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DIFFERENCE SCHEME OF HIGHEST ACCURACY ORDER BASED ON THE SOLUTION DECOMPOSITION METHOD FOR A SINGULARLY PERTURBED REACTION-DIFFUSION EQUATION

LIDIA SHISHKINA

Institute of Mathematics and Mechanics, Ural Branch of Russian Academy of Sciences

S. Kovalevskaya Str., 16, 620990, Yekaterinburg, Russia

E-mail: Lida@convex.ru

For a singularly perturbed ordinary differential reaction-diffusion equation with a perturbation parameter ε ($\varepsilon \in (0,1]$) multiplying the highest-order derivative in the equation, we develop a technique to construct a difference scheme on uniform grids with highest accuracy order. The solution of such a scheme converges ε-uniformly in the maximum norm at the rate $\mathcal{O}\left(N^{-6}\ \ln^6 N\right)$, where $N+1$ is the number of nodes in the uniform grids used. In constructing the schemes, we use the solution decomposition method ([1; 2]), in which grid approximations of the regular and singular components in the solution are considered on uniform grids, and the Richardson extrapolation technique ([1; 2]). In the papers [1; 2], we have constructed difference schemes convergent with improved accuracy order close to fourth. However, the Richardson technique used in [1; 2] turned out to be little use to construct difference schemes with convergence order above the fourth in x. In the present research, we apply the Richardson extrapolation method and a technique of the grid solution decomposition which are modified compared to those in [1; 2] used previously. The essential point here is the use of three embedded grids in the Richardson extrapolation method, as well as the construction of improved expansions for the regular solution components.

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REFERENCES

[1] G. Shishkin and L. Shishkina. Improved Difference Scheme of the Solution Decomposition Method for a Singularly Perturbed Reaction-Diffusion Equation. *Trudy Instituta Matematiki I Mekhaniki UrO RAN (Yekaterinburg)*, **16** (01):255–271, 2010.(in Russian)

[2] G. Shishkin and L. Shishkina. A Richardson Scheme of the Decomposition Method for Solving Singularly Perturbed Parabolic Reaction-Diffusion Equation. *Comp. Math. Math. Phys.*, **50** (12):2003–2022, 2010.