Multiphysics Modelling and Simulation strategies for processes in fractured porous media

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Kundan Kumar\*, Sorin pop†

\* Department of Mathematics, University of Bergen, Norway

Allegaten 41, Realfagbygget, 5007 Bergen, Norway

[Kundan.kumar@uib.no](mailto:Kundan.kumar@uib.no), https://www.uib.no/en/persons/Kundan.Kumar

† Mathematics and Statistics, Hasselt University, Belgium

Campus Diepenbeek, Agoralaan Gebouw D   
BE 3590 Diepenbeek, Belgium   
E-mail: [sorin.pop@uhasselt.be](mailto:sorin.pop@uhasselt.be), https://www.uhasselt.be/cmat

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ABSTRACT

Numerous subsurface engineering applications involve fluid flow, mechanical deformations, or reactive transport in porous media. Prominent examples are in geothermal energy, nuclear waste storage, geological CO2 sequestration, oil recovery, or energy storage. Usually, these processes are strongly coupled, interacting at different scales and with the complex geological structure. In particular, fractures have a strong impact on the overall behaviour of the system: the fracture network form the primary conduit for flow and transport, and act as the most vulnerable regions for mechanical instability. Moreover, a fractured medium is often anisotropic, heterogeneous, with strong discontinuities in the material properties, spanning several orders of magnitude. For the numerical simulation, the interactions between various processes and the complexity of the fractured system bring challenges from both mathematical and computational point of view.

The talks in this minisymposium will present recent advances in the modelling and the numerical simulation of multiphysics processes in fractured media. Incorporating fractures or faults in the model description requires either resolving them at full resolution, or representing them as reduced dimensional objects embedded in the full dimensional domain. In the latter case, one needs a mixed-dimensional description of the processes, and an appropriate coupling of the different model components defined on objects of different dimensionality. The dimensionality reduction of fractures raises interesting questions regarding the choice of the appropriate models, and the quantification of the modelling errors. Furthermore, the mesh generation for the fractured system, and the derivation of efficient solution procedures for the resulting equations is truly challenging, in particular if mechanical deformations need to be considered. Such aspects will be discussed in this minisymposium.