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Multigrid treatment of implicit continuum diffusion[1] MANAURE FRANCISQUEZ, BEN ZHU, BARRETT ROGERS, Dartmouth College — Implicit treatment of diffusive terms of various differential orders common in continuum mechanics modeling, such as computational fluid dynamics, is investigated with spectral and multigrid algorithms in non-periodic 2D domains. In doubly periodic time dependent problems these terms can be efficiently and implicitly handled by spectral methods, but in non-periodic systems solved with distributed memory parallel computing and 2D domain decomposition, this efficiency is lost for large numbers of processors. We built and present here a multigrid algorithm for these types of problems which outperforms a spectral solution that employs the highly optimized FFTW library. This multigrid algorithm is not only suitable for high performance computing but may also be able to efficiently treat implicit diffusion of arbitrary order by introducing auxiliary equations of lower order. We test these solvers for fourth and sixth order diffusion with idealized harmonic test functions as well as a turbulent 2D magnetohydrodynamic simulation. It is also shown that an anisotropic operator without cross-terms can improve model accuracy and speed, and we examine the impact that the various diffusion operators have on the energy, the enstrophy, and the qualitative aspect of a simulation.

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