Proposing a Wavelet Based Meshless Method for Simulation of Magnetic Materials

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One of the most practical problems in area of magnetics is to analyze the behavior of lossy magnetic materials at high frequencies. Analysis and simulation of these objects by efficient numerical techniques lead us toward a deep comprehension of these materials in different situations and frequencies. Meshless method is a novel numerical technique that can work better than other numerical methods as FDM, FEM and etc. in many aspects [1]. So, implementation of this method for computational analysis of magnetic materials will discover more properties of their nature. However, the highly accurate numerical analysis of these problems whose partial differential equations are more complicated than other electromagnetic problems needs a method that is able to zoom in those sub domains in which the above objects behave in a complicated manner. In this work, we focus on this fact; a combination between a strong numerical method, i.e., meshless method, and multiresolution analysis (MRA) [2] that makes us able to reach a highly accurate computational method. There are two novel parts in this work. At first, we propose direct meshless method based on partition of unity theorem [3] in which the shape functions are proposed directly and there is no need to basis functions. This idea reduces the computational time, when it is compared with conventional meshless methods. Also, it provides an interesting relation between shape functions in meshless method and scaling-wavelet functions in MRA. Secondly, we will propose two new functional spaces for scaling and wavelet functions to make them compatible on electromagnetic problems and call them computational MRA (CMRA). This achievement reduces the total number of nodes to reach a given error. To illustrate its accuracy and fast computational time, we solve a magnetic problem in complex magnetic dielectrics. The results of wavelet-meshless method (CMRA) are in very good agreement in comparison with other numerical methods, i.e., conventional MRA meshless and FEM methods.

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