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Towards robust optimization of chromatographic separation processes with flow reversal

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Column liquid chromatography plays an important role in the downstream processing of biopharmaceuticals, where the goal is to capture and purify a target protein from a mixture. Our goal is to employ a model-based approach for process optimization to improve the quality of the product, while also achieving further economical and ecological benefits.

Rate models in combination with suitable reaction schemes that model the specific adsorption process are often employed to describe chromatographic processes. The optimal control problems (OCPs) are hence governed by advection-diffusion-reaction-type partial differential equations (PDEs) with high nonlinearities. Furthermore, at least one flow reversal is typically performed in practical applications to obtain sharper elution profiles, thus leading to switching dynamics. Lastly, it is important to determine robust solutions in order to safeguard against, e.g., uncertain model parameters, such as reaction rates and feed composition.

In this talk we present developments towards robustly optimal switching control applied to chromatographic separation processes and discuss the obtained results.

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