

# FMH606 Master's Thesis

**Title:** Stochastic MPC for optimal operation of hydropower plant

**USN supervisors:** Main supervisor: Roshan Sharma; co-supervisor: Changhun Jeong

**External partner:** Skagerak Energi AS

## **Task background:**

Dalsfoss hydropower plant is located at Kragerø. In this hydropower plant, there are strict requirements to maintain the water level at the dam between prescribed lower and upper levels. This would have been relatively easier to do if the amount of water flowing into Lake Toke (which is the reservoir) was exactly known. In reality, inflow of water into the lake are calculated using hydrological models, weather forecast etc. and 50 different possible inflows to the lake are predicted every day. The inflow predictions are done for the next 13 days. Thus the task of controlling the water level cannot be straight forward solved using deterministic MPC. For this we should develop a stochastic MPC which is capable of using all the 50 inflow prediction scenarios and which is also robust in nature. Robust in a sense that no matter which (out of the possible 50) inflow occurs into the system, the MPC should still be able to satisfy the water level concession requirements.

## **Aim:**

The aim of this thesis is to take into account the uncertainties present in a process/plant and develop an MPC that can handle it. An example is the robust MPC or stochastic MPC. In particular, it is of interest to look into non-conservative robust/stochastic MPC. The developed robust MPC should be applied to the Dalsfoss hydropower case study. The mathematical model of the case study (together with full process description) will be provided to the student by the supervisor.

## **Task description:**

The following are the main tasks:

- (i) Detailed literature review on different methods for Robust/Stochastic MPC.
- (ii) Evaluate the possible objective functions for stochastic MPC.
- (iii) Develop stochastic MPC for optimal operation of the Dalsfoss hydropower plant. Real historical data of inflow ensembles will be provided by Skagerak Energy AS.
- (iv) Study about conservativeness and robustness of the developed MPC through detailed simulations.
- (v) Document the work in a report. The report should be technically sound. Presentation of the work.


**Student category:** IIA and EPE students

The tasks requires that the student is able to program in MATLAB and is interested to learn about advanced control.


**Is the task suitable for online students (not present at the campus)?** Yes

**Practical arrangements:** N/A

**Signatures:**

Supervisor (date and signature):  17.01.2022

Student (write clearly in all capitalized letters): NABIN K C

Student (date and signature):  17.01.22