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Methods for the Image based Quantitative Analysis of Dynamic Biological Processes

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We will present two complementary approaches to describe dynamic biological processes by image based analysis of microscopic time lapse recordings.
The first method describes the shape dynamics of an object's 2D contour by using so-called shape space trajectories. By this method dynamic phenotypes can be grouped or assigned to pre-learned classes automatically based on their shape development. In our initial experiments we applied this method to discriminate different phenotypes in two applications: Growing plant cells (p*rotoplasts)* and movement patterns of *C'elegans*.
The second method presented is capable of describing intra-cellular dynamics. Here we apply a so-called optical flow algorithm which computes dense motion fields from consecutive image frames. Using this method valuable information can be extracted directly from brightfield image sequences. In our primary experiments on time lapse recordings of growing plant cells (p*rotoplasts*) we could directly use this method to distinguish dead from living cells. Additionally the different motion dynamics during cell division could be uncovered that cannot be observed directly from brightfield. While this method requires time lapse recordings with sufficiently high temporal resolution it however does not rely on any object segmentations.
Both approaches could be used complementary to provide a quantitative analysis of dynamic biological processes , e.g. for the characterization of cell populations.