

Theoretical analysis on confocal microscopy with radially polarized focused beam

Peiwen Meng, Sylvania Pereira, and Paul Urbach

Optics Research Group, Department of Imaging Physics, Delft University of Technology,
Lorentzweg 1, 2628CJ Delft, Netherlands

E-mail: P.Meng@tudelft.nl

KEY WORDS: Microscopy, Diffraction, Super-resolution, Polarization.

1. INTRODUCTION

We present an analysis on confocal microscopy with radially polarized light. In our model, linearly and radially polarized focused field excite two dipoles at the object plane. To obtain the best resolution, we also apply an optimized pupil field [1] and an annular pupil illuminated by radially polarized beam. Figure 1 shows the configuration of the confocal imaging system. A laser beam is focused onto the sample by high NA objective lens L_1 . The light scattered by the dipolar particle is collected by the same objective lens and focused by a small NA lens L_2 onto a pinhole in front of a detector. A polarization convertor is added at the detector side, which transforms the radially polarized light into x -polarized light in order to make the signal detectable with a single mode fiber [2].

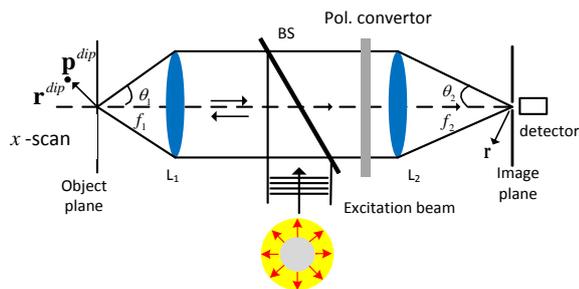


Figure 1: Schematic of a confocal microscope.

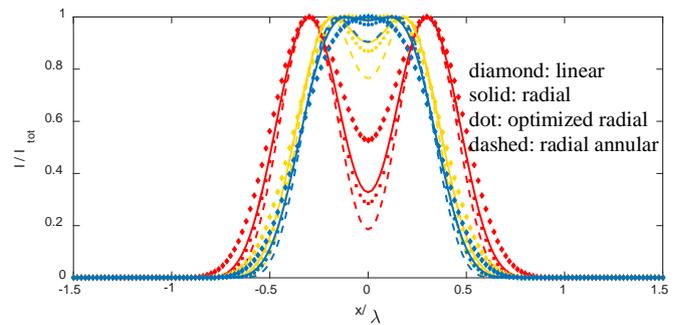


Figure 2: Profiles of the intensities of two separated dipoles at the detector plane with different pupil fields and distance.

2. SIMULATION RESULTS

Figure 2 shows the cross sections of the intensity at the detector plane by scanning two identical dipoles separated by distances: $d = 0.6\lambda$ (red), $d = 0.4\lambda$ (yellow), $d = 0.36\lambda$ (blue) along x direction. The pupil field is taken as either linear, radial, optimized radial [1] or radial with annular pupil by blocking 90% of the lens. It can be seen that even when the distance decreases to 0.36λ , for the radial polarized excitation with an annular pupil and with optimized pupil field, the two dipoles can be resolved [3].

3. CONCLUSION

We present a theoretical analysis on a confocal system illuminated by a radially polarized field with optimized and annular pupil. From our analysis, we show that dipoles separated by a distance of $d = 0.36\lambda$ can be resolved in both cases, i.e., beyond the diffraction limit. Our next step will be to consider the influence of the substrate (plain or with multilayers). Its implementation will be discussed as well.

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