Stepwise introduction of Model Predictive Control – an MPC/PID hybrid

**Background**

ABB Ability System 800xA is our flagship product for industrial automation and it includes AC 800M, a controller family for process control. Control applications for the AC 800M controllers are developed using our own development tools, and these applications control the production processes in the factories through the plant equipment such as pumps and valves.

In a factory, most of the control loops are controlled by PID controllers. However, for some control loops it's not possible to get acceptable control performance with PID control alone and then more advanced controllers are desirable. One commonly used advanced controller is the Model Predictive Controller (MPC). It calculates the control signal with optimization using a plant model and, unlike the PID, it can handle advanced constraints. MPC is often used to control PID controller setpoints, but it can also be used to directly control the plant equipment. In both cases, MPC makes great use of the better models obtained with machine learning.

It is common to start with PID control and if that doesn’t give acceptable performance, then more advanced controllers are considered. One obstacle is then that replacing a PID controller causes interruptions in the production. In a novel approach, MPC control is introduced stepwise by connecting the MPC control signal as feedward to the existing PID controller. In this hybrid approach, you keep the familiar PID controller for setpoint control and at the same time you can have advanced contraint handling from the MPC controller.

Compared to PID controllers, MPC controllers use great amounts of CPU and RAM to execute. Historically, due to hardware limitations, they are not executed in our current AC 800M controllers, but instead in stand-alone PCs. For MPC controllers with direct impact on plant equipment, like the novel hybrid MPC/PID, you want to have the MPC controller in the AC 800M controller. With our latest AC 800M controller architecture and hardware, it should be possible to execute all MPC controllers in the AC 800M controller itself.

**Assignment**

The goal of this Master Thesis is to implement an MPC/PID hybrid in our latest AC 800M controller. In this Master Thesis, you will create a hybrid MPC/PID in our new controller architecture.

**Requirements**

Master Program in Engineering, including advanced level courses in both computer science and automatic control

The work will be carried out mainly on site at ABB Malmö