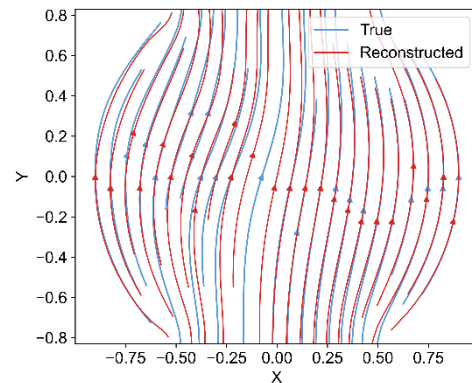
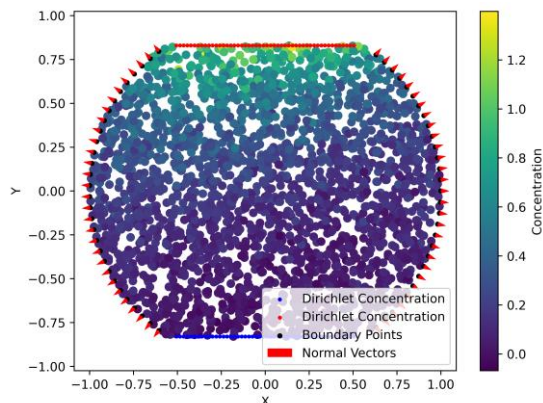


# Master Thesis!



## Reconstruction of flow fields in porous media from concentration measurements using adjoint state optimization



The FlowForLife research project is developing a microfluidic supply network for artificial cell clusters. A key aspect of the network design is oxygen transport in the surrounding porous matrix. To experimentally characterize this transport, oxygen-quenching luminescent particles are added to the matrix. The local oxygen concentration can be determined using each individual particle.

Based on these point-like concentration measurements, the underlying flow field in the porous surrounding matrix is to be reconstructed. To do this, a solution to the convection-diffusion equation must be found that best reproduces the measured concentration field and satisfies the mass conservation for the flow field.

One way to solve this inverse problem is adjoint state optimization. The goal of this master thesis is to implement a corresponding numerical framework in the DOLFIN/FEniCS software package and to identify suitable numerical parameters and regularization strategies. To this end, synthetic test cases will be used.

Possible tasks within the scope of the master's thesis are:

- Literature research on inverse problems and scalar field inversion with adjoint state optimization
- Implementation of forward and adjoint equations on a simplified geometry
- Gradual increase in model complexity through realistic geometries and consideration of measurement noise
- Evaluation of the accuracy, stability, and suitability of the methodology

Start immediately.

If you are interested, simply contact Till Werner [werner@sla.tu-darmstadt.de](mailto:werner@sla.tu-darmstadt.de).