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Wenjun Ying* (wjying@mtu.edu), Michigan Technological University, Department of Mathematical Sciences, 1400 Townsend Drive, 206 Fisher Hall, Houghton, MI 49931. *Kernel-free Boundary Integral Method for Elliptic Boundary Value Problems.*

It is well-known that an elliptic boundary value problem (BVP) can be equivalently reformulated as a boundary integral equation (BIE). The solution of the elliptic BVP is obtained by solving the corresponding BIE via an operator discretization approach, which gives the method the name of boundary integral method. The applicability of the boundary integral method is based on the assumption that the kernels of the integral operators are analytically known. However, the kernels of the integral operators are generally very difficult to find except in the simplest cases where the elliptic operator has isotropic and constant coefficients and the BVP is posed in a free space or a simple domain with idealized boundary conditions. This talk will introduce the kernel free boundary integral (KFBI) method for general elliptic BVPs. The KFBI method avoids the need to know the analytical expressions for the kernels of the integral operators. Instead, the boundary and volume integrals involved are approximated by structured grid-based numerical solutions, which are obtained with the standard finite difference or finite element method. Some preliminary results of an adaptive version of the KFBI method for constant coefficients problems will be presented. (Received February 09, 2009)