



**POLITECNICO
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MOX Seminar Series

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Multi-scale and multi-physics modeling of complex flow and transport processes for energy storage in the subsurface

23 November 2017, 2:00 pm

Aula Consiglio VII Piano - Edificio 14, Dipartimento di Matematica POLITECNICO DI MILANO.

Abstract:

The subsurface is being increasingly utilised both as a resource and as an energy and waste repository. Historically, there have been few issues of concern related to competition between resources, with groundwater contamination being a notable exception. However, with increasing exploitation, resource conflicts are becoming increasingly common and complex. Current issues in this regard include, for example, the long-range impact of mechanical, chemical and thermal energy storage on groundwater resources, and the complex effects surrounding hydraulic fracturing in both geothermal and shale gas production.

To analyse and predict the mutual influence of subsurface projects and their impact on groundwater reservoirs, advanced numerical models are necessary. In general, these subsurface systems include processes of varying complexity occurring in different parts of the domain of interest. These processes mostly take place on different spatial and temporal scales. It is extremely challenging to model such systems in an adequate way, accounting for the spatially varying and scale-dependent character of these processes.

In this seminar, we will give an overview of possible utilisation conflicts in subsurface systems and of how the groundwater is affected and review several model coupling concepts with a focus on the lecturer's work in this field. The concepts are divided into temporal and spatial coupling concepts, where the latter are sub-divided into multi-process, multi-scale, multi-dimensional, and multi-compartment coupling strategies. We will present a large-scale simulation showing the general applicability of the modelling concepts of such complicated natural systems, especially the impact on the groundwater of simultaneously using geothermal energy and storing chemical and thermal energy. At the same time, we will show that such real large-scale systems provide a good environment for balancing the efficiency potential and possible weaknesses of the approaches discussed.

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Rainer Helmig:

Prof. Helmig is head of the Department of Hydromechanics and Modelling of Hydrosystems at the University of Stuttgart. In 1995, he was awarded the renowned "Dresdner Grundwasserforschungspreis" for his doctoral thesis on "Theory and numerics of multiphase flow through fractured porous media". He was co-founder and, from 2009 to 2011, President of the International Society for Porous Media "InterPore"; he is spokesman of the International Research Training Group "NUPUS – Nonlinearities and upscaling in porous media" with partner universities in Delft, Utrecht, Eindhoven, Wageningen and Bergen, and he is a member of the Executive Board of Directors of the Cluster of Excellence Simulation Technology at the University of Stuttgart. He is on the editorial boards of a number of journals and has been selected as Darcy Lecturer 2015 by the US National Ground Water Association.