NTNU
Norwegian University of Science and Technology

Faculty of Information Technology, Mathematics and Electrical Engineering

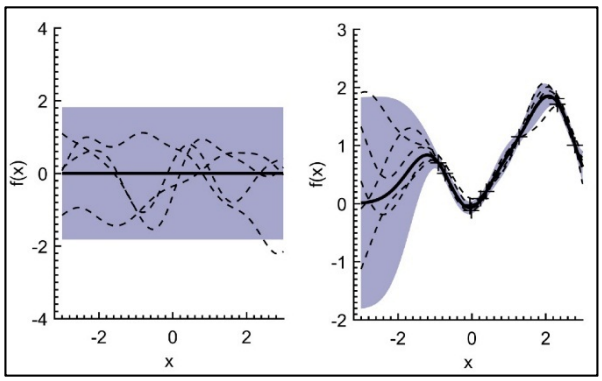
Department of Engineering Cybernetics

Project assignment

Subject: Engineering Cybernetics

Title: Gaussian process predictive control to trade off exploration/exploitation
Title (in Norwegian): Gausiske prosessbasert modelprediktiv regulering med kombinert utforskning/utnytting

There is an increasing interest in control engineering to apply techniques from machine learning. One promising direction involves the application of Gaussian process (GP) models, which provide a flexible, nonparametric approach to modelling nonlinear systems. One major advantage of GPs compared to other nonlinear regression methods is the ability to give not only accurate predictions but also a measure of uncertainty for each prediction. This allows the efficient trade-off between exploitation/exploration, which has been used to great success in global optimization approaches known as Bayesian optimization. This work will be in the area of fault-tolerant model-predictive control. The aim is to explore and implement a novel model predictive control formulation involving Gaussian processes to return a nonlinear system to a stable set point to retain safe-operation after a fault has occurred. The methods developed will be tested on a case study from the chemical industry. This masterproject is ideal for students who are used to Matlab programming, and want to work on a novel integration of MPC fault handling and stochastic processes.



Task description:

1. Perform a literature study on GPs in MPC and reinforcement learning with a focus on taking advantage of both prediction and uncertainty information.
2. Develop and implement an optimal control formulation involving GPs that trade off exploration/exploitation to return to a safe set point after a fault has occurred.
3. Explore effectiveness and robustness of proposed approach on a suitable test case study from the chemical industry.

The report should include a draft for a conference paper.

Starting date: 11.01.2017

End date: 06.06.2017

Co-supervisors: PhD student Eric Bradford, NTNU
Postdoc Brage Rugstad Knudsen, NTNU

Trondheim, 13.08.2015
Bjarne Foss
Professor/supervisor