1014-35-633 **Petr Kloucek**, **Danny C. Sorensen** and **Jennifer L. Wightman*** (wightman@coastal.edu), Department of Mathematics and Statistics, Coastal Carolina University, P. O. Box 261954, Conway, SC 29528. *Using the Finite Element Approximation of Steklov Eigenfunctions to Solve the Laplace Equation Efficiently with Multiple Boundary Data.*

We present a method for construction of an approximate basis of the trace space $H^{1/2}$ based on a combination of the Steklov spectral method and a finite element approximation. Specifically, we approximate the Steklov eigenfunctions with respect to a particular finite element basis. Then solutions of elliptic boundary value problems with Dirichlet boundary conditions can be efficiently and accurately expanded in the discrete Steklov basis. We provide a reformulation of the discrete Steklov eigenproblem as a generalized eigenproblem that we solve by the implicitly restarted Arnoldi method of ARPACK. We include examples highlighting the computational properties of the proposed method for the solution of elliptic problems on bounded domains using both a conforming bilinear finite element and a nonconforming harmonic finite element. In addition, we document the efficiency of the proposed method by solving a Dirichlet problem for the Laplace equation on a densely perforated domain. Finally, we consider an example with discontinuous boundary data, yielding an ill-posed elliptic problem, in the framework of a generalized Steklov representation. (Received September 21, 2005)