1014-35-1359        **James V Lambers\*** (`lambers@stanford.edu`), Department of Petroleum Engineering, Stanford University, 367 Panama St Rm 065, Stanford, CA 94305-2220, **Maeve L McCarthy** (`maeve.mccarthy@murraystate.edu`), Mathematics and Statistics, Murray State University, Faculty Hall 6-C, Murray, KY 42071-3341, and **Patrick Guidotti** (`gpatrick@math.uci.edu`), Department of Mathematics, University of California, Irvine, MSTB 103, Irvine, CA 92697-3875. *Eigenvalue Characterization and Computation for the Laplacian on General Domains, and its Application to Inverse Spectral Problems.*

We address the problem of characterizing and efficiently computing approximate eigenvalues of the negative Laplacian $-\Delta$ on a general domain $\Omega \subset \mathbb{R}^n$ with piecewise smooth boundary. We consider homogeneous Dirichlet, Neumann or Robin boundary conditions. The basic idea is to view an eigenfunction as a superposition of generalized eigenfunctions of the corresponding free space operator, or the operator defined on an unbounded wedge in the case of, e.g., an L-shaped domain. Our approach has a number of advantages over the well-known Method of Particular Solutions (MPS) of Fox, Henrici and Moler, or its recent modification due to Betcke and Trefethen. Eigenvalues can be located by computing singular values of much smaller matrices than with the MPS; furthermore, they can be located without exhaustive scanning of the real number line, and without including interior points of $\Omega$ in the discretization. In addition to the forward spectral problem, we discuss how this approach can be used to solve inverse spectral problems for Laplace's equation, as well as the weighted Helmholtz equation. (Received September 28, 2005)

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