ABSTRACT

AN $\varepsilon-$UNIFORM METHOD FOR A BOUNDARY VALUE PROBLEM ON EQUIDISTANT MESHES

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In this thesis we propose a fully discrete $\varepsilon-$uniform finite difference method on an equidistant mesh for a singularly perturbed two-point boundary value problem. We start with a fitted operator method reflecting the singular perturbation nature of the problem through a local boundary value problem. However, to solve the local boundary value problem we employ an upwind method on a Shishkin mesh in local domain, instead of solving it exactly. Thus we show that it is possible to develop $\varepsilon-$uniform method, totally in the context of finite differences without knowing location of the layer a priori and without solving any differential equation exactly.

Imagine a river-a river flowing strongly and smoothly. Liquid pollution pours into the water at a certain point or Imagine a drop of ink dropped into a glass of water. What shape does the pollution stain form on the surface of the river or ink in the glass of water? In real life, we need diffusion to explain this problem near by the convection. We further study the convergence properties of the numerical method proposed and prove that it nodally convergence to the true solution for any ε.

Key Words
Finite differences, Uniform convergence, ε-uniform, Singular perturbation, Fitted operator method, Shishkin mesh.