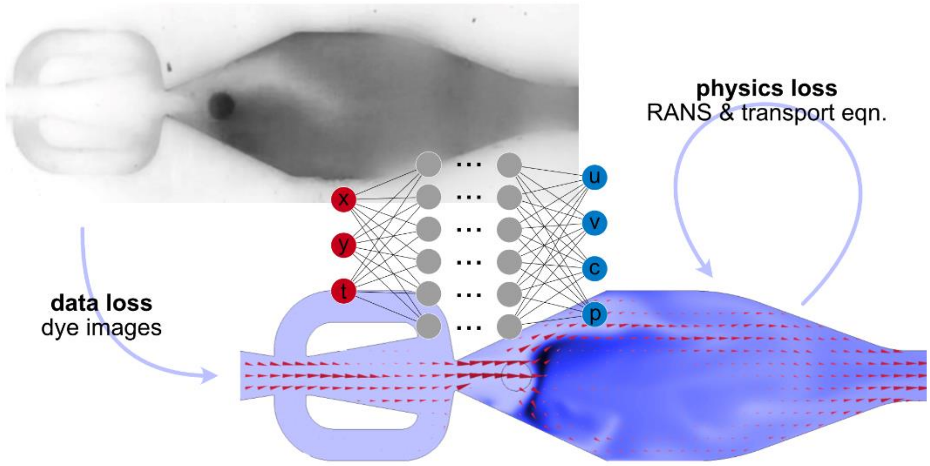
Advertisement for a Master's thesis with the topic:

Development of a physics-informed neural network to get quantitative measurement data from flow visualizations in micromixers



The innovative FDmiX mixers offer outstanding performance for the rapid mixing of liquids [1]. This technology is used on a very small scale in the production of nanoparticles, which are used for mRNA vaccines, for example. A major challenge here is the experimental investigation of the processes in the micromixer. The combination of simple flow visualizations with innovative machine learning offers great potential to solve this problem [2]. In turbulent flows, these so-called physics-informed neural networks (PINN) can already achieve very good results [3]. In the present project, their application for turbulent mixing processes is to be tested. The work is part of a cooperation between the company FDX, the TU Berlin and the University of Calgary. This offers the opportunity to gain an insight into current research in industry and university and to supplement the work with a stay abroad.

Tasks:

- Implementation of a PINN for the determination of oscillating velocity fields
- Extension of the PINN for flow visualization as input data
- Evaluation of the PINN on CFD data and, if necessary, adaptation of the turbulence model

Required Skills:

- Passion for programming and experience with numerical methods.
- Programming experience in Python (ideally also Tensorflow or Torch)
- Familiar with basics of turbulent flows

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Literature:

1. FDmiX mixing technology from FDX: https://www.fdx.de/fdmix/
2. Maziar Raissi *et al.*, Hidden fluid mechanics: Learning velocity and pressure fields from flow visualizations. *Science* **367**,1026-1030(2020). DOI: 10.1126/science.aaw4741
3. Jakob G. R. von Saldern et al., Mean flow data assimilation based on physics-informed neural networks. *Physics of Fluids* 34 (11): 115129. https://doi.org/10.1063/5.0116218