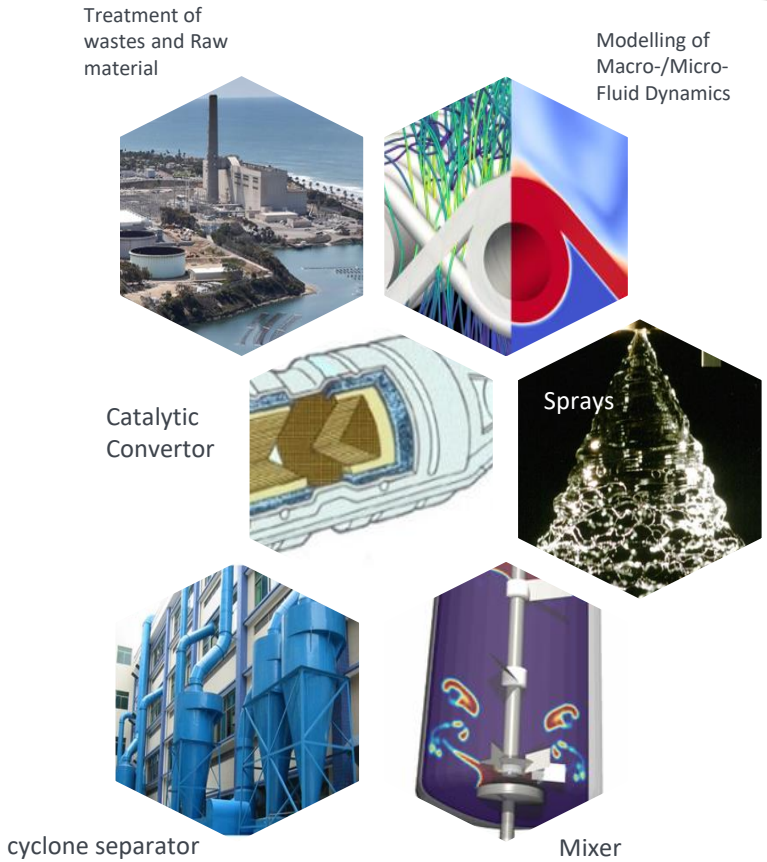
University of Stuttgart
Institute of Mechanical Process Engineering

Information Session for MSc. WASTE Students

Arnav Ajmani | Team@IMVT

Mechanical Process Engineering

- **Treatment of wastes and Raw materials** using mechanical effects
- **Transport-/Flow processes**
- Deal with
  - Gases, Liquids and Solids
  - Dispersed Systems
- Four Basic Operations
  - Separation
  - Mixing
  - Agglomeration
  - Break-up



Industrial Partners

Alantum
Allgaier
AUDI
BASF
BAYER
BEHR
BERU
Bielomatik
BOSCH
C.A.R.R.D.
Christ
Daimler
Dürr
Eberspächer
E.G.O.
Eisenmann
Elastogran
ElringKlinger
EnBW
Fraunhofer
FrankPlastic
Haver&Boecker
Hoefliger
Kärcher
KTI Plersch
LTG
Mahle
MANN+HUMMEL
Miele
Pall Seitz-Schenk
Sartorius
Spörl
Stihl
VW
Weko
WKP
Woco
Wurth
Zeiss
Züblin

