On the Use of Jump Functions with Radial Basis Functions in the Solution of Partial Differential Equations in Inhomogeneous Regions

Richard Gordon* (1), Elliott Hutchcraft (1), Suppakiat Tuksenvarajan(1)
(1) Electrical Engineering, University of Mississippi, University, MS 38677

In recent years, research utilizing radial basis functions (RBF) has proliferated and significant attention has been given to them in the field of electromagnetics, where the focus of the research using RBFs has been mostly in inverse scattering problems (I. T. Rekanos, "On-line inverse scattering of condiucting cylinders using radial basis-function neural networks," Microwave Opt. Technol Let, vol. 28, pp. 378-380, 2001). These functions have been applied in inverse methods primarily because they are known to have very good interpolation qualities. These functions, when employed in a meshless algorithm, are also attractive for use in the solution of partial differential equations. The traditional RBFs are infinitely smooth. While this is convenient in some applications, it makes it awkward to utilize RBFs for the modeling of fields in the vicinity of material interfaces, where there may be discontinuities in the normal components of the fields being modeled. In order to circumvent this difficulty, some researchers have recently proposed the use of special "jump" functions near material interfaces (S.L. Ho, S. Yang, J.M. Machado, and H.C. Wong, "Application of a Meshless Method in Electromagnetics," IEEE Transactions on Magnetics, vol. 37, no. 5, pp. 3198-3202, September, 2001). In this abstract and presentation, RBFs in conjunction with a meshless algorithm are used to solve electromagnetics problems in one, two, and three dimensional regions in which material interfaces are present. The use of different "jump" functions will be discussed. Numerical results and comparison with analytical solutions will be presented. The effects of the use of "jump" functions on the solution accuracy and stability will also be demonstrated.