

MULTIGRID REDUCTION IN TIME FOR CHAOTIC DYNAMICAL SYSTEMS

DAVID A. VARGAS

In collaboration with: J. B. Schroder, R. Falgout, S. Günther

Abstract. Multigrid Reduction in Time (MGRIT) extends the well known two-level Parareal algorithm to a full multigrid method, and has demonstrated optimal scaling for parabolic problems. However, chaotic problems have proved more difficult, since chaotic initial value problems are inherently ill-conditioned. MGRIT relies on a hierarchy of successively coarser time-grids to iteratively correct the solution on the finest time-grid, but due to the nature of chaotic systems, subtle inaccuracies on the coarser levels can lead to poor coarse-grid corrections. Here we propose a modification to nonlinear FAS multigrid, as well as a novel time-coarsening scheme, which together better capture long term behavior on coarse grids and greatly improve convergence of MGRIT for chaotic initial value problems. We provide supporting numerical results for the Lorenz system and the Kuramoto–Sivashinsky equation model problems.