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Seminar

Transformed Primal-Dual Methods for Nonlinear Partial Differential Equations

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Abstract

Steady-state nonlinear partial differential equations can be understood as finding the minimum of some smooth convex energy with equality constraints. After introducing the Lagrange multiplier, we are seeking the saddle point of a nonlinear system. A transformed primal-dual (TPD) flow is developed for such a nonlinear saddle point system. The flow for the dual variable contains a Schur complement which is strongly convex. Exponential stability of the saddle point is obtained by showing the strong Lyapunov property. A TPD iteration is derived by time discretization of the TPD flow. Under mild assumption, the algorithm is linearly convergent and the convergence rate depends on the relative condition number of the objective function and the Schur complement under variant metric as preconditioners. The developed algorithm is then applied to nonlinear partial differential equations: Darcy–Forchheimer model and a nonlinear electromagnetic model. Numerical results demonstrate the efficiency of the method. This is joint work with Long Chen (UC Irvine) and Ruchi Guo (CUHK).

Date: 12 October 2023 (Thursday)
Time: 10:30am – 11:30am (Hong Kong Time)
Venue: LSB 222, Lady Shaw Building

All are Welcome