BubbleML

- ▶ Dataset
- ▶ Water boiling
  - ▶ Water is heated to 80 degrees or more
  - ▶ Visible water vapor
- ▶ Stationary water (pool) or water moving through a tube
- ▶ Dataset is generated using Flash-X simulator
- ▶ Dataset consists of velocity, bubbles, temperature, pressure
- ▶ Dataset was used e.g. to train optical flow models

Computational Fluid Dynamics

- Allows for generation of dataset
- Bubble movement can be simulated
- Plethora of paid and free solutions
- Very difficult to set up

Computational Fluid Dynamics

- Flash-X
- OpenFOAM
- Fluidsim
- CFD-Tool
- FluidX3D
- SPH-EXA
- Lethe

Flash-X

- Used to generate Bubble ML dataset
- Open source but requires registration via email to access
  - Handled very quickly on maintainer side
- Written in Fortran 90
- We had trouble building it

OpenFOAM

- Open source
- Written in C++
- Naval Hydro Pack can simulate open seas
- Bubble rising simulation
- Widely used, often recommended
- Custom configuration language
- Output is text files, one per simulation frame
- Python wrapper to setup simulations (PyFoamSetup)
- Seems like the best option when it comes to CFD
- Very difficult to learn

CFDTool

- Matlab toolbox
- Commercial project
- Can use multiple CFD solvers
- Includes OpenFOAM integration

Bubble velocimetry using the conventional and CNN-based optical flow algorithms

- ▶ Claims there are no suitable datasets
- ▶ Images in this paper are generated
  - ▶ Bubbles move randomly
  - ▶ May not change shape
- ▶ CNNs used to detect bubbles
- ▶ Predicts bubble velocity
- ▶ CNN-based model (PWC-Net)
- ▶ Lucas-Kanade and Farnebäck methods

Deep learning-based automated and universal bubble detection and mask extraction in complex two-phase flows.

- ▶ Referenced by the previous paper
- ▶ Promises to detect up to 95% of all bubbles
- ▶ Detection software is FOSS
- ▶ https://github.com/ywflow/BubMask

BubbleML

- ▶ Model pretrained on flying chairs
- ▶ RAFT and GMFlow
- ▶ Suggest physics-informed models should be used
- ▶ Bubbles change shape and thus are difficult to track