

LOCNET: DEEP LEARNING-BASED 3D POINT SOURCE LOCALIZATION WITH ROTATING POINT SPREAD FUNCTION

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Three-dimensional (3D) point source recovery from two-dimensional (2D) data is a challenging problem with wide-ranging applications in single-molecule localization microscopy and space-debris localization telescope. Point spread function (PSF) engineering is a promising technique to solve this 3D localization problem. Specifically, we consider the problem of 3D localization of point sources from a 2D image using a rotating PSF where the depth information is encoded in the angle of rotation of a single-lobe PSF for each point source. Instead of applying a model-based optimization, we introduce a convolution neural network (CNN)-based approach to automatically localize the point sources in full 3D space. A hard sample training strategy is proposed to further improve the performance of the CNN. Contrary to the traditional model-based methods, our technique is efficient and outperforms the current state-of-the-art method by more than 11% in the precision rate with a comparable improvement in the recall rate.