Associate Professorship of Bioseparation Engineering
TUM School of Engineering and Design
Technical University of Munich

Bachelor's / Master's / Semester Thesis

- CFD-Simulation of Inertial Focusing -
Simulative Design of Dean Flow Fractionation Device

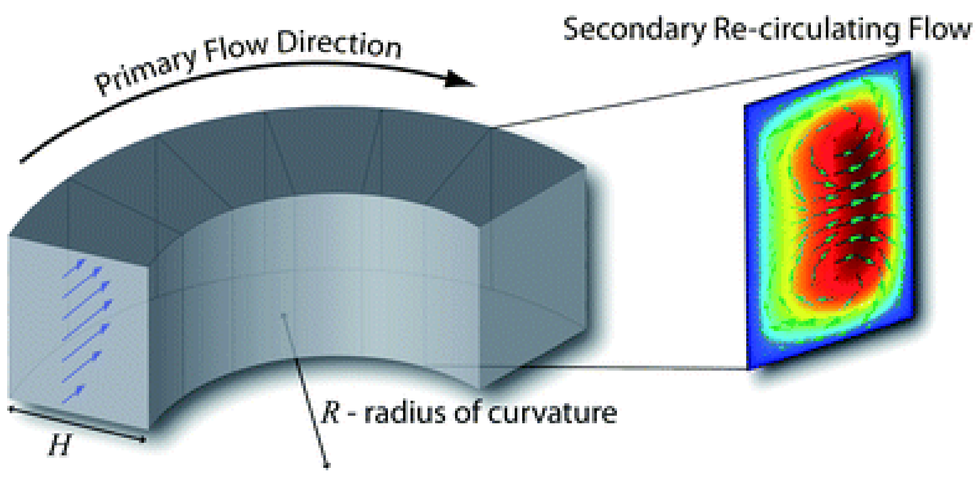
Keywords: CFD-Simulation, Inertial Focusing, Laminar Flow, Particle Tracing, Microfluidics, Pathogen Detection

Project Description

Early and accessible detection of pathogens is crucial to prevent the spread of infectious diseases. A novel Point-of-Care detection system promises to deliver results about the contamination in minutes. Therefore it needs a far higher-than-natural pathogen concentration is needed.

Inertial focusing provides an elegant possibility to achieve that by exploiting the cell's physical properties (density, shape, deformability,…).

This thesis aims to design suitable microfluidic chambers to achieve adequate separation and enrichment, by simulating different chamber configurations. To validate the results, the simulated chambers can be printed out and real flow-configurations can be tested.



Dean-, or Secondary-Flow

Even in laminar, microfluidic flow-configurations particle inertia causes two counter-rotating vortices. By Di Carlo (2009)

Starting Literature:

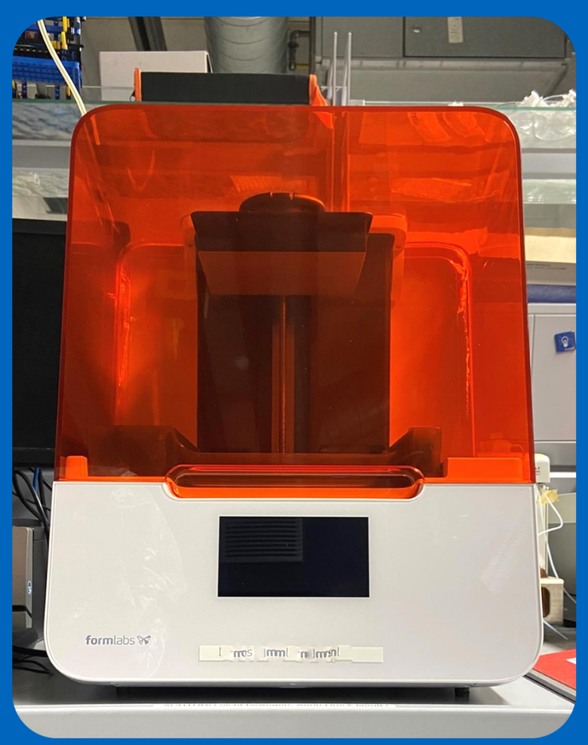
doi.org/10.1146/annurev-bioeng-121813-120704
doi.org/10.1039/B912547G
doi.org/10.1038/srep01259

Profile

- Independent and structured work
- Enjoyment of simulative work
- Chemical Engineering, Chemistry, Industrial Biotechnology, Mechanical Engineering, Bioprocess Engineering, or similar

Ideal, but not required:

- Experience with CFD-Simulations (esp. in COMSOL Multiphysics)



FormLabs 3B+

Available SLA printer to validate the simulation parameters and results

Tasks

1. Literature review to examine existing solutions
2. CFD-Simulation with COMSOL, ANSYS, or Simulink
3. Validation of simulative results with 3D printed microfluidic chambers

Model of a Spiral Channel

Used to obtain initial simulation results.

Patrick Muschak | p.muschak@tum.de | Room MW2437