Academic Relations/Connections USA

Stanford

University of California, Davis

University of California, Irvine

Massachusetts Institute of Technology

University of San Diego

CalTech

University of California, San Diego

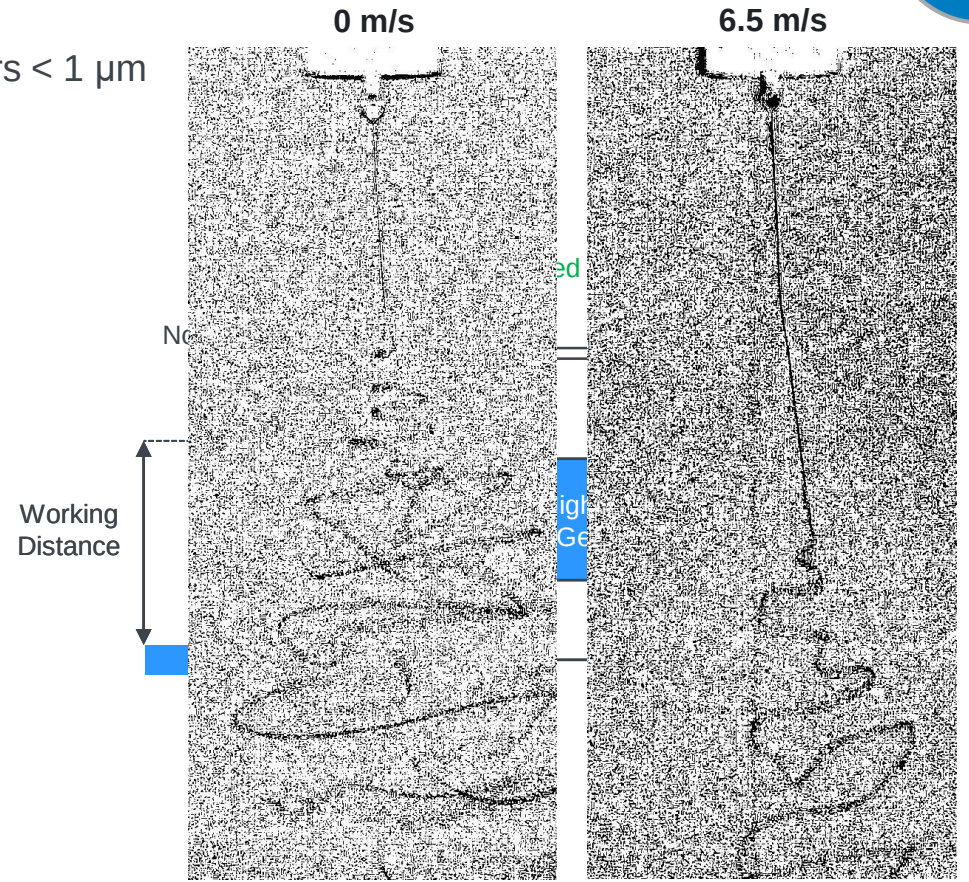
University of Colorado, Boulder

Colorado School of Mines

Fabrication of Nanofibers via Gas-Assisted Electrospinning

Function Principle

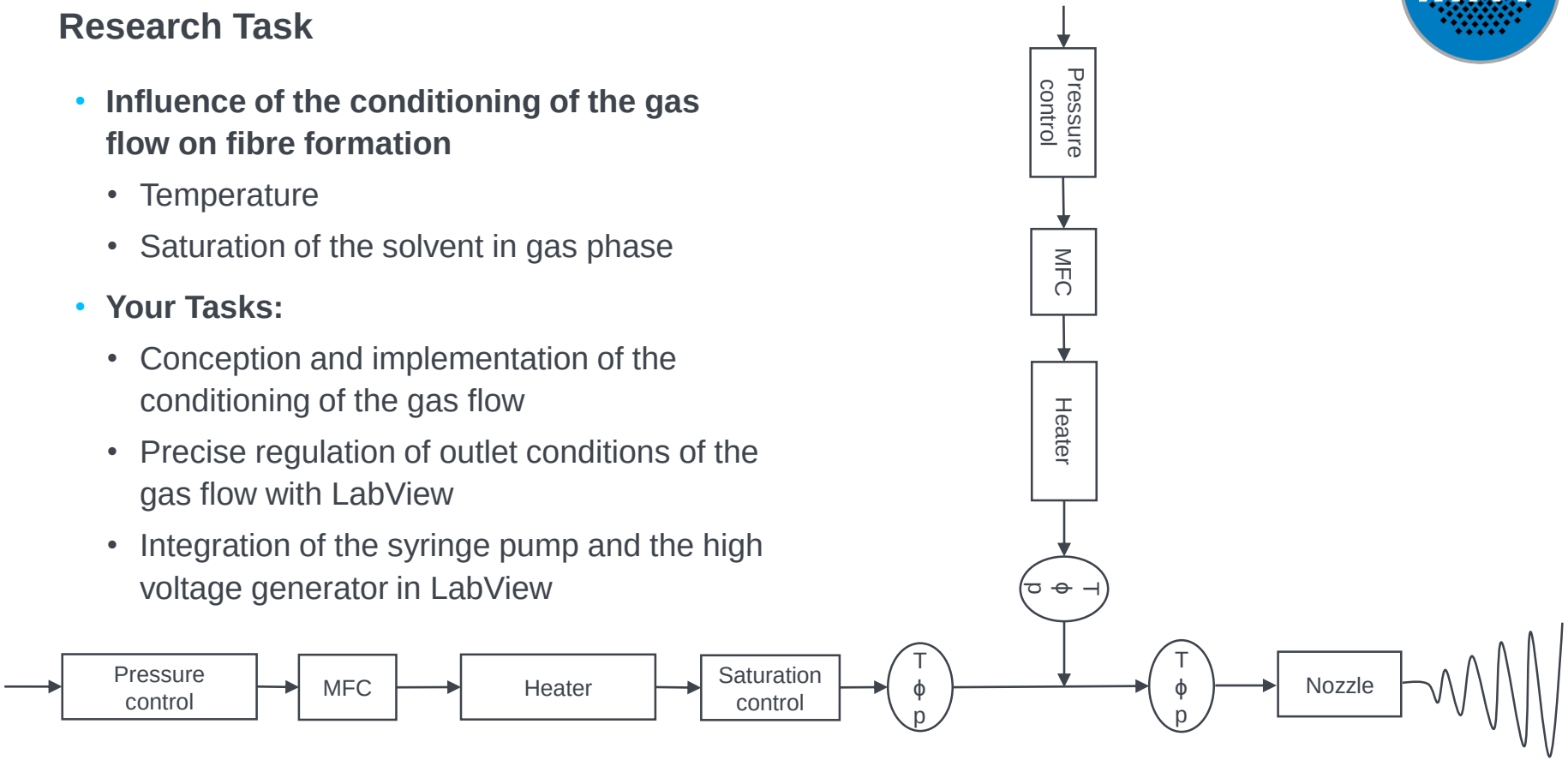
- **Overall Goal :** Uniform Polymer Fibers < 1 µm
- Five main components
  - Cannula (Diameter: < 1 mm)
  - Collector
  - High Voltage Generator (+/- 30 kV)
  - Syringe Pump (2 ml/h)
  - Nozzle (Diameter: 2-5 mm)
- Typical Working Distance: 15 cm
- Typical Voltage: 1kV/cm
- Typical Air Velocity: 30 m/s



