Project title: Modelling, analysis, and computations of inverse problems for random heterogeneous systems

Summary: Random heterogeneous systems are ubiquitous in our world. Examples include natural porous media such as soil/rocks, biological membranes such as plasma membranes, synthetic membranes for desalination/filtration, or growth of neural networks in brains. We will start with fundamental statistical, thermodynamic and physical formulations describing transport in random heterogeneous systems on the microscale. With these tools, we will mathematically formulate efficient and reliable inverse problems for identifying the structure of such systems. In a second step, we shall also account for interfacial processes by interaction energies. This will lead to new reliable and efficient, analytical and computational upscaling/coarse graining methodologies.

Potential collaborations: The project is well suited for national and international collaborations, e.g. with Imperial College [S. Kalliadasis (Chem. Eng.) and G.A. Pavliotis, (Maths)], University of Edinburgh [B. Goddard (Math.), P. Valluri and Y. Zheng (School of Eng.)], University of Alberta-Camrose [P. Berg (Physics)]. This project is closely related to inverse problems in the energy and oil industry where one aims to understand the structure of reservoirs under a small amount of measurements. These shall ultimately allow us to initiate a range of industrial collaborations with the help of computational results demonstrating the reliability and capability of our mathematical and computational framework for industrial challenges in oil recover, CO2 storage, complex multiphase systems such as batteries and fuel cells, e.g. weight, charging time or storage capacity.

PhD Candidate: We are looking for a PhD candidate with degree in Mathematics (Analysis,Probability), Mathematical Physics, or any other equivalent field. The student should be enthusiastic for learning and understanding new concepts and preferably have a fundamental understanding in one of the following fields: analysis, finite element methods, probability theory, statistical mechanics, quantum mechanics

If you are interested, please contact me, Dr. Markus Schmuck, by email (**M.Schmuck@hw.ac.uk**), and apply via the link **http://www.hw.ac.uk/student-life/how-to-apply/postgraduate.htm** after selecting a Funding scheme under the tab Funding on the website **http://www.macs.hw.ac.uk/research/phd/phd-opportunities.htm** and indicate the appropriate funding scheme on your application. Further additional information on my research see my **Personal Web**. The successful candidate will be based at the Maxwell Institute at Heriot-Watt but will closely collaborate with teams at University of Edinburgh and Imperial College London. The successful candidate is also expected to present results at premier conferences in fluid dynamics like the American Physical Society - Division of Fluid Dynamics and British Applied Mathematical Colloqium and publish in premier journals such as Journal of Fluid Mechanics.