



Thesis Topic (B.Sc. / M.Sc.)

Variational Inference for Spot Tracking in Fluorescence Microscopy

Tracking of moving targets through a noisy background is a classical problem in signal and image processing and many sophisticated inference techniques are available. However, most of these techniques perform an initial detection step to extract a set of features from the image. The extracted features are then used as the latent variables in a state space or hidden Markov model.

While the detection-tracking approach reduces complexity and allows to run fast inference algorithms (e.g. a Kalman filter), it does not exploit the available information optimally.

An integrated approach to spot tracking aims to include a generative model of the image into the state space model, allowing the tracking algorithm to run directly on the raw image data. Due to the non-linearity of such image models the posterior distribution over the latent states is intractable.

In recent years, variational inference has emerged as one of the major tools to compute approximate posterior distributions. However, applications to time-dependent probabilistic models have been rare.

The goal of this project is to develop a variational inference algorithm for an existing generative image model. Synthetic and real microscopic data to test the method are available.

Prerequisites: Good knowledge of Matlab, some background in probabilistic modeling, statistics or machine learning

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- Tracking
- State Space Models
- Machine Learning
- Variational Inference
- Image Processing

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