Fabrication of Nanofibers via Gas-Assisted Electrospinning

Research Task

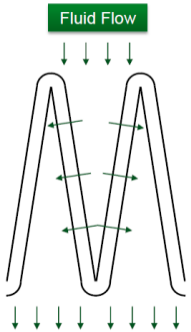
- **Influence of the conditioning of the gas flow on fibre formation**
  - Temperature
  - Saturation of the solvent in gas phase
- **Your Tasks:**
  - Conception and implementation of the conditioning of the gas flow
  - Precise regulation of outlet conditions of the gas flow with LabView
  - Integration of the syringe pump and the high voltage generator in LabView

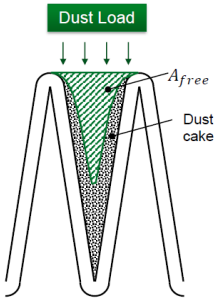


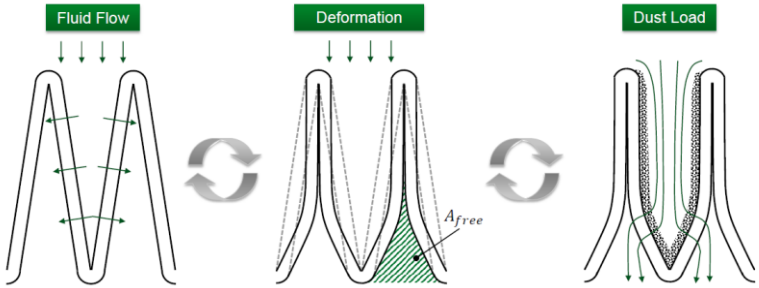
Fluid Structure Interaction in Porous Media

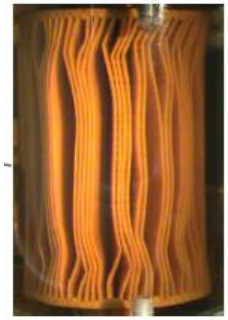
Problem:

