Efficient Parallel Algorithms for Nonlinear Mortar Interface Problems

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ABSTRACT: Mortar methods are a popular domain decomposition technique for the numerical simulation of multiphase flow through porous media. Similar to other multiscale methods, it is a challenge to implement an approach with competitive parallel performance, in order to solve the underlying coupled, highly heterogeneous, nonlinear systems on a large scale. This talk highlights several new parallel algorithms that have recently been developed to give a fresh perspective on the problem and offer significant performance gains. The key strategy is to linearize the coupled system in both subdomain and interface variables simultaneously, forming a global Jacobian and reducing the system to a linearized interface problem. These schemes are much simpler than previous formulations, in which nonlinear subdomain problems were coupled with nonlinear interface conditions, leading to nested Newton iterations and requiring forward difference approximations. We numerically demonstrate the improved stability and scalability of the global Jacobian approaches.