NONLINEAR AND ROBUST FETI-DP DOMAIN DECOMPOSITION METHODS

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Abstract

New nonlinear FETI-DP (Dual-Primal Finite Element Tearing and Interconnecting) and BDDC (Balancing Domain Decomposition by Constraints) domain decomposition methods are introduced. In all of these methods, in each iteration, local nonlinear problems are solved on the subdomains. The new approaches have the potential to reduce communication and to show a significantly improved performance, especially for problems with localized nonlinearities, compared to a standard Newton-Krylov-FETI-DP or BDDC approach. Moreover, the coarse space of the nonlinear FETI-DP methods can be used to accelerate the Newton convergence. It is also found that the new nonlinear FETI-DP and nonlinear BDDC methods are not as closely related as in the linear context. Numerical results for the p-Laplace operator are presented.

Robustness with respect to discontinuities in the coefficients of the pde is another important and desirable property of domain decomposition methods. Adaptive coarse spaces can be used to obtain independence on coefficient jumps for highly heterogeneous problems, even when coefficient jumps inside subdomains are present. If time allows, for FETI-DP methods, we also present a new approach to obtain independence of the coefficient jumps by solving certain local eigenvalue problems and enriching the FETI-DP coarse space with eigenvectors.