Mathematical Modelling and Simulation of Processes in Biological Tissues and Membranes

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Abstract: Modelling and simulations of biological structures and functions are challenges to Mathematics and Computational Sciences. Due to the rapid increase of information about processes and structures on the molecular and cellular level, it is necessary to couple model equations for macroscopic state variables to the equations describing the processes on the micro-scale. In joint research with M. Neuss-Radu and A. Mikelic, we derived effective equations for processes in tissues and membranes, using multi-scale techniques to determine the limit with respect to a characteristic scale. The underlying concepts are similar to those in modelling chromatographic processes. More than 150 years ago, the chemist Runge discovered chromatographic patterns and conjectured that living systems follow similar laws of self-organisation. This lecture is providing a survey on the results, obtained so far.

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