A multi-scale iterative scheme for a phase-field model for reactive transport problems

In a porous medium mineral precipitation and dissolution can significantly alter the pore structure. These reactions affect the porosity and the Darcy-scale flow through the medium. The pore structure changes introduce an evolving boundary between the fluid and grains, and we apply a phase-field approach to model the evolution of the interface.
We consider a two-scale phase-field model of reactive transport processes in porous media. The model is the result of a formal homogenization procedure where the pore and Darcy scales are coupled through the calculation of effective parameters. The proposed numerical scheme is a combination of techniques to solve the coupled non-linear system of equations. At each time step, the macro-scale system receives updated information from the cell problems as the phase field evolves.
Here we show the boundedness of the numerical solutions and the convergence of the scheme. In the numerical examples we combine mesh refinement on the micro scale with different linearization techniques to improve the accuracy and the efficiency of the simulations.