



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI  
SHORT ABSTRACT OF THESIS

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In electromagnetic analysis, standard nodal finite elements often lead to spurious solutions. Techniques like penalty function and regularization partially address this by pushing spurious modes to higher end of the spectrum, but fail to capture singular eigenvalues in domains with sharp edges and corners. To overcome this, edge elements with degrees of freedom along edges have been developed. We propose a technique to convert nodal to edge data structures for electromagnetic analysis, demonstrating superior performance of edge elements in complex domains. Edge elements show better coarse mesh accuracy and robustness, particularly in predicting singular eigenvalues in sharp-edge domains. For time-domain analysis of electromagnetic radiation and scattering, popular methods include Finite Difference Time Domain (FDTD) and Time Domain FEM (TDFEM). We propose a conserved quantity under specific boundary conditions and a time-marching scheme within the edge element framework, maintaining this conservation property regardless of time step size. Additionally, implementing symmetric boundary conditions in FEM can reduce computational cost. However, in potential formulation, this is challenging. We present a novel implementation of symmetric boundary conditions within a nodal framework, applicable to both harmonic and transient electromagnetic analysis for a variety of radiation and scattering problems.