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Parallel implicit phase-field solver based on domain decomposition methods

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Phase-field modeling has found numerous applications in material sciences. Due to the multi-scale nature, partial differential equations arising in many phase-field models are typically high-order nonlinear parabolic PDEs containing both diffusive and anti-diffusive terms and are often stiff and highly ill-conditioned. In this work, stabilized implicit schemes with an adaptive time-stepping strategy for some typical phase-field problems are investigated. We apply a Newton-Krylov-Schwarz algorithm to solve the nonlinear system of equations arising at each time step. Low-order homogeneous boundary conditions for the overlapping subdomains are imposed in the Schwarz preconditioner to achieve promising convergence result. Numerical tests on a supercomputer with thousands of processor cores are provided to show the scalability of the parallel solver.