

Modeling and Simulation of Disperse Systems (WZ1338)

Daniel Nasato, Ali Khajehesamedini, Gurmeet Kaur

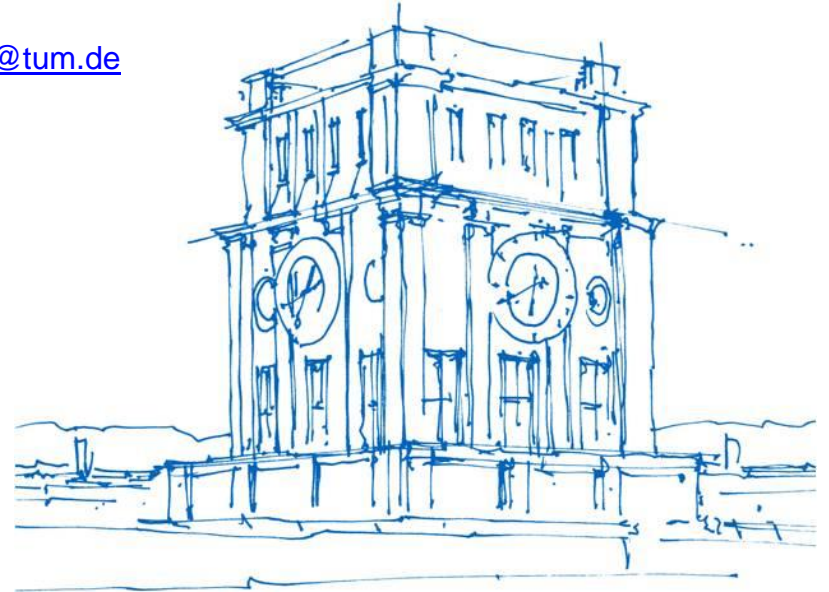
daniel.nasato@tum.de, ali.khajehesamedini@tum.de, gurmeet.kaur@tum.de

Technische Universität München

Wissenschaftszentrum Weihenstephan

Lehrstuhl für Systemverfahrenstechnik

Freising, 7. April 2021

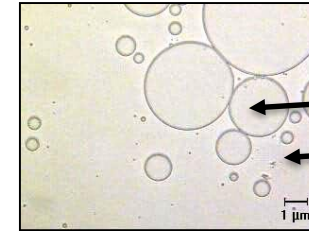


Uhrenturm der TUM

Disperse System

Definition

Heterogenous system in which one phase is distributed or dispersed within the continuous phase



Dispersed phase

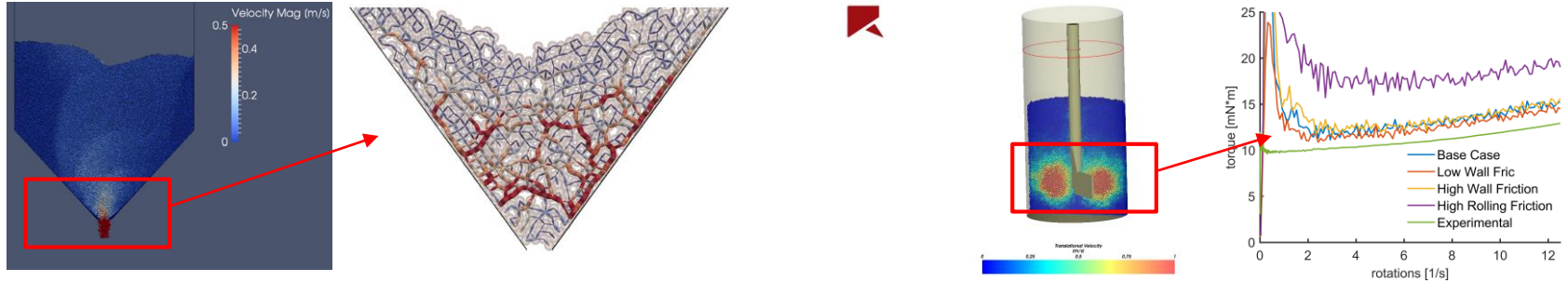
Continuous phase

Examples

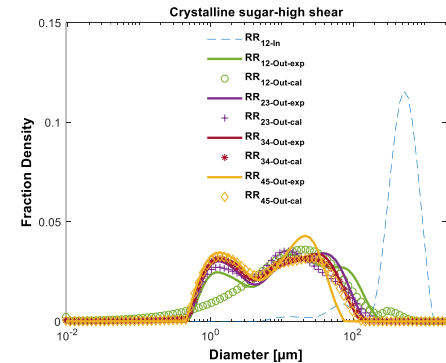
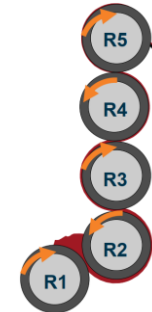


Simulation of Disperse System

- Tracking the movement of particles as **individuals** based on newton's second law

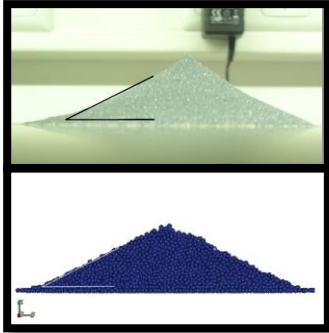


- Tracking the evolution of distribution of **population** of particles/ droplets/ bubbles based on conservation laws



