Parallel performance of preconditioners for mechanics with a second gradient regularization problems

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Abstract: The modeling of a deep geological disposal facility built in a clay-based host rock is of interest to us. To avoid problems with the loss of uniqueness of a solution and, more importantly, problems of localization which are often encountered in soil computations, we consider non-locally regularized equations based on a second gradient theory [1]. The objective of this work is the development of a scalable solution technique for the linearized equation. There has been research on models involving second gradient regularization, but linear solvers have not been in the focus of these works [2]. We will present a block preconditioner for the mechanics equilibrium equations with a regularization via a second gradient of dilation. Our proposed preconditioner is based on the theory of block preconditioners for saddle point problems [3]. We use a block Jacobi approach, where we precondition with an algebraic multigrid the blocks corresponding to the finite element discretization of the displacement and micro volume changes, whereas the Lagrange multipliers block is preconditioned with a mass matrix. The method is implemented in code_aster [4]. Numerical results reflect the good performance of the proposed preconditioner that shows to be weakly scalable until more than 2000 cores. Furthermore, the iteration count of the iterative solver is independent of the mesh size.

References:

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