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Simulation of interface-coupled porous-medium applications using partitioned coupling methods

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Many real-world applications involve interface-coupled processes and porous media. Common examples are the hydromechanical coupling of liquid in a fracture under high pressure and the resulting deformation of the surrounding porous medium or coupled free and porous-medium flow. These examples play an important role in hydraulic simulations or simulations of filters. Moreover, the underlying problems can be split in two non-overlapping subdomains with different physical properties and mathematical models that are separated by a sharp interface. Solving such problems numerically leads to ill-conditioned (linearized) systems of equations if a monolithic solution strategy is used.

We circumvent the problem of ill-conditioned system of equations by solving the problems by partitioned black-box methods which are based on the idea of domain decomposition techniques. The individual problems are solved separately in an iterative manner. Suitable values for the coupling condition on the interface ensure that we recover the coupled behavior of the original problem. Additionally, we employ so-called accelerators based on interface quasi-Newton methods for stabilization and acceleration of the iterative coupling process. The black-box nature of the applied coupling method only relies on the data exchanged between the subdomains which simplifies the coupling of different solver (software) packages.

We investigate different black-box coupling methods for the mentioned porous-medium applications to show their versatility and to identify suitable accelerator configurations. The presented approach is based on the open-source library preCICE (www.precice.org) which, amongst other things, includes functionality to communicate data, to steer the coupling process, and to apply the acceleration to the coupling process.

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References

Time Block Preference

Time Block B (14:00-17:00 CET)

Participation

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