Deformation of pleated cellulose based filter medium



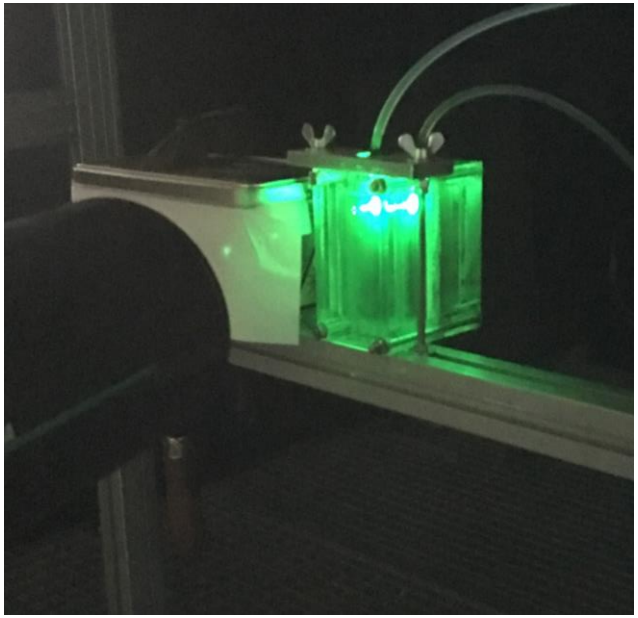


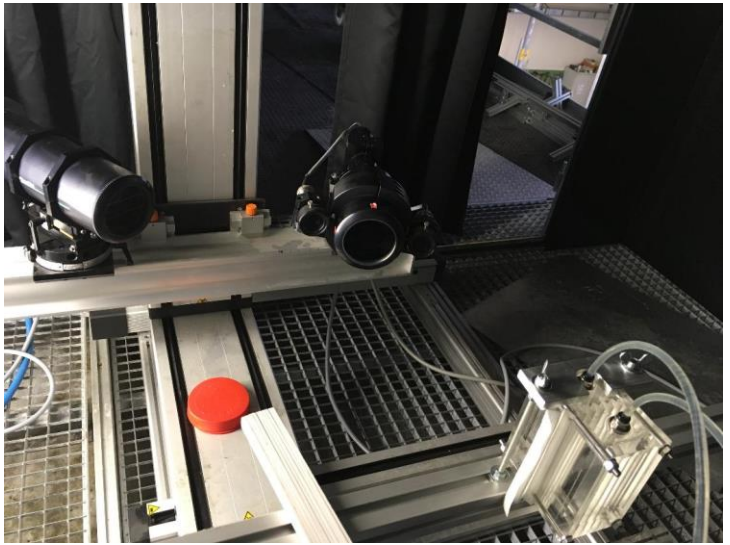


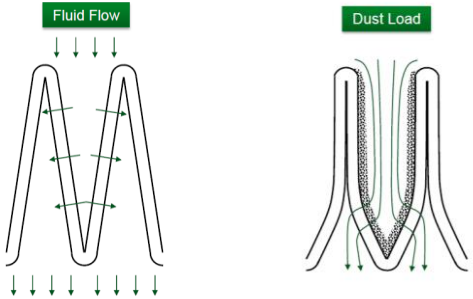


Thesis I: *Conception of a Filtration Rig and Flow Measurements using Laser Doppler Anemometer*

- Measurement of Flow parameters
- Deposition of Particles in the filter
- Efficiency of the Filtration

