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Models, Learning and Sensing in Hydrology

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Uncertainty quantification of numerical models: From water resources, mine water management up to geothermal applications

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Abstract: Geophysical and more broadly geoscientific applications have many sources of uncertainties, arising from, for instance, unresolved and unaccounted physical processes, inaccurate geometrical information, and variations in the parameter distributions. Several methodologies exist to quantify the uncertainty behind numerical models used for flow and transport processes in water resources and geothermal applications. However, there is not a current agreement about the methodology, especially when numerical modelling is applied in the industry. In many cases, even the uncertainty is not addressed. In the present study, we focus on the uncertainty associated to the parameter distributions. Mostly, parameter values are locally known in some locations nearby exploration wells. At a large (and regional) scale, lithological information is understood, but the variability of the hydraulic and thermal parameters at that scale may be large. Thus, several assumptions are usually made for the reservoir simulations (homogenization techniques). This leads to a high degree of uncertainty in the model predictions such as fluid pressure and temperature distributions.

We discuss two cases (mining and geothermal applications) and demonstrate the impact of parameter uncertainty to model predictions. On the one hand, numerically expensive methods such as Monte Carlo are used to estimate flows to a mine. On the other hand, Iterative Ensemble Smoothing techniques are used to reduce the numerical effort for the uncertainty quantification in a modelling exercise in a deep geothermal reservoir in Germany.

Moderated by Dr. Jawairia Ashfaq Ahmad, Centre for Water Informatics & Technology (LUMS)

Speaker Biography: Dr. Carlos Rivera Villarreyes works as Global Product Specialist for FEFLOW. Dr. Rivera has profound knowledge of groundwater and unsaturated-zone modelling as well as parameter estimation and uncertainty analysis (e.g., with PEST), all these in the context of mining applications among others. He has carried several groundwater modelling projects and trained professionals in groundwater modelling around the globe.

The webinar can be attended via Zoom. In order to attend, the participants must register at the following link:
https://wit.lums.edu.pk/MLSH2022
Instructions to log into the webinar will be sent via email.

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