Chair of Process Systems Engineering
TUM School of Life Sciences
Technical University of Munich

Interdisciplinary project (IDP)

Model reduction of a General Rate Model using Proper Orthogonal Decomposition

Motivation and problem definition

Mathematical optimization is an essential tool for many industrial and research applications in order to optimize design processes. Mathematical models have to be solved very often in optimization problems, which is why the computing effort is crucial. Model reduction is an established possibility to reduce the computation time, which approximates a complex model with a sufficiently accurate model that is much easier to solve. With the help of proper orthogonal decomposition, a high-dimensional model can be decomposed into different singular value modes. These modes are then sorted according to their importance in describing the model. Figure 1 shows an exemplary model that already eight modes can represent about 99% of the complete model. The remaining 142 modes could thus be ignored if this accuracy is sufficient for the corresponding application.

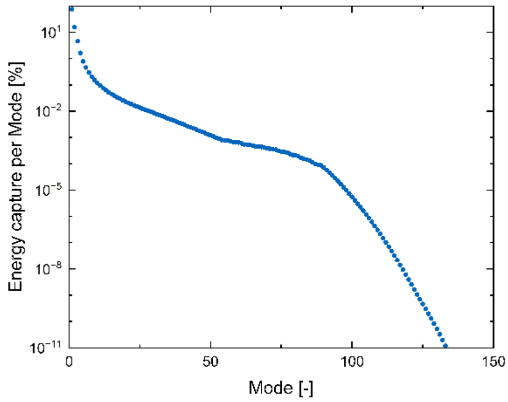

Figure 1: Results of the energy capture per mode

Research objectives

In this thesis, an already existing two-dimensional general rate model should be reduced by using proper orthogonal decomposition. Comparable models have already been approximated at our chair and can be used as a starting point. The reduced model will be used to formulate an optimal control problem, which is why further adaptations of the model reduction will be necessary. With the help of the optimal control problem, particle packings with axial gradients of the particle diameter can be optimally designed. Those stratified packings have possible applications in the field of chromatographic separation or in the washing of porous media.

You may expect

Within the scope of this thesis, you can learn various numerical methods. In addition, this work allows you to get in touch with model reduction techniques and optimal control theory through intensive supervision. Are you interested? Then get in touch with me!

Technical University of Munich
Chair of Process Systems Engineering
Alexander Eppink (EG30)
Gregor-Mendel-Straße 4, 85354 Freising
alexander.eppink@tum.de