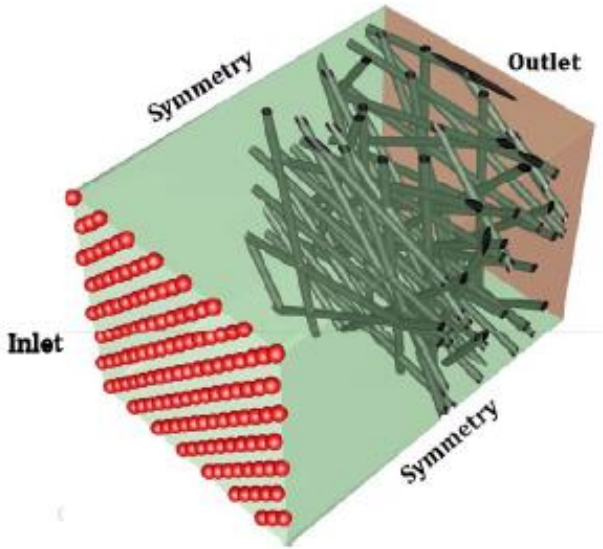




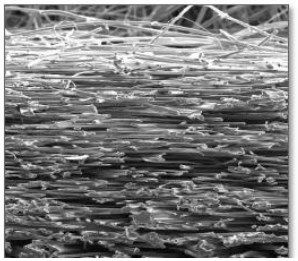


Thesis II : *Simulation of Particle, Filter and Fluid Interaction*

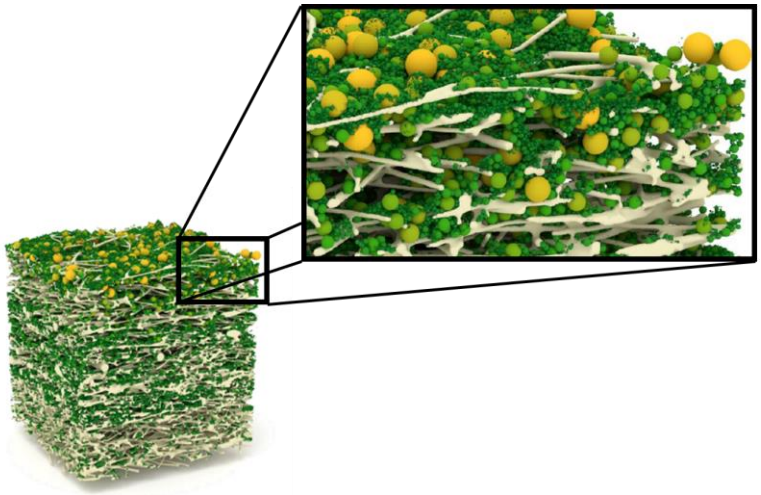
- Setting up of Multiphase Simulations using Computational Fluid Dynamics (CFD) and Discrete Element Method (DEM) Codes



Real existing
filter medium



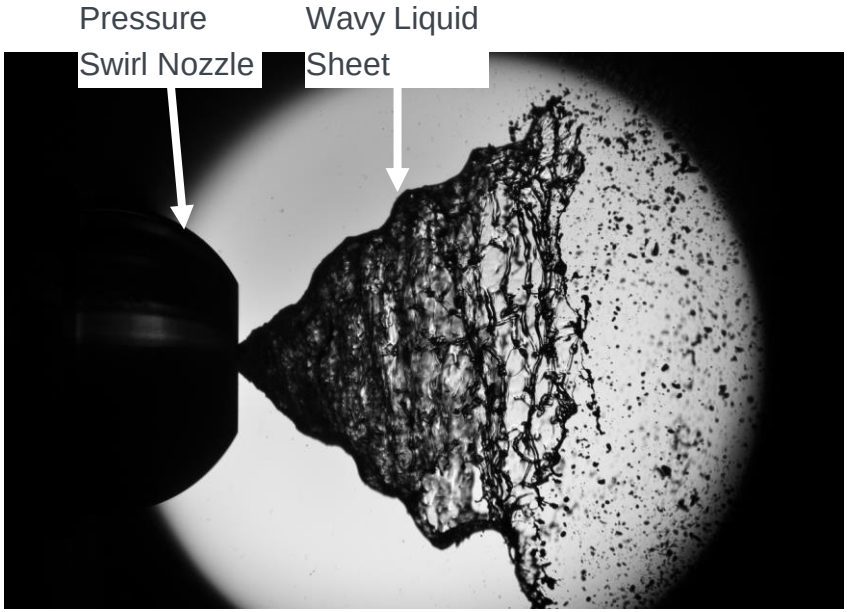
Virtual
material prototype



Pressure Swirl nozzles

General description

- Some atomizers form wavy liquid sheets
- Surface waves lead to atomization
- Challenge: Determine frequency and amplitude of surface waves
- Goal: Properties of surface waves ⟷ Properties of drops



Thesis I: Measurement of thin liquid films

Tasks

- Integrate sensors into simplified experimental setup
- Validate measurement concept
- Measure and compare experimental results with analytical solutions

Thesis II: Building up a experimental setup for 360° record of pressure swirl nozzles

Tasks

- Market/Literature research about existing 360° lenses
- Building an setup for first experiments
- Develop method to determine waves from images

