

Quantum-inspired protocols for super-resolution and localization

Author

JAROSLAV REHACEK - Palacký University Olomouc

Abstract

An overview of quantum-inspired techniques of optical super-resolution and localization will be presented. We start with revisiting the resolution limits of spatially-invariant imaging systems, where we identify a class of point-spread functions with a linear information decrease for small separations. We proceed by establishing the multiparameter quantum Cramér-Rao bound for simultaneously estimating the centroid, the separation, and the relative intensities of two incoherent optical point sources. There is always a quadratic improvement in an optimal detection in comparison with the intensity measurements. Some hints will be provided on how the optimal measurements achieving the ultimate precision predicted by quantum theory can be constructed. After discussing experimental feasibility of such protocols, we move on to investigate the ultimate precision in axial localization using vortex beams and their superpositions. It turns out that microscopy methods based on rotating vortex beams may benefit from replacing traditional intensity sensors with mode-sorting devices. We conclude by summarizing potential strengths and weaknesses of modal projections with respect to conventional imaging techniques in all those applications.