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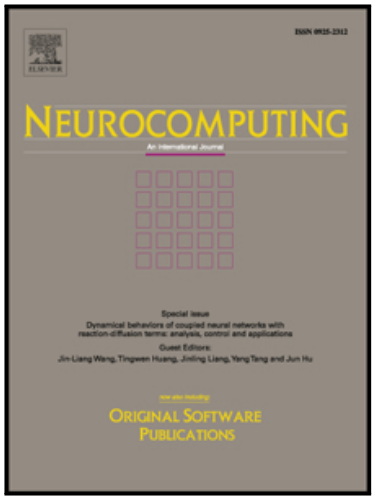

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Learning solutions to two dimensional electromagnetic equations using LS-SVM☆

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Abstract

In this paper, a new approach based on least squares support vector machines (LS-SVM) is proposed for solving the electromagnetic equations. Firstly, the cubic spline function is employed to smooth the discontinuous boundary. LS-SVM is used to solve the modified problem. Secondly, nonlinear electromagnetic equation is solved by LS-SVM. Finally, multimedia electromagnetic equation is solved by LS-SVM. Same as to the artificial neural networks (ANN), the approximate solutions are composed of two parts. The first part is a known function that satisfies the boundary conditions. The second part is the product of two terms. One term is also a known function which vanished on the boundary. The left part is the combination of kernel functions containing regression parameters. The parameters can be obtained by solving a system of equations. The numerical results show that the proposed method in this paper is feasible.

Keywords: Linear electromagnetic equation, nonlinear electromagnetic equation, multimedia electromagnetic equation, discontinuous boundary conditions, least squares support vector machines, cubic spline

1. Introduction

Numerical computation of electromagnetic equation is mainly component of computational electromagnetics. There are mainly three categories methods for computing electromagnetic equations. The first category is analytical method, which provides the analytical solutions [1]. Unfortunately, there are only a small amount of electromagnetic equations which can be expressed by the analytical formulas. The second category is numerical method, which is widely used in engineering. At present, the electromagnetic equations are successfully solved by finite element method (FEM) [2]. The FEM needs to high quality meshes, so it is difficult to solve variable structures and high speed problems. The meshes are not necessary when using element free method to solve electromagnetic equations, so element free method is high efficient performance. Galerkin's element free (EFG) method is one of the mature element free methods, but shape functions do not satisfy the Kronecker delta property. Therefore, essential boundary conditions cannot be directly imposed as is done in the FEM and the finite difference method [3]-[4]. Radical basis function mixed with finite element method (RBF-FEM) is presented in [5]. It is easy to handle the essential boundary conditions by the RBF-FEM, but it uses numerical integration, which decreases the accuracy of the solutions. The third category is approximate solutions method, and the approximate solutions are be clearly expressed by this method. The drawback is that the error of solution is not easy to be estimated [6].

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