Liquid Film Breakup

Defining the Physical Problem

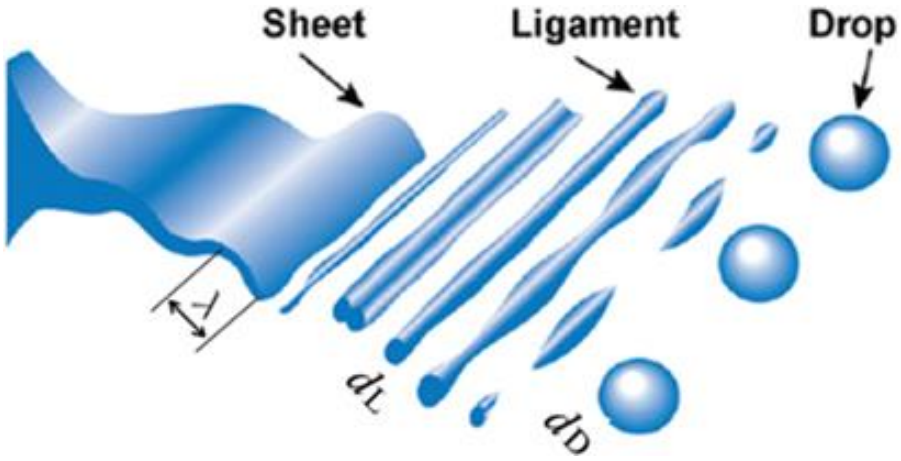
- Discharging Liquid through a slit nozzle
- With/Without injection modulation

Physical Mechanism

- Initial disturbances
- Hydrodynamic instabilities
- Large distortions
- Disintegration

Other Phenomena

- Capillary waves
- Collision/Coalescence

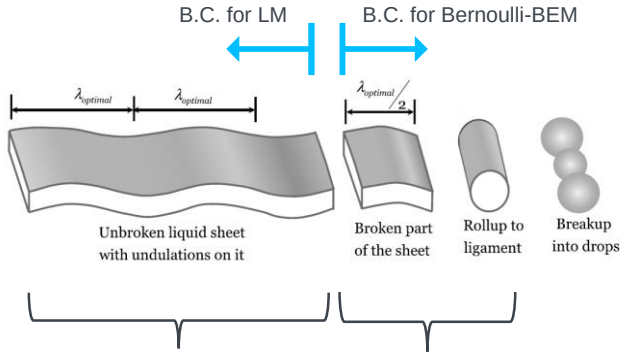


In many applications, droplets size distribution and their positions are of interest.

Thesis I: Modelling of thin film breakup using a coupled Lubrication-Boundary Element Method (BEM)

Tasks

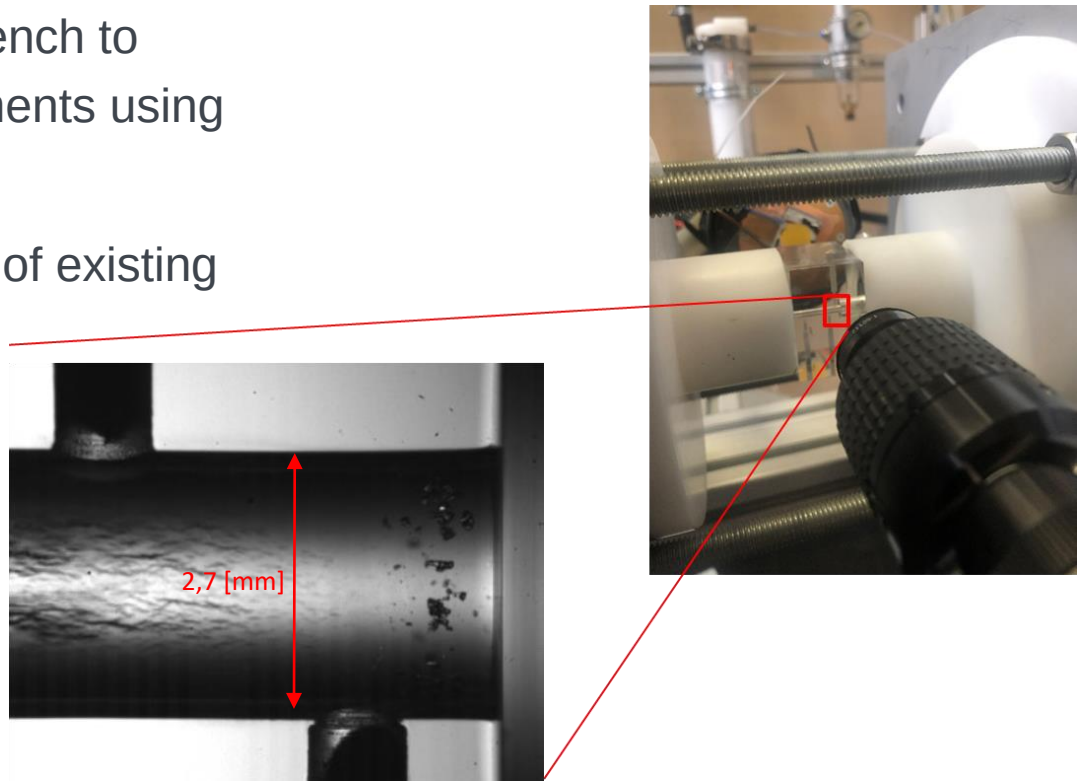
- Re-implementation of Lubrication Model in C (The algorithm is already available.)
- Implementing a proper boundary condition for each method so that they can be solved simultaneously (coupling the methods)
- Validation of results using experimental or numerical results from other projects