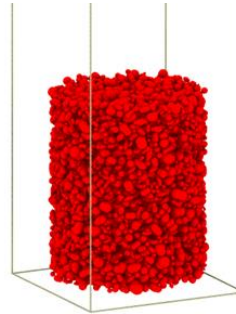
Discrete Element Method (DEM)

Static angle of repose



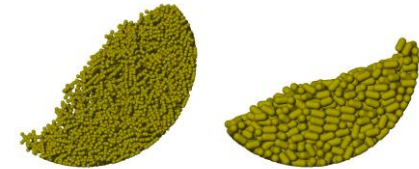
Research of Daniel Nasato

Bulk density and particle shape



Research of Daniel Nasato

Dynamic angle of repose

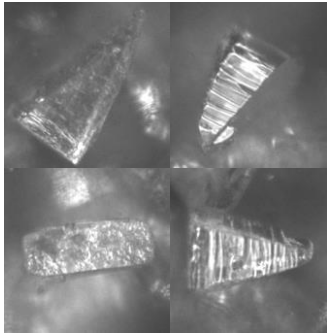


Research of Daniel Nasato

- Contact models, integration schemes, monitors and material calibration
- Examples and Exercises in Matlab to fix the concepts
- Learn open source DEM tool (ready for projects) and Commercial Rocky-DEM (industry standard)
 - Packing density, angle of repose (spheres and non-spherical particles), hopper discharge.

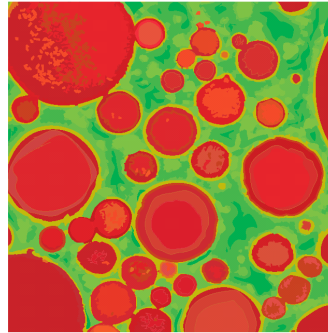
Population Balance Model (PBM)

Size distribution of
lactose crystals



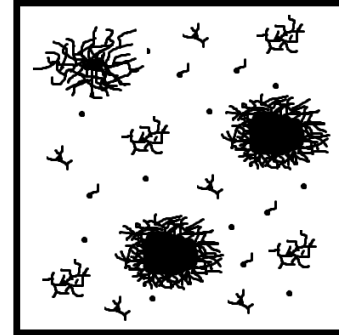
Kail, Briesen, Marquardt,
ProcessNet JT, 2007

Size distribution of
fat droplets in milk



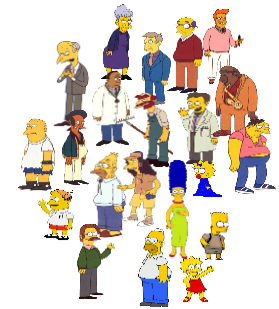
Webpage: Swedish Institute of
Food and Bioengineering

Size and shape distribution
in bioprocesses



Research of Ali Khajehesamedini
and Stefan Schmideder

Age distribution of
Germany



First showcase in lecture

- Modeling and simulation of property distributed systems
- Properties: size, shape, age
- Extremely wide field of applications
- Simulation of growth, nucleation, breakage and aggregation

Premise of the course

□ Who should attend

Master students who are passionate about the simulation of disperse flows

□ Requirements

Fundamental knowledge of engineering mathematics

□ Times of the sessions (12+12)

Lectures: Thursdays 14:00 - 15:30 (first session 15.04.21)

Solving exercises: Tuesdays 14:30 - 15:30 (first session 27.04.21)

Premise of the course (con't)

□ How to attend the sessions

TUM zoom (links are provided in TUM Moodle)

□ How to access the content

TUM Moodle (recorded sessions, slides, exercises, filled notebooks, extra readings)

□ Evaluation

A report about 2 different simulation cases (75%) and a short presentation of the report (25%)

15. April - 21. April



Lecture 01: Introduction - 15.04 / 14h

Zoom-Meeting <https://tum-conf.zoom.us/j/62627529507>

Meeting-ID: 626 2752 9507

Kenncode: 694921



Schedule

Lecture	Exercise	Theme
01.W - 15.04.2021	-	Introduction to Modeling and Simulation of Disperse Systems
02.W - 22.04.2021	27.04.2021	Introduction to DEM
03.W - 29.04.2021	04.05.2021	Integration Schemes and Material model Calibration
04.W - 06.05.2021	11.05.2021	Boundary conditions, monitors and other granular models
05.W - 13.05.2021	18.05.2021	Holyday, no Lecture
06.W - 20.05.2021	25.05.2021	Neighbor lists and non-spherical particles
07.W - 27.05.2021	01.06.2021	Hands-on!
08.W - 03.06.2021	08.06.2021	Holyday, no Lecture
09.W - 10.06.2021	15.06.2021	Introduction to property distributed systems and PBM
10.W - 17.06.2021	22.06.2021	PBM: equation and rate equations for nucleation, growth, transport and volume change
11.W - 24.06.2021	29.06.2021	PBM: rate equations for aggregation and breakage
12.W - 01.07.2021	06.07.2021	Numerical Methods to solve PBE: Method of classes - aggregation and breakage
13. W - 08.07.2021	13.07.2021	Numerical Methods to solve PBE: Method of classes & Flux limiter - Growth and nucleation
14.W - 15.07.2021	20.07.2021	Numerical Methods to solve PBE: Quadrature Method of moments

Thank you for your attention

Looking forward to our first
session on Wednesday

15.April at 14:00

