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Zhen Chao* (chaozhen@uwm.edu) and **Dexuan Xie**. *A modified preconditioned conjugate gradient method for a nonsymmetric elliptic boundary value problem.*

In this talk, we present a modified preconditioned conjugate gradient (mPCG) method for solving a second order non-symmetric and indefinite elliptic boundary value problem. We first approximate the problem as a finite element linear system, and then reformulate it as a symmetric indefinite augmented linear system based on the least square approach. We next construct mPCG for solving this augmented linear system through introducing a singularity test and a novel preconditioner to deal with the singularity and convergence rate issues. As an application, we derive a fast mPCG for solving a steady state convection diffusion boundary value problem via a PCG-multigrid scheme for solving each related preconditioning linear system. We programmed this mPCG method in Python and Fortran based on the finite element library from the FEniCS project. Numerical results demonstrate the efficiency of this mPCG program in comparison to the commonly-used GMRES or MIN-RES methods. (Received September 25, 2018)