Optimal control of membrane separation processes in the presence of fouling and uncertainties

(Master thesis topic proposal)

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Pressure-driven membrane filtration is considered to be a mature technology, however broad innovation potential exists. Reduction of operational costs is a key to exploit this technology and to make it competitive and sustainable for the future. The effectiveness of membrane separation can be negatively influenced by various phenomena (e.g. membrane fouling) and disturbances. As a result, membrane system can be driven away from the designed optimal regime. Automatic control of the membrane separation processes is then required to respond to the disturbances such that (usually very strict) separation goals are fulfilled and the optimality is restored.

The work on the proposed topic will identify nominally optimal open-loop control policies for selected batch membrane separation processes, analyze the effect of membrane fouling and possibly occurring disturbances, and finally propose a solution for feedback control scheme which will guarantee meeting tight constraints and will optimize the cost for running the process.

Tasks and work plan:

- To find nominally optimal open-loop control policies of selected batch membrane separation processes for optimization of operational costs of the plant
- To model the membrane fouling and analyze its effect on the nominally optimal open-loop control
- To find open-loop control strategies for selected membrane separation processes in the presence of fouling
- To apply recent feedback-type strategies (robust predictive control, dynamic real-time optimization) in order to achieve required separation performance and to restore the optimality of the system in the presence of fouling and disturbances
- To verify the designed control strategies by means of numerical simulation