IBI Cross-Disciplinary Sandwich Seminar

“Fourier Image Resolution in Optical Nanoscopy”

Monday – November 26, 2012 – 12:15 p.m.
EPFL – room SV 1717a

Prof. Bernd Rieger

Faculty of Applied Sciences, Delft University of Technology,
Delft (NL)

host: Prof. A. Radenovic

Abstract

Fourier Ring Correlation is proposed as a resolution measure for superresolution microscopy based on single emitter localization. The measure incorporates the effects of the emitter localization uncertainty and the density of localized emitters. It has been applied to simulated PALM and STORM images and experimental dSTORM data. In addition, an analytical expression has been derived for the resolution for two lines.

Localization microscopy techniques, such as PALM and STORM, provide a way of breaking Abbe’s diffraction limit to resolution in far-field optical microscopy. These techniques produce high resolution ‘pointillistic’ images consisting of nanoscopic dots representing uncertain localizations of single fluorescent molecules. Common resolution concepts are either based on the localization uncertainty or on the Nyquist criterion for the average density of localized emitters. We propose a resolution measure that takes both localization uncertainty and density into account: the Fourier ring correlation (FRC) (and the related spectral signal-to-noise-ratio). These concepts have long been used in electron tomography, but are new to the field of superresolution fluorescence microscopy. The FRC is a measure of the correlation between two halves of the whole dataset in Fourier space. In time-lapse acquisitions inherent to localization microscopy, two halves can be obtained e.g. by splitting the time series in half. For high spatial frequencies the FRC decays to 0. The largest spatial frequency for which the correlation between the two halves is still significant is a measure of the resolution in the image.

The definition of the FRC can be used to derive an explicit expression for the smallest distance between two parallel lines that can still be resolved. This expression provides new insights into the trade-off between the density of localized emitters and the localization uncertainty (following from the photon count per emitter), which we will discuss in great detail. Also, we will present the application of the FRC resolution to simulated PALM and STORM images and experimental dSTORM images. This demonstrates the usefulness of the computed measure where localization uncertainty and the Nyquist criterion alone fail.

Sandwiches will be provided

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