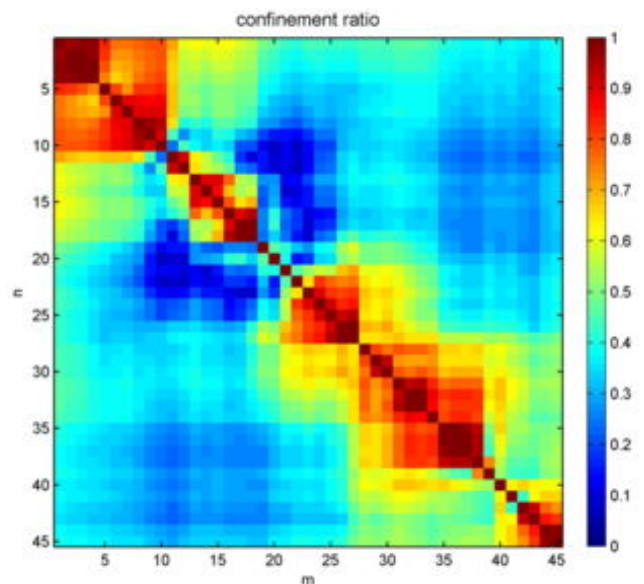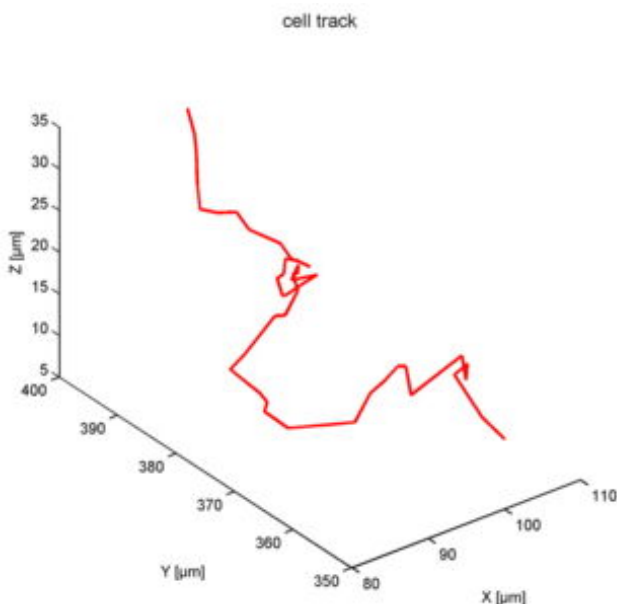# Quantitative Analysis of Biological Processes in Image Data

Automated image analysis is generally followed by a rigorous quantification of the biological process under investigation. Depending on the envisaged readout of the experiment, a quantitative description includes the size, density and shape characteristics of cells and molecules that play a central role in the experimental assay. If video data are available, tracking of moving objects yields their distributions of instantaneous speeds and turning angles, as well as the frequency and duration of contacts between different types of interaction partners.

Often, quantitative analyses require the identification of mathematical measures that appropriately describe the biological processes under consideration. For example, cell migration is the driving force behind the dynamics of many diverse biological processes and valuable information contained in image data is often disregarded because statistical analyses are performed at the level of cell populations rather than at the single-cell level. We investigate how a fully automated characterization and parameter-free classification of tracked objects as obtained from image data can be realized. In contrast to standard computations of average cell track characteristics, we could demonstrate the importance of track analysis at the level of single cells in order to correctly interpret their migration behavior. This approach will be extended to make the characterization of cells more comprehensive by also including the dynamics of cell shapes during migration.

Quantitative description of a biological process is the main result of the microscopy image analysis. However, quantification of aspects contained in the image data may not always be sufficient for the complete understanding of the process under investigation. Therefore, from the viewpoint of the Image-based Systems Biology approach, extracted quantitative parameters are only intermediate results that are exploited as a basis for constructing image-derived models.