NMPC Application using JModelica.org: Features and Performance

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Nonlinear Model Predictive Control (NMPC) is a control algorithm where an optimizer generates control inputs based on a prediction of the nonlinear system behaviour. Main advantage of this method is the explicit consideration of system limitations (constraints) and improved control quality for dynamic load changes and systems with a wide range of operating points. Main disadvantage is the computational cost. Hence performance is an important key to extend the scope of application for this control strategy.

In this presentation we show the recent performance improvements for NMPC using JModelica.org. These were achieved by using variable elimination based on Block Lower Triangle (BLT) transformation and exploiting of specific problem characteristics. This includes initializing the optimization with data from a previous optimization (warmstart) and reducing the computional overhead by reusing the optimization discretization. Their effect is explained theoretically, followed by performance tests for an industrial application. Specifically steam temperature control for a Heat Recovery Steam Generator (HRSG) with 4 control inputs, 6 states and 2 control outputs was chosen. Performance increases by a factor of two and five were observed for the mentioned features.

At the end of presentation you should have a realistic impression whether NMPC is a suitable control strategy for your specific control problem and whether the performance of the openly available tool JModelica.org matches your needs.