

Mathematical Methods and Models in Biosciences

June 15–20, 2025, Sofia, Bulgaria

<https://biomath.math.bas.bg/biomath/index.php/bmcs>

Mathematical aspects of organization and disorganization in biology

Mirosław Lachowicz

Faculty of Mathematics, Informatics and Mechanics,
University of Warsaw, Poland
m.lachowicz@mimuw.edu.pl

In the talk I am going to discuss whether and how it is possible to mathematically model *order*, that is *self-organization*, and *disorder*, that is *disorganization*, in life systems. I refer to the theory of integro-differential equations, the so-called *kinetic equations* [1]. I am going to show that the blow-ups of solutions, which usually are treated as “bad”, can actually describe some *self-organization*, that can, in some cases, be “positive”, like healing processes. The results can be applied to processes in biology; like DNA denaturation; medicine; tendon healing process or invasion of cancer and social sciences; e.g. opinion formation. Moreover, I am going to discuss the importance of nonlocal modeling of some biological phenomena including the invasion of cancer on the surrounding tissue, see [2]. I am going to present various nonlocal models [3, 4], and show their applications.

References

- [1] M. Lachowicz, *Modeling Order and Disorder*, Taylor & Francis, 2025, in press.
- [2] Z. Szymańska, M. Lachowicz, N. Sfakianakis, M. A. J. Chaplain, Mathematical modelling of cancer invasion: Phenotypic transition provides insight into multifocal foci formation, *Journal of Computational Science*, 75:102175, 2024.
- [3] M. Lachowicz, M. Matusik, K. Topolski, Space-nonlocal description of cell movement, *Discrete and Continuous Dynamical Systems – Series B*, 2025.
- [4] M. Lachowicz, M. Matusik, K. A. Topolski, Asymptotic equivalence of nonlocal and local models of cell movement, to appear.