Suggested project topics at Norske Skog Skogn

Introduction

Norske Skog Skogn is a pulp and paper mill producing newspaper and improved newspaper grades. At the plant there are several topics[1] suitable for the specialisation project, which can be continued with a master thesis. The supervisor from Skogn will be Andreas B. Volden[2]. Some topics comprise more analytical work using e.g. MATLAB/SIMULINK or similar (Octave and SciLab are preferred alernatives), while other topics are more PLC programming oriented or a combination of both above mentioned. Below pages provide some initial knowledge on suggested projects. For interested students further information is available from Andreas by email or for a plant visit particurlary on the topics.

[1] These are a selection of scope-defined projects - there exist suitable projects beyond the ones given here.

[2] Andreas' email: andreas-burheim.volden@norskeskog.com

Project 1: Steam boiler control, bottleneck identification and moving towards optimal operation

The mill's primary boiler providing steam is a compact CFB (circulating fluidized bed). Todays boiler production is constrained below rated capacity. Main tasks of this project includes identifying active (and potential active) contrainst, revise control structure and control loops performance to identify production bottleneck(s). Parallel to assesing an increase of boiler performance, the candidates shall consider boiler emissions and aim to lower these. Initially, the candidates shall review literature on the boiler principle, preferably from similar applications of CFB boilers. The project could continue on last year's master thesis or take a new perspective.

Project 2: Steam network dynamics, performance and control

Steam production comprises two systems: steam boilers and heat recovery. The steam producers may vary, and additionally steam demand may abruptly change due to process variations. This cause disturbances over the network and decrease steam reliability. The network additionally comprises steam condition equipment, accumulators and safety devices. The main objective of this project is to investigate steam network dynamics by using mechanistic and empirical modelling. Further, an analysis of the control loops involved and their suitability is of significant interest and shall comprise a major part of the project together with measures to increase process performance.

Project 3: Optimizing control and operation of two dewatering processes (two projects)

Effluent sludge dewatering

The dewatering process consist of two main steps - pre-dewatering and mechanical dewatering. Additionally, water and chemicals are added to improve the dewatering process. The main issue will be to investigate control loop oscillations and substantiate loop diagnoses. Additionally, the candidates shall investigate optimization of the dewatering process in terms of speed, torque, chemical dosing, and most important, dry matter content.

Bark dewatering

Dewatering of bark comprises batch-wise mechanical pressing, and runs in sequence either by timers or level measurement. The dewatering operation is at best sub-optimal, and is subject for a complete revision. Essentially this project comprises ABB PLC programming and commissioning. The task require a thorough study of today's program to fully understand all features, interlocks and potential risks. If time allows it, the program could be further developed to operate presses in obtaining a continuous output downstream.

Project 4: Control loop analysis and improvement for an activated sludge effluent treatment plant

The mill's effluent comprises process water, fibre residuals, rejected pulp and mass from the upstream processes, chemical excess, and cooling water discharges. Flow upstream the treatment plant is constantly varying and causing disturbances at the treatment plant inlet. The main task of this project will be to investigate how to increase process performance by means of rejecting disturbances upstream, and the governing goal would be to ensure operation within the licensed release to recipient. This includes investigations towards, but not limited to feed-forward modelling or pre-positioning, tight controller tuning and gain scheduling if applicable.

Project 5: Control loop diagnosis, disturbance identification and improved control of thermo-mechanical pulp production

Pulp production is by far the plant's most energy demanding process. The main pulping process takes place in a rotating grinder, or refiner, and within the refiner steam, chemical additives, and energy are added. Currently, a research project on a control scheme based on internal variables[3] is ongoing. A necessary step of this project is to derive status qou of the current control scheme. Data sets have been collected during process variations and step response tests. The primary goals of this project will be to analyse the data sets to identify and locate disturbances, valve stiction, and poor performing control loops, and accordingly, address the issues identified taking relevant constraints into consideration.

Project 6: Developing a novel approach for best practice to split range control including different manipulated variables

Valves as manipulated variables in control loops are a well established practice. In terms of energy efficiency, valves are not ideal as they introdce a significant pressure drop. A typical application to improve efficiency is to include an additional manipulated variable - for instance, a variable speed driven pump. The primary philosophy for control is to fully utilize the pumps operational range prior to engaging the valve. For instance, operations demanding low flow may require a degree of freedom below the pumps minimum operational speed. The candidate shall utilize data from a selection of such applications at the plant, and develop a general approach for controller tuning. Additionally, both the valve and pump characteristics should be considered in the development.

[3]Today's control structure is entirely based on traditional external variables. Internal variables are either measured or estimated using soft sensor consisting of a non-linear mechanistic model and a regression model.

Project 7: Compressed air network dynamics, performance and control

Compressed air is a vital resource at the mill. It is used in a wide range of applications, e.g., for actuation of valves and tools. The air is compressed by a set of large electrical driven compressors and cooled before entering the distribution network. Due to the sheer number of consumers, the demand for compressed air is somewhat stochastic and impossible to predict. The main objective of this project is to obtain an understanding of the distribution network dynamics and to analyse the control philosophy of the compressors and its suitability. The scope comprises development of a simple dynamic model for each compressor, and additionally, a model comprising the distribution network dynamics. Both mechanistic and empirical (or a combination of both) modelling approaches could be utilized.