FAR-FIELD REFLECTION MICROSCOPE USING OPTICAL DIFFRACTION TOMOGRAPHY – APPLICATION TO PROFILOMETRY

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Optical Diffraction Tomography (ODT) has been shown to be a powerful technique for increasing the resolution by a factor of 2 with respect to conventional microscopy[1]. In this case, the field diffracted by the object is measured for various angles of incidence. For each incidence angle, the recorded data (the amplitude and the phase of the field as a function of the diffraction angle) are recorded and processed in order to reconstruct numerically the permittivity profile of the object. This reconstruction can be obtained with a standard 3D Fourier transform, but in some cases iterative inversion algorithms based on the resolution of Maxwell’s equations are required[2,3]. ODT uses coherent illumination and the resolution improvement is obtained thanks to an extended domain of accessible spatial frequencies given by successive illuminations. Resolution improvement is not the only advantage of ODT. Indeed, ODT gives quantitative information on the permittivity distribution of the object. Thus, inhomogeneous objects can be characterized.

Since yet, ODT has been applied to observe biological samples in transmission mode. It has also been applied for increasing the resolution of images by using the concepts of synthetic aperture digital holography[4]. In order to observe opaque samples with an increased resolution, we propose a setup working in reflection mode. We present the results obtained with different samples that show the performances of the system. We also present the results obtained with different inversion algorithms.

This technique can also be used to determine the profile of “non deterministic objects”. In this case, ODT microscopes can act as optical profilometers. We show the results obtained with different types of surfaces (gratings, random surfaces…).