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Advanced machine learning in bioprocess development

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Abstract

With an increasing demand for biopharmaceuticals in general and more and more players entering the biosimilar market, there is an increased focus on process development and control to stay ahead of the competition. However, true process understanding is often limited due to the high complexity of the system hindering the usage of simple mechanistic equations for process description. Further, long process times and large amounts of critical process parameters (CPPs) limit the number of optimization experiments for a full design space description.

Advanced machine learning methods, such as hybrid models, help to get more information from fewer experiments by bridging the gap between mechanistic understanding and underlying unknown mechanism hidden in the data. Hence, the combination of well-understood, mechanistic equations and data-driven algorithms increases the predictive capability while simultaneously reducing the number of experiments required to understand, model, and predict bioprocesses.

Within his presentation, both and upstream and downstream hybrid modeling approach will be covered to demonstrate both the potential and superior extrapolation capability of such models. In an E. coli upstream fed-batch process a hybrid model was applied to better describe and understand the impact of the critical process parameters on the critical quality attributes in a time-resolved manner. This approach enabled intra-process changes allowing us to screen a specific design space in 50% of the time. In the downstream tangential flow filtration showcase, the superior performance of a hybrid model approach will be demonstrated. Here a full process model could be generated within a single working day, enabling accurate flux predictions over the full process length. Further, the superior behavior of the hybrid model compared to the film theory will also be demonstrated.

Biography

Maximilian is a Ph.D. student at the University of Natural Resources and Life Sciences, Vienna, Austria. He is currently developing hybrid-models to increase process understanding of crossflow filtration systems for biopharmaceutical applications, thereby being able to predict filtration outcomes based on process and sample characteristics. He is also co-founder of Novasign, a university spin-off applying advanced modeling solutions for pharma industries. The company aims to support customers in developing advanced process models for faster process development and also to use the models for model predictive control. Maximilian is a trained Downstream Process Engineer and holds a Master Degree in Technical Chemistry from the University of Technology Vienna.

Publications

1. Publication I: Comparison of Modeling Methods for DoE-Based Holistic Upstream Process Characterization

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