Looking for New Paradigms Towards a Biological-Mathematical Theory of Complex Multicellular Systems

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Abstract

This lecture deals with the development of new paradigms based on the methods of the mathematical kinetic theory for active particles to model the dynamics of large systems of interacting cells. Interactions are ruled, not only by laws of classical mechanics, but also by biological functions which are able to modify the above laws. It is technically shown, also by reasoning on specific examples, how the theory can be applied to model large complex systems in biology.

A challenging, however difficult, objective is the development of a mathematical theory of biological systems. This means not simply designing mathematical models, but deriving a self-consistent robust mathematical description of a sufficiently large variety of biological phenomena. The above target may need years to be properly developed for a large variety of biological systems. On the other hand it is a fascinating perspective which is worth to be pursued, while some conceptual frameworks can be already designed at least for some specific systems. Here we aim to propose the guiding lines towards a mathematical theory for multicellular systems in vertebrates with special attention to the competition between tumor and immune cells.