Efficient resolution of singularly perturbed coupled systems: Equations of reaction-diffusion type[1]

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Resumen

In this talk we are interested in a class of singularly perturbed linear system of reaction-diffusion type, coupled in the reaction terms, where the positive diffusion parameters in each equation can be different and also they can take very small values. The presence of these diffusion parameters cause that, in general, the exact solution of the continuous problem has boundary layers at the ends of the spatial domain. Examples of this type of problems appear in some areas; by instance, in the study of the flow in the porous material and in the fractured system (Barenblatt system), in the modelization of diffusion process in bones, considered as a multiple porosity medium, in turbulent interactions of waves and currents or in diffusion process in electroanalytic chemistry.

To find a good approximation of the solution it is necessary to use numerical methods giving convergence to the exact solution independently of the values of the diffusion parameters; this type of methods are called uniformly convergent methods. For the construction and the analysis of the uniform convergence of this type of methods, it is convenient to dispose of appropriate information about the asymptotic behaviour of the exact solution and its partial derivatives with respect to the diffusion parameters. For singularly perturbed coupled systems, some results in this way can be found in [3, 4] for the steady case and in [1, 2] for the evolutionary case.

We display some numerical experiments illustrating in practice the theoretical results. From these examples we can see both the uniform convergence of the numerical method and also the efficiency of different strategies to solve the linear systems resulting from the numerical discretization.

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Referencias

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