Image processing for super-resolution microscopy

Dr. Bernd Rieger ,
Quantitative Imaging Group, Department of Imaging Physics
Delft University of Technology, Lorentzweg 1, 2628CJ Delft, The Netherlands
b.rieger@tudelft.nl

Over the last decade a number of optical nanoscopy techniques have been proposed to bridge the resolution gap between electron (~1 nm) and conventional light microscopy (>200 nm). Localization microscopy is one of these nanoscopic techniques where, where fluorescent emitters are photo-chemically manipulated to switch on and off, such that at each instant in time only a sparse subset of all emitters is fluorescent. Recording thousands of frames thus provides a sequence of images of different random subsets of nearly all fluorescent emitters. Before a super resolved image can be visualized, however, a series of image processing steps needs to be undertaken. The first step in processing the raw frames consists of identifying and segmenting regions of interest (ROIs) that contain the emissions of single fluorescent emitters. Once ROIs in the raw data have been segmented, the next step is to estimate the positions of the emitting fluorescent molecules in these regions. Subsequently post-processing of the raw localizations takes place by filtering of the localizations to remove ones that do not represent trustworthy or accurate position estimates of single fluorescent emitters. The final step in the processing pipeline from raw data to super-resolution image is the actual visualization of the data.

In this presentation, I will discuss all the involved image processing steps and point to directions of further research with respect to image processing.