On Layer-adapted Meshes for General Linear Turning Point Problems

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We consider linear second order singularly perturbed boundary value problems with turning points on an interval. The number, location, and multiplicity of the turning points – zeros of the convection factor – is (almost) arbitrary.

As result of the general setting, we have to be aware that different types of layers like exponential boundary layers, interior cusp-type layers, and certain power-type boundary layers may occur, see Liseikin (2001). In order to treat these layers and to enable uniform estimates, a convenient mesh construction strategy will be given which combines the well known Shishkin-type meshes with piecewise equidistant meshes proposed by Sun and Stynes (1994).

In this talk we discuss the mesh construction and sketch how certain mesh properties can be used to prove uniform error estimates in the energy norm for higher order finite elements. The results are concretized for several examples with different layers. We also reveal that in general the energy norm is not balanced. This will be illustrated by some numerical experiments.

References:

[1] V. D. Liseikin, *Layer resolving grids and transformations for singular perturbation problems*, VSP, Utrecht, 2001.

[2] G. Sun, M. Stynes, Finite element methods on piecewise equidistant meshes for interior turning point problems, *Numer. Algorithms* 8(1), 111–129, 1994.

[3] S. Becher, Uniform error estimates for general semilinear turning point problems on layer-adapted meshes, `arXiv:1701.06323v1 [math.NA]`, 2017.

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