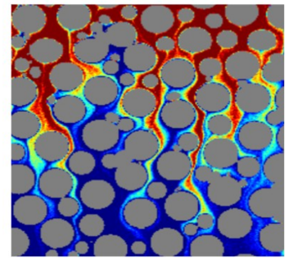
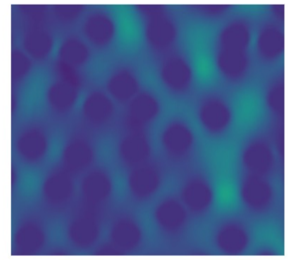
Cargese Practical: Fluid Transport and Mixing in Microfluidic Chips





Course Description:

This module provides an in-depth exploration of microfluidic technologies and their applications in studying flow and solute mixing phenomena in porous media. Participants will learn the principles of microfluidic device fabrication, fluid dynamics at the microscale, and experimental techniques for visualizing and quantifying flow fields and solute mixing characteristics at the pore scale. The course will combine theoretical lectures, hands-on laboratory sessions, and data analysis workshops to offer a comprehensive understanding of the subject.

Learning Objectives:

By the end of this module, participants will be able to:

- Apply advanced imaging techniques to resolve flow velocities and solute concentrations within microfluidic models
- Analyze and interpret experimental data to understand flow structure, solute transport, and fluid mixing mechanisms
- Design experiments to investigate specific research questions about fluid flow, deformation, and solute mixing in porous media

Module Outline:

The first week will involve a series of practical lectures, including:

- Practical Introduction (*Day 1: Sophie Roman*): Design considerations for studying transport and mixing in microfluidic devices: Fluorescence-based methods, introduction to micro/millifluidic setups and image analysis
- Introduction to solute transport and mixing phenomena (*Day 2: Joaquin Jimenez-Martinez*)
- Physics of multiphase flow in porous media (*Day 3: Paula Reis)*
- Introduction to particle tracking velocimetry in porous media *(Day 4: Kevin Pierce)*

In the second week, students can participate in different hands-on labs:

- Fluorescence-based imaging of solute mixing in micrscale porous models (*Joaquin Jimenez-Martinez, Zahra Hajian*)
- Particle tracking velocimetry in milliscale porous models (*Kevin Pierce, Paula Reis*).
- Fluorescence-based imaging of solute mixing in milliscale porous models (*Pietro de Anna, Wenqiao Jiao*)

Experimental projects will include hands-on work (setting up and conducting experiments), data analysis and interpretation (quantitative analysis of flow and mixing characteristics), and presentation of research findings (last day).

Responsible: Joaquin Jimenez-Martinez (Eawag & ETH Zurich); Kevin Pierce (University of Oslo); Paula Reis (University of Oslo); Sophie Roman (University of Orléans); Zahra Hajian (Eawag & ETH Zurich); Pietro de Anna (University of Lausanne); Wenqiao Jiao (University of Lausanne)