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A UNIFORMLY CONVERGENT HYBRID FINITE DIFFERENCE SCHEME FOR TWO-PARAMETER SINGULARLY PERTURBED PARABOLIC PROBLEM

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In the present work, a parameter-uniform numerical method is constructed for solving one-dimensional singularly perturbed parabolic problems with two small parameters modeling diffusion-convection-reaction processes on a rectangular domain. The solution of this class of problems may exhibit the exponential (or parabolic) boundary layers at both the left and right part of the lateral surface of the domain, depending on the size of the parameters. The asymptotic behaviour of the solution and its partial derivatives is given. A decomposition of the solution in its regular and singular parts has been used for the asymptotic analysis of the spatial derivatives. To approximate the solution we consider the implicit Euler method for time stepping on uniform mesh and a special hybrid monotone difference operator for spatial discretization on a special piecewise uniform Shishkin mesh. We prove that this scheme is uniformly convergent , with respect to both the singular perturbation parameters, having first-order convergence in temporal direction and almost second-order convergence in spatial direction, in the discrete maximum norm. Numerical experiments illustrate the order of convergence proved theoretically.

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