technische universität dortmund

Fakultät Bio- und Chemieingenieurwesen

LS für Systemdynamik
und Prozessführung

Diplomarbeit / Masterarbeit

Auction-based Mechanism for Distributed Resource Allocation

Abstract:

Control engineers have recently been focusing on practically solving the problem of how to operate large-scale dynamic plants in a coordinated way. These plants usually have interconnected streams of material and energy (steam, power, side products), which are rather complicated to control. Chemical plants are very specific representatives of such coupled networks of energy and material. That is why we decided to offer a practical implementation of an advanced algorithm for plant-wide control in a chemical plant in cooperation with INEOS Cologne.

One of the possible approaches for plant-wide optimal control on plants with interconnected streams of material and energy is implementing market-based techniques in the process of price definition. Namely, to all the shared resources (coupled streams) a specific price will be attached. This price is to be regulated by a coordinator that has a goal to equalize the demand with the availability of the resources in the coupled streams. This happens only at an 'equilibrium price'. This process imitates the real behavior in big production sites, where plant managers discuss the prices of the coupling streams on a defined period of time (e.g. daily or weekly).
The goal is to automate this process and to optimize the plant wide control by adjusting the price of the coupled streams. The coordinator should define the optimal operating regimes for all interconnected plants in order to obtain optimal site operation. The coordinator will react to the market disturbances (e.g. Change of the global price of the imported resources, increased/reduced demand of some product etc.) and should automatically define the new equilibrium price.

One practical problem that needs to be addressed is the price change times. Prices cannot change continually and cannot change very often. The practical implementation of the results will be done on-site at INEOS Cologne.

Objectives:

The aim of the master thesis is to study the auction based mechanisms for distributed resource allocation, to design controller for a simple case study involving three simplified plants which are interconnected with streams of energy and material (Steam, Electricity, Waste gases, other intermediate streams) in presence of market disturbances. The proposed algorithm should define the economically optimal working regime for this simulated chemical site.

Steps:

- Study the existing auction-based mechanism.
- Improvement of the models of the simplified plants and implementation in Modelica/MATLAB.
- Simulation of the plant behavior and implementation of centralized control algorithm.
- Simulation study of an auction-based mechanism for optimal price definition of the coupled streams of material and energy.

Remarks:

- Part of the thesis will be done on-site at INEOS Cologne.

Diplomarbeit / Masterarbeit

Beginning and duration:

Immediately, 6 months, full time

Contact:

Goran Stojanovski, Tel.: 0231 / 755-5124, G2-5.10, goran.stojanovski@bci.tu-dortmund.de

Dr. Stefan Kraemer stefan.kraemer@ineos.com