数学与系统科学研究院

计算数学所学术报告

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报告题目：

The Mixed Spectral Element Method for Waveguide Problem and its Application in Subsurface EM Exploration

邀请人：　唐贻发 研究员

报告时间：2017 年 5 月 28 日（周日）

晚上 18:30-19:30

报告地点：　数学院南楼七层

702 教室

Abstract:

The increasing complexity of microwave and optical waveguide structures requires highly accurate and efficient simulation methods to calculate waveguide modes and to optimize geometrical and material parameters for waveguide engineering. The mixed spectral element method is proposed by applying the Vardapetyan and Demkowicz's formulation to solve the dielectric waveguide problems. Compared with the conventional variational formulation, only one part of the vectorial Helmholtz equation has been employed here. Along with the spectral accuracy that the conventional SEM has, this method is completely free of spurious eigenmodes because of the constraint enforced by Gauss' law. It utilizes the Gauss-Lobatto-Legendre (GLL) polynomials to construct the vector curl-conforming edge-based basis functions for the transverse electric field vector, and the scalar continuous nodal-based basis functions for the longitudinal component of the electric field, respectively.

Meanwhile in subsurface electromagnetic exploration, since the lossy (conductive) underground medium is attenuative to electromagnetic waves, only low-frequency electromagnetic fields can penetrate deep into the ground. However, numerical methods in computational electromagnetics often suffer from the low-frequency breakdown phenomenon due to the fact that Gauss' law is not enforced. The proposed mixed SEM by employing the divergence-free equation as the constraint condition has been investigated to improve the rate of convergence at low frequencies. Numerous numerical results shown that the mixed SEM is well suited for solving large low-frequency systems such as surface-to-borehole electromagnetic (SBEM) and controlled source EM (CSEM) systems by an iterative solver.

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