Experimental imaging of mixing in porous media

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Motivation:
Mixing is the operation of bringing a system from a state of segregation to uniformity, like when you use a spoon to speed up the dissolution of sugar in your coffee. Solute mixing has broad implications for how chemicals and pollutants spread and react in the soil or other porous environments, where the complex flow paths act as the spoon. Since porous media (such as rock) are generally opaque, it is hard – but nevertheless highly desirable – to image the mixing dynamics within this confinement, especially when the flow field is time-dependent like in two-phase flow.

Project description:
We will employ state-of-the-art stereolithography 3D printing techniques to study the dynamics of mixing in porous media. Our setup allows for the full visualisation of how blobs and strips of dye (i.e. solute) deform in time. Image analysis techniques will be developed to track the spreading in real time, and we will assess how different boundary and flow conditions affect the dynamics. The experiments will be compared to numerical simulations performed under similar conditions (see other project) and could support the development of more energy-efficient micromixers.

Resources:
The student will learn to use the 3D printing facilities at PoreLab UiO, and have access to dedicated computing resources for image analysis.

Required background:
Interest in fluid dynamics, experimental methods, data analysis.

Experimental visualisation of chaotic mixing patterns during time dependent flow through a 3D printed porous medium.