center for systems biology dresden

COMPUTER VISION LAB DRESDEN

MOSAIC Group and Computer Vision Lab Dresden,
MPI-CBG and TU Dresden

Master Thesis

We are looking for a student who would like do his or her master thesis on the topic:

Pose Estimation of Articulated Objects in Microscopy Images Using Discriminative Methods

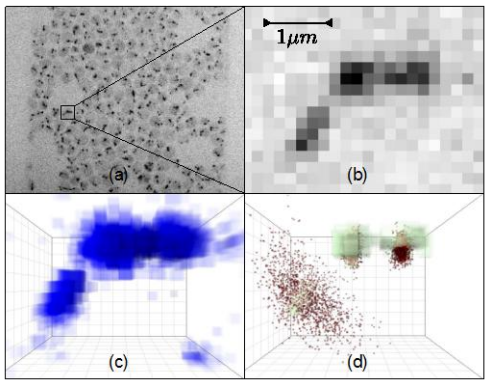

Image: (a) microscopy image of dividing cells; (b) zoom onto a single cell. The spindle Is in dark colors. (c) Probability cloud of spindle poses from a generative model; (d) possible spindle end-points from the model. Image from: J. Cardinale, A. Rauch, Y. Barral, G. Székely, and I. F. Sbalzarini. Bayesian image analysis with on-line confidence estimates and its application to microtubule tracking. In *Proc. IEEE Intl. Symposium Biomedical Imaging (ISBI)*, pages 1091–1094, Boston, 2009.

Automatically estimating the pose (the position, orientation and articulation) of biological objects in microscopy images has become a crucial bottleneck in experimental cell biology, where large amounts of microscopy images are generated. The specific task, which will be the focus of this thesis, is finding the pose of the spindle system in a dividing cell. The spindle apparatus is the mechanical "rope" that tears the chromosomes apart in order to divide the genetic material between the two daughter cells. Its mechanics and working are to be understood by quantitative image analysis.

In the area of microscopy the process of image formation is well understood. As a result, generative methods are frequently used in microscopy-related vision problems. They often define the best estimate as the most probable one, based on the model of image formation. In other areas of computer vision, however, discriminative approaches have recently been very successful. They use training data to directly learn a mapping from the image to the estimate.

In this master thesis it should be investigated how a discriminative computer vision technique can be applied to a pose estimation problem in a biological setting, which has previously been solved using a generative approach, and how they can be combined with existing generative approaches.
The aspects of the thesis should be:

- Study of literature
- Design and implementation of a random forest to estimate the pose of a spindle in a cell
- Applying and evaluating the system on real microscopy images
- Investigating how the system can be combined with generative approaches

The student should ideally have a background in computer vision, image processing or machine learning, and possess good programming abilities.

Please contact Alexander Krull (*alexander.krull@tu-dresden.de*)