Technology Overview

Technology

- Model Predictive Control (MPC) and Mixed Logical Dynamic (MLD) systems

Used in the ABB products

- Expert Optimizer from version 5.0

MPC

Model Predictive Control, or MPC, is a multivariable control algorithm and is an advanced method of process control.

It is based on the “receding horizon” principle where the model predictive controller uses the model of the process, a history of past control moves, current plant measurements, and an optimization cost function over the prediction horizon, to calculate the optimum control moves. The MPC then sends to the corresponding regulatory controller, this set of independent variable moves to be implemented in the process as setpoints. Therefore a sequence of optimum actions extending into the future are calculated while incorporating the dynamics of the system. MPC technology can – unlike many other controller strategies – take account of lag times directly in the model, so it is a suitable method for controlling processes that are affected by this.

MLD

As we need to deal with systems that use both logical and dynamic aspects, the Mixed Logical Dynamic (MLD) framework establishes a link between both demands. MLD’s most favorable feature is its ability to model logical parts of processes, for example on/off switches, discrete mechanisms, combinational and sequential networks, along with a heuristic knowledge about a plant’s operation. This makes it a powerful tool for modeling discrete-time linear hybrid systems.

MPC + MLD together

MPC and MLD are well suited to work together and that makes them extremely powerful. The most obvious advantage of this blend is to combine the benefits of MPC’s predictive and constraints handling features with MLD’s ability to model the logical and continuous characteristics of the process. It follows therefore, that MPC and MLD used together, as used in Expert Optimizer, can establish an optimization problem with explicit links between the discrete worlds of equipment availability and customer demands and the continuous worlds of temperatures, pressures and concentrations, usual in chemical processes.

A good analogy to help understand how MPC and MLD work is to think of the two technologies together as a 'chess Grandmaster' of a process. Just like in a game of chess the decisions about which move to make when handling a process are multiple and the interactions are complex. Each move opens up many counter moves that require anticipation and constant fine tuning of the game plan in pursuit of the targets. MPC and MLD are able to handle these moves because the model can:

- Select a series of current and future optimal 'moves'.
- Implement the decision.
- Absorb the effects of process unpredictability and dynamics and feed them into the model to further improve predictions and decisions.
- Use information from online and offline analyzers, and compare the prediction to the cost and quality targets.
- Give a prediction of the quality AFTER the mill and/or silos etc.