technische universität dortmund

Fakultät Bio- und Chemieingenieurwesen
LS für Systemdynamik und Prozessführung

Diplomarbeit / Masterarbeit

Robust Operation of a Pipeless Plant by means of Reactive Scheduling and Dynamic Logic Reconfiguration

Introduction:
Robust and at the same time efficient operation of production plants requires solutions for the successful handling of uncertain events, such as errors/malfunction/maintenance of equipment, changing demands, and production delays.

In previous works, methods for the algorithmic generation of control code from pre-computed deterministic schedules were developed [1, 2]. These methods are based on so-called building blocks to generate IEC 61131-3 code in the PLCopen [3] data format.

To ensure an "optimal" operation in the sense of robustness and efficiency of the plant, dynamic rescheduling of the tasks and dynamic reconfiguration of the logic controller are required.

Objectives:
The scope of this thesis is to develop a dynamic control system based on reconfigurable logic controllers and to integrate a reactive scheduling algorithm for the robust operation of a pipeless plant. The control logic is generated for a part (e.g. first hour of operation) based on a deterministic schedule. Either shortly before the end of a control period or in case of an urgent event that requires rescheduling of the production plan, all unfinished tasks are rescheduled based on the current state of execution. To this end, all necessary information e.g. the current state of the plant including the availability of the resources, the finished tasks, the tasks that are currently executed, etc. have to be provided to the reactive scheduling algorithm.

On the other hand, the control logic has to handle rescheduling requests initiated in the production planning layer based on changes in the production demand, e.g. a new (high priority) order, or cancellation of an order.

During the rescheduling and the generation of the control logic the logic controller has to ensure that the plant continues production in an appropriate way.

Steps:

a) Familiarization with the SFC formalism, TA-based scheduling [4, 5], and the controller generation techniques [1, 2].
b) Definition of SFC building blocks for the nominal control of the MULTIFORM pipeless plant [6] as well as for error handling.
c) Implementation of reconfigurable logic controllers for the given hardware according to the scheme given in [2].
d) Classification of scenarios of uncertain events, e.g. scenarios that demand reactive scheduling, or can be handled within the logic controller by priority rules.

e) Integration of a rescheduling algorithm and the logic controller generation algorithm with the given hardware of the case study. (The development and implementation of a reactive scheduling algorithm is not within the scope of this thesis.)

f) Extensive testing of the developed methodologies and algorithms.

g) Written documentation of all developed methodologies, all results of the application to the case study, all developed software, and all other results of this thesis.

Duration:

6 month, fulltime

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Literature:

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[7] Fischer, Stephan; Hüfner, Martin; Sonntag, Christian; Engell, Sebastian: *Systematic Generation of Logic Controllers in a Model-based Multi-formalism Design Environment*. In: Proc. 18th IFAC World Congress, 2011