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Uncertainty Quantification in DFN simulations with random geometry

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In the framework of underground flow simulations in fractured media, modeled by Discrete Fracture Networks (DFNs), we focus on the issue of the non-deterministic description of the network. For performing numerical simulations, fractures are indeed typically sampled from probabilistic distributions for both hydro-geological properties (fracture transmissivity) and geometrical features (orientation in the 3D space, position, size). An uncertainty quantification analysis is mandatory in these situations, for assessing the impact of stochastic parameters on some relevant quantities of interest (as, for example, the equivalent permeability). In the relevant case of stochastic description of the geometry of the network, the network connectivity may change among samples; as a consequence, the quantity of interest is likely to display a non-smooth behavior in the space of stochastic parameters. This situation is known to represent a challenging issue also for modern UQ techniques such as stochastic collocation strategies. We will address the issue of the application of effective, modern UQ techniques, as the Multilevel Monte Carlo Method (MLMC), for accurately computing suitable statistics of the quantity of interest at a moderate computational cost, considering both stochastic transmissivities and stochastic geometrical parameters.

References

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Primary authors: BERRONE, Stefano (Politecnico di Torino, Italy); Dr PIERACCINI, Sandra (Politecnico di Torino); Dr SCIALO, Stefano (Politecnico di Torino); VICINI, Fabio (Politecnico di Torino)

Presenter: Dr SCIALO, Stefano (Politecnico di Torino)

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