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Robust pointwise a posteriori error estimates for time-dependent singularly perturbed problems

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ABSTRACT

Consider the singularly perturbed time-dependent reaction-diffusion equation

$$\mathcal{M}u := u_t - \varepsilon^2 u_{xx} + cu = f \quad \text{in} \quad (0,1) \times (0,T]$$

subject to initial conditions and homogeneous Dirichlet boundary conditions. The parameter $\varepsilon > 0$ is small, $c \geq \gamma^2$ with some positive constant γ.

The efficiency of standard numerical methods deteriorates as the perturbation parameter ε approaches zero. This is because layers form. These are regions where the solution varies rapidely. In the present talk, bounds for the GREEN's function associated with the differential operator $\mathcal{M}$ are derived. These bounds are applied to design an a posteriori error estimator in the maximum norm for a finite difference scheme. The estimator is robust with respect to the perturbation parameter.

Numerical results will be presented to illustrate the theoretical findings.

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