Thesis I: Development of Test Bench to measure Flow characteristics using Particle Image Velocimetry (PIV)

Tasks

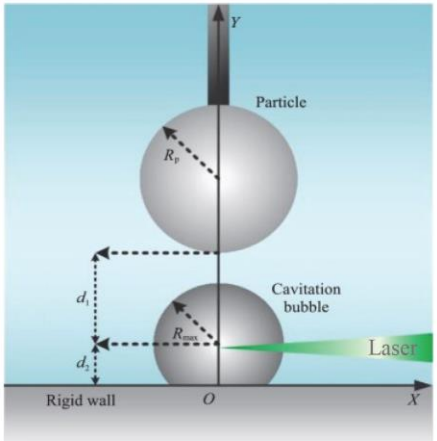
- Development of Test Bench to conduct flow measurements using PIV
- Validation with the help of existing CFD Results



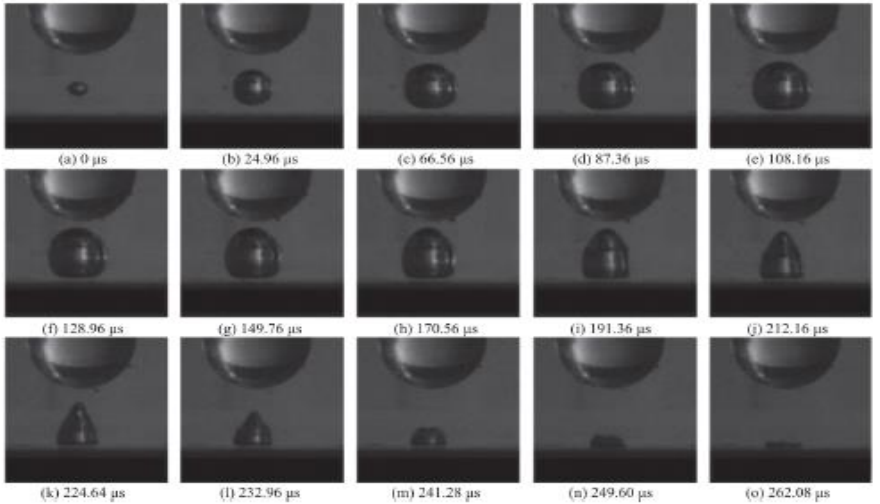
Thesis II: Development and Construction of a Test Rig for analyzing the Interaction between Cavitation Bubble and Solid Particle

Tasks

- Conception of a Test Rig for Analyzing bubble and particle interaction
- Assembling and Commissioning of the Test Rig
- Image Analysis with „Matlab Image Processing Toolbox“



Journal of Hydrodynamics, 2018, 30(6): 1012-1021
https://doi.org/10.1007/s42241-018-0128-0



Journal of Hydrodynamics, 2018, 30(6): 1012-1021
https://doi.org/10.1007/s42241-018-0128-0

University of Stuttgart
Institute of Mechanical Process Engineering

Thank You for your attention!

Arnav Ajmani

Email: arnav.ajmani@imvt.uni-stuttgart.de

Web: www.imvt.uni-stuttgart.de

Institut für Mechanische Verfahrenstechnik

Böblinger Str. 72

70199 Stuttgart