Co-Design of variational formulations and parallel solvers in Non-Isothermal ThermoChemo- Mechanics: Comparison of the Minimization and Saddle-Point formulation of a coupled mechanics diffusion model implemented in deal.II

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The present contribution considers a fully coupled chemo-mechanical deformation-diffusion boundary value problem related to the swelling in hydrogels. The results, obtained from the minimization and saddle-point formulation of the rate-type variational principle will be compared and the implementation based on the corresponding incremental form in the finite element library deal.II will be illustrated.
Conforming finite elements and a sparse direct solver (UMFPACK) are employed in the simulation of two representative boundary value problems and the role of the incompressibility constraint, inherently present in the constitutive model of hydrogel is systematically investigated in mesh convergence studies.
These results will also serve as baseline for further parallel computations employing the domain decompostion based FROSch solver framework.