
On Volume-Surface Reaction-Diffusion Systems and Applications in Cell-Biology

Klemens Fellner*[†]

¹University of Graz (KFU) – Institute for Mathematics and Scientific Computing, Heinrichstr. 36, 8010
Graz, Austria

Abstract

Volume-Surface Reaction-Diffusion (VSRD) systems appear naturally (besides many applications) in cell-biology when describing the dynamics of proteins exchanged between cytoplasm and cortex. In *Drosophila* SOP precursor stem-cells, the protein Lgl has been identified to play a key role in the asymmetric localisation of so-called cell-fate determinates during mitosis, i.e. during asymmetric stem-cell division. A mathematical VSRD models describing the kinetics between four conformations of Lgl is presented and mathematically analysed in terms of global existence, large-time behaviour and quasi-steady-state approximation. The rich behaviour of the model is illustrated via numerical simulations based on a suitable finite-element discretisation for such VSRD systems. A class of reduced, yet nonlinear models is likewise analysed and moreover shown to satisfy exponential convergence towards equilibrium via the entropy method. Finally, an entropy method without detailed balance condition is presented, which applies to complex balance and even more general first order reaction networks.

*Speaker

[†]Corresponding author: Klemens.Fellner@uni-graz.at