Fictitious Domain methods for simulating thermo-hydro-mechanical processes in fractures

Cyrill von Planta\textsuperscript{1}, Maria G.C. Nestola\textsuperscript{1}, Daniel Vogler\textsuperscript{2}, Patrick Zulian\textsuperscript{1}, Nasibeh Hassanjankoshkroud\textsuperscript{4}, Xiaoqing Chen\textsuperscript{2}, Martin O. Saar\textsuperscript{2,3}, and Rolf Krause\textsuperscript{1}

\textsuperscript{1}Università della Svizzera Italiana, Switzerland, Institute of Computational Science, Switzerland (cyrill.planta@gmail.com)
\textsuperscript{2}ETH Zurich, Switzerland, Geothermal Energy and Geofluids Group, Institute of Geophysics, Department of Earth Sciences
\textsuperscript{3}University of Minnesota, USA, Department of Earth and Environmental Sciences
\textsuperscript{4}FAU Erlangen, Germany, Institute of System Simulation

Fictitious domain methods provide an promising way for simulating fluid structure interaction in fractures with complex geometries. The main characteristic of the method is that the solid and the fluid problem are simulated on different, non-matching meshes, with the solid being immersed into the fluid. The problems are coupled by $L^2$ - projections, which transfer physical variables between the two computational domains and either the penalty, augmented Lagrangian or Lagrange multiplier method to represent the solid in the fluid. We show the evolution of our framework in the last three years, starting with benchmark problems such as Poiseuille flow, with successive extension to contact, fracture intersections and thermal coupling.