

Defining Generalized Resolution of Optical Diffraction Tomography

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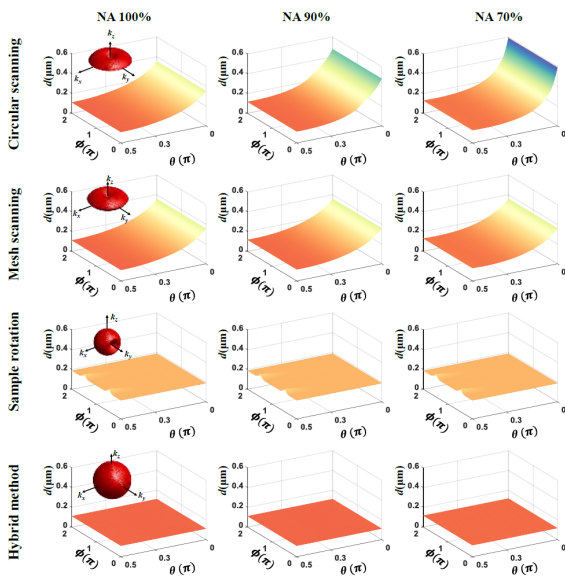
1. Introduction

Optical diffraction tomography (ODT) is a technique which acquires three dimensional(3D) Refractive index (RI) distribution of a sample via reconstructing holographic images from different illumination angles [1]. Because of its quantitative and label-free character, ODT is being recognized as an invaluable tool for studying various cells.

Even though ODT is being employed in various studies, there does not exist a general definition of resolution in ODT. Conventional studies only mentioned range the optical transfer function covers along the lateral and axial direction in Fourier space under particular illumination and collection geometry [2]. Thus, more general and quantitative approach in ODT resolution was needed.

We hereby introduce a new definition of 3D spatial resolution in ODT with a systematic and quantitative manner for arbitrary viewing angles. According to our new definition, we were able to measured general resolution of ODT in various illumination and collection geometry. Furthermore, we've experimentally obtained point spread function(PSF) by sample imaging as an experimental verification of our definition of resolution.

2. Method/Result



We define generalized resolution of ODT following Fourier slice theorem. According to Fourier slice theorem, highest spatial frequency in arbitrary direction can be determined by projection of the collected Fourier spectra onto the desired direction [3]. Quantitative measurement of the generalized resolution was conducted numerically via MATLAB code. We've created effective optical transfer function (OTF) of different beam illumination, collection geometries and different numerical apertures (NA). By projecting effective highest collectable frequencies along 3D angles were measured numerically. As an experimental verification of the definition, we've obtained PSF of our imaging system from reconstructed tomogram, using deconvolution.

Figure 1. Generalized resolution of ODT in various imaging conditions

3. References

- [1] Kim, K et al., "Optical diffraction tomography techniques for the study of cell pathophysiology", *Journal of Biomedical Photonics & Engineering* **2**(2), 020201(2016)
- [2] Bertrand Simon et al., "Tomographic diffractive microscopy with isotropic resolution", *Optica* **4**(4), 460-463 (2017)
- [3] A. C. Kak, and M. Slaney, "Principles of computerized tomographic imaging", Chapter3 (Society for Industrial and Applied Mathematics, Philadelphia, 2001)