北京理工大學

数学与统计学院学术报告

Uniform Convergence Analysis of the Rectangular Morley Element on Shishkin Meshes for Fourth-Order Singular Perturbation Problems

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摘要： The buckling problem of a two-dimensional, linearly elastic thin plate can be described by a fourth-order singular perturbation problem (the perturbation parameter is related to the plate thickness). Fourth-order problems are often solved using nonconforming finite element methods. However, when considering the presence of a boundary layer in the buckling thin plate (i.e., as the perturbation parameter approaches zero), using the rectangular Morley element on a quasi-uniform mesh leads to order reduction (the convergence order in the energy norm drops to half-order). A similar phenomenon occurs with some other finite element methods. By employing a Shishkin mesh, which uses anisotropic refinement in the region containing the boundary layer, the convergence properties of the rectangular Morley element can be restored. This report analyzes the aforementioned convergence. By extending the superconvergence results for the consistency errors associated with the fourth-order and second-order parts of the rectangular Morley element to the anisotropic case and performing specialized handling for the singular perturbation problem, we provide a uniform convergence analysis. For the fourth-order singular perturbation problem, the rectangular Morley element is compared with another nonconforming element, the Adini element. In certain cases, the rectangular Morley element demonstrates stronger convergence.

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