of describing the system configuration in addition to implementing applications in a graphical notation. This makes it easier to distribute the increasingly complex applications to a large number of PLCs and thus implement a networked system.

Aim of the Thesis

The aim of this work is to take the first step towards integrating control algorithms developed in Simulink into the IEC 61499 standard. The integration makes it possible to combine the advantages of Simulink with those of the IEC 61499 standard and to enable an easy connection for the realization of complex networked control systems. This requires **literature research** as well as investigation and comparison of the two languages to identify best practices for development in each language. The first step is to define suitable control mechanisms and to **develop configurable IEC 61499 library blocks** to enable their use in control systems, for example for use in PLCs of production systems.

Required Knowledge

- Fundamentals of control theory
- Programming knowledge required
- Basics of automation engineering advantageous, e.g. from the lecture "Production Automation Systems"
- Excellent German and/or English skills



Model-based simulation in Simulink and identification of parameters

Transfer of parameters to IEC 61499 library Function Block

Learning Outcomes

- Experience in control software engineering with IEC 61499
- Knowledge in applying controllers in practice
- Experience in the scientific method
- There is an Erasmus agreement with University of Oldenburg. We support an exchange stay, for instance, for experiments on a demonstrator.