Control of a Three-Tank System using Multi-Fidelity Gaussian Processes

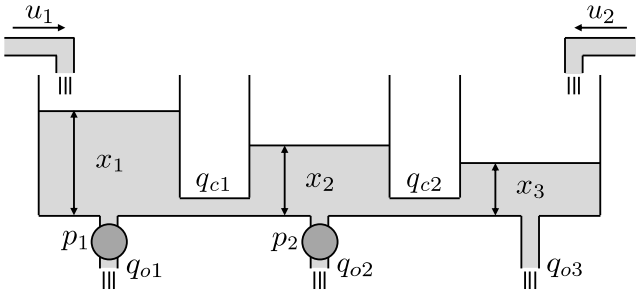
TECHNISCHE UNIVERSITÄT DARMSTADT

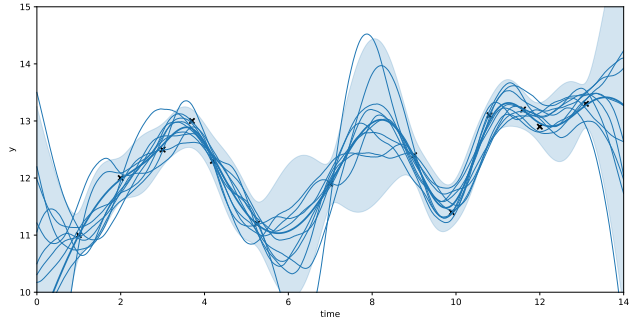
Master's Thesis

In industrial applications, we often face the challenge that a process cannot be modelled well analytically. Possible reasons are the complexity or unknown dependencies of the process. A possible alternative is the utilization of a data-driven system model. However, often the amount of high-quality data, derived from process measurements or some other high-fidelity model, is severely limited. In contrast, a basic (low-fidelity) system model can often be derived, able to produce a high quantity of low-quality data.

Within the scope of this master's thesis, you will investigate the idea of using Multi-Fidelity Gaussian Processes to combine these two data sources to construct a surrogate model of the system. Hereby, you will first conduct a literature review concerning the idea of Multi-Fidelity Gaussian Processes. As an example process, an interconnected three-tank system will be used. Based on this process, you will then use a low- and a high-fidelity system model to obtain the data to be used in the Gaussian Process. This can be initially achieved in a simulation environment and later using a real experimental setup. Based on the surrogate model, you will then design a suitable controller, e.g., a model predictive controller, to control the three-tank system. The performances of the surrogate model and the resulting controller will be investigated and compared with similar methods.

For this master's thesis, basic knowledge in the area of control engineering, especially regarding model predictive control and machine learning, is required. Furthermore, knowledge in system modeling and programming with Matlab/Simulink and python are desirable. If you have any questions, feel free to contact us.





https://www.lancaster.ac.uk/stor-i-student-sites/thomas-newman/2022/05/05/gaussian-processes-in-regression/

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