
Victoria E. Howle
**Block-structured preconditioners for finite element
discretization of coupled fluid problems**

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Many important engineering and scientific systems require the solution of extensions of standard incompressible flow models, whether by coupling them to other processes or by incorporating additional nonlinear effects. Finite element methods and other numerical techniques provide effective discretizations of these systems, and the generation of the resulting algebraic systems may be automated by high-level software tools such those in the Sundance project, but the efficient solution of these algebraic equations remains an important challenge.

Frequently, the nonlinear equations are linearized by a fixed point or Newton technique, and then the linear systems are solved by a preconditioned Krylov method such as GMRES. In this talk, we discuss important extensions to the methodology and analysis of preconditioning such systems. In particular, we extend existing block-structured preconditioners (such as those of Elman, et al.) to address these coupled systems, showing how an effective preconditioner for Navier-Stokes may be combined with one for some other process such as convection-diffusion of temperature to obtain a preconditioner for the Newton linearization of a nonlinearly coupled system such as Bénard convection.