Element-Free Galerkin Method for Solving Wave Equations

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The finite element method has found widespread application in computational electromagnetics. While it is a powerful tool, it requires an underlying mesh to describe the structure. However, in many scenarios exact geometric information is unavailable or is time varying. Under such circumstances, it is desirable to develop a formulation that does not depend on the underlying tessellation. Furthermore, it is also desirable to have a technique that is adaptive, i.e., the user increases the density of points in a region to increase the computational accuracy. In this context, meshless methods have found extensive application in both mechanics as well as computational electronics (T. Belytschko, Y. Krongauz, D. Organ, M. Fleming, and P. Krysl, *Comput. Methods Appl. Mech. and Engr.*, **139**, 3-47, 1996; G. Li and N. R. Aluru , *Sensors and Actuators A*, **91**, 278-291, 2001). Meshless methods, also known as finite point cloud techniques, relies on a set of points to describe the underlying function; this coupled with the moving least squares approach for the construction of the interpolation function and Galerkin testing yields the element-free Galerkin (EFG) method.

The EFG method has been successfully applied in static and quasi-static electromagnetic field computation in two and three dimensions. This and all other formulations to date have relied on using scalar basis functions to discretize the solution domain. The main thrust of our work is to extend these approaches to tackle vector problems. To this end, we propose the development of vector basis functions that will then be used in the underlying computational scheme. The resulting algorithm is first validated by determining resonant modes of cavities. This scheme will then be extended to analyze loaded cavities.