## PHD PROFILE, II YEAR STUDENTS, A.A. 2018/2019


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- *Research title: Characterization of multi-phase flow in porous media by means of X-ray micro computed tomography*
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## OUTLINE OF THE RESEARCH

Segmentation and morphology classification of porous systems, containing multiple fluid phases is a challenging research topic for the comprehension of countless physical problems in a variety of technical applications.

The fluids contained in porous media distribute with respect to the solid structure in a way to minimize the system energetics. Wetting fluids spread over the solid, whereas non-wetting fluids occupy the pore centers. The pore structure is in general several orders of magnitude smaller than the characteristic scales governing the overall processes. For example, desaturation of the non-wetting phase is caused by either an increase in viscous forces or reduction in capillary forces. The appropriate formulation of these forces at the macroscale is unclear, since complex pore-scale fluid topologies are not resolved on the macroscale. Dimensionless scaling groups, based on averaged microscale variables, have been proposed in an attempt to overcome this deficiency. Currently, ambiguities are present at interfaces, when investigating porous multi-phase systems using standard resolution micro computed tomography (micro-CT). This may result in large errors at the microscale and hence motivates the application of high resolution micro-CT for this research project.

The envisaged results are:

- Design and production of calibrated porous model bodies of different complexity
- Geometrical characterization of those micro-porous structures and analytical calculation of characteristic parameters, such as porosity, permeability, tortuosity, pore size distribution, etc.
- Comparison of the analytically obtained values with those extracted from the micro-tomography data
- Development of segmentation and evaluation algorithms for the obtained micro-tomographic data
- Analysis of the interfacial properties of multiple fluid, infiltrated into the porous structures, by conducting micro-tomographic scans at different states of saturation
- Analysis and visualization of fluid displacement mechanisms on the pore scale

The obtained results can potentially be utilized to optimize processes, such as oil and gas recovery, subterranean carbon-dioxide storage, chemical separations, catalysis and material manufacturing by providing a better understanding of the aforementioned problems and are therefore essential to many industries.

The project is embedded in the international research training group 'DropIT', that brings together researchers of different fields of different universities in Italy and Germany.