Abstract

We consider a second-order singularly perturbed boundary value problem with two small parameters. We obtain information about the analytic regularity of the solution, using the method of asymptotic expansions and describe an $hp$-version of finite element method on the so-called Spectral Boundary Layer Mesh for the approximation of the solution. We focus on three regimes determined by the relationship between the singular perturbation parameters and through numerical computations we show that the method converges at an exponential rate, independently of the singular perturbation parameters, when the error is measured in the energy norm.