

# Paul Kieckhefen

Computational Engineer

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## Expertise

### Method Development for Modeling Industrial-Scale Multiphase Flows.

- Using pattern recognition to rapidly simulate recurrent multiphase flows [3, 6]
- Parallelization of coupled simulation codes [3]
- Applying machine-learning methods for physically accurate length scale bridging in theory and practice
- Deploying simulation codes in high-performance computing environments

### Apparatus Optimization using Computational Techniques.

- Fluidized beds [2] and spouted beds [6, 7] for spray coating and granulation
- Granular mixing in batch and continuous mixers
- Consulting for pharmaceutical, food and chemical industries

## Education

02.2018- present **Research Assistant**, Institute of Solids Process Engineering and Particle Technology, Hamburg University of Technology.

Supervisor: Prof. Dr.-Ing. habil. Dr. h.c. Stefan Heinrich (stefan.heinrich@tuhh.de)

- Simulation of solids processing apparatuses from food, pharmaceutical and chemical industries using the Discrete Element Method (DEM) and Computational Fluid Dynamics (CFD)
- Development of a product-property guided scale-up approach for fluidized bed spray granulation using CFD-DEM
- Development of a novel liquid bridge formation model and segregated calibration workflow for the simulation of wetted materials
- Grant proposal preparation: Two successful DFG grants approved (438775980, 454277381)
- Teaching duties: Simulation of gas cyclones using the MP-PIC method
- Collaboration with Princeton University

04.2016- **M. Sc. Process Engineering**, Hamburg University of Technology, Grade: 1.3 (with distinction).

01.2018 Thesis: *Evaluation of the Recurrence CFD method for the Simulation of Industrially Relevant Fluid and Particle Dynamics* at BASF SE, Ludwigshafen with grade 1.0.

10.2013- **B. Sc. Bioprocess Engineering**, Hamburg University of Technology, Grade: 1.6 (very good).

03.2016 Thesis: *CFD-DEM Simulation of a Prismatic Spouted Bed* with grade: 1.0

## Experience

### Internships

09.2017- **Evaluation of the Recurrence CFD method for the Simulation of Industrially Relevant**

01.2018 **Fluid and Particle Dynamics**, BASF SE, Ludwigshafen; Johannes Kepler University Linz, AT.

Supervisors: Moritz Höfert (moritz.hoefert@basf.com), Dr. Thomas Lichtenegger (thomas.lichtenegger@jku.at)

- Implementation of a volumetric timeseries extrapolation method for flow processes on the basis of recurrence analysis
- Application of a novel method to a variety of industrially relevant application cases [6]

04.2016- **Simulation of Cascaded, Continuous Spouted Beds**, BASF SE, Ludwigshafen.

09.2016 Supervisor: Moritz Höfert (moritz.hoefert@basf.com)

- Simulation of spouted beds with the CFD-DEM method and validation against lab experiments [5]
- Simulation of pilot-scale cascaded spouted beds and design of internal and operating conditions

### Work as a Student Researcher

03.2015- **Coating in Spouted Beds**, Institute of Solids Process Engineering and Particle Technology, Hamburg

08.2017 University of Technology.

Supervisor: Dr.-Ing. Swantje Pietsch (swantje.pietsch@tuhh.de)

- Development of coupled OpenFOAM solvers for the simulation of heat and mass transport processes [8]
- Planning, conducting and evaluating coupled CFD-DEM simulations of spouted and fluidized beds on both the laboratory and pilot scale

## Qualifications

Tech excellent: Python (pandas, scikit-\*, SciPy stack), C++ (MPI, CUDA)  
Skills advanced: LabView, Bash, MATLAB, LaTeX proficient: Docker, keras  
Software OpenFOAM, LIGGGHTS, CFDEMcoupling, SolidWorks, ANSYS Fluent  
Lang. German: native speaker English: fluent

## Publications

- [1] P. Kieckhefen, M. Dosta, S. Pietsch, and S. Heinrich. “Possibilities and Limits of Computational Fluid Dynamics-Discrete Element Method Simulations in Process Engineering: A Review of Recent Advancements and Future Trends”. *Annual Review of Chemical and Biomolecular Engineering* (2020). DOI: 10.1146/annurev-chembioeng-110519-075414.
- [2] E. Diez, P. Kieckhefen, K. Meyer, A. Bück, E. Tsotsas, and S. Heinrich. “Particle dynamics in a multi-staged fluidized bed: Particle transport behavior on micro-scale by discrete particle modelling”. *Advanced Powder Technology* (2019). DOI: 10.1016/j.appt.2019.05.025.
- [3] T. Lichtenegger, P. Kieckhefen, S. Heinrich, and S. Pirker. “Dynamics and long-time behavior of gas–solid flows on recurrent-transient backgrounds”. *Chemical Engineering Journal* 364 (2019), 562–577. DOI: 10.1016/j.cej.2019.01.161.
- [4] S. Pietsch, P. Kieckhefen, M. Müller, M. Schönherr, F. K. Jäger, and S. Heinrich. “Influence of binary and ternary particle systems on the spouting stability in a three-dimensional prismatic spouted bed”. *Powder Technology* (2019). DOI: 10.1016/j.powtec.2019.08.065.
- [5] P. Kieckhefen, S. Pietsch, M. Höfert, M. Schönherr, S. Heinrich, and F. Kleine Jäger. “Influence of gas inflow modelling on CFD-DEM simulations of three-dimensional prismatic spouted beds”. *Powder Technology* 329 (2018), 167–180.
- [6] P. Kieckhefen, T. Lichtenegger, S. Pietsch, S. Pirker, and S. Heinrich. “Simulation of spray coating in a spouted bed using recurrence CFD”. *Particuology* (2018). DOI: 10.1016/j.partic.2018.01.008.
- [7] S. Pietsch, P. Kieckhefen, S. Heinrich, M. Müller, M. Schönherr, and F. K. Jäger. “CFD-DEM modelling of circulation frequencies and residence times in a prismatic spouted bed”. *Chemical Engineering Research and Design* (2018). DOI: 10.1016/j.cherd.2018.01.013.
- [8] S. Pietsch, P. Kieckhefen, M. Müller, M. Schönherr, F. K. Jäger, and S. Heinrich. “Novel production method of tracer particles for residence time measurements in gas-solid processes”. *Powder Technology* (2018). DOI: 10.1016/j.powtec.2018.06.040.