Non-convex optimization for 3D point source localization using a rotating point spread function

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We consider the high-resolution imaging problem of 3D point source image recovery from 2D data using a method based on point spread function (PSF) engineering. The method involves the use of a rotating PSF with a single lobe to obtain depth from defocus. The amount of rotation of the PSF encodes the depth position of the point source. Applications include high-resolution single molecule localization microscopy as well as the localization of space debris using a space-based telescope. Finding the locations and fluxes of the point sources is a large-scale sparse 3D inverse problem. A new nonconvex regularization method with a data-fitting term based on Kullback-Leibler divergence is proposed for 3D localization for the Poisson noise model. We will present numerical experiments to illustrate the efficiency and stability of the algorithm.