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Automated analysis of dynamic properties in biological systems from image data

Image-based Systems Biology is concerned with the mathematical modeling and computer simulation based spatio-temporal image data. The basis for these models is acquired by automatizing the data analysis of microscopy images on infection processes for high- throughput scanning. The objective of this PhD project is to establish a comprehensive software platform that starts with the automated analysis of time-series image data and ends with plotting characteristic system properties as obtained from a mathematical analysis.

This requires
(i) to develop algorithms for the automated image analysis of biological systems that allow for the efficient high-throughput scanning of data from microscopy measurements, and
(ii) to develop algorithms for the mathematical characterization of dynamic system properties.

The software platform will be widely applicable to the image analysis of various biological systems and to the characterization of their dynamic properties. For example, with regard to interacting cellular systems the mathematical analysis includes the computation of the speed distribution, the turning angle distribution, the time-dependent displacement vector, etc that are derived from cell tracks as obtained

from the automated image analysis. With regard to the image analysis, different methods will be applied ranging from the application of commercial software (e.g., Definiens) to the development of algorithms based on a pixel-by-pixel analysis. The challenge of this task is to perform this analysis in a fully automated fashion.

Publications

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