

Numerical Modelling of Reaction and Diffusion Systems in a Biological Cell Including Surface Reactions by Homogenization

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A human cell consists schematically of an outer cellular membrane, a cytoplasm containing a large number of organelles (mitochondria, endoplasmic reticulum etc.), a nuclear membrane and finally the cellular nucleus containing DNA. The organelle membranes create a complex and dense system of membranes or subdomains throughout the cytoplasm. The mathematical description leads to a system of reaction-diffusion equations in a complex geometrical domain, dominated by thin membraneous structures with similar physical and chemical properties. In a previous model, we considered only spatially distributed reaction and diffusion processes. However, from experiments it is known that membrane bound proteins play an important role in the metabolism of certain substances. In the talk we will present a new homogenization approach including homogenization of surface reactions and diffusion.