HIGH RESOLUTION OPTICAL PROFILOMETRY WITH TOMOGRAPHIC
DIFFRACTIVE MICROSCOPY

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1. ABSTRACT
In recent years the principles of Tomographic Diffractive Microscopy [1] have been studied for obtaining quantitative images with a sub-wavelength resolution. Experimental and theoretical results have demonstrated that multiple scattering leads to the coupling between spatial frequencies of the electromagnetic field. In particular, it has been shown that, in the multiple scattering regime, the information carried by propagative components of the field, measured far away from the object (far field), is related to features of the object at a scale smaller than the diffraction limit. By using a numerical reconstruction algorithm based on the resolution of Maxwell equations with no approximation, and by illuminating successfully the object under different incidences it is possible to obtain super-resolved images in far-field [2,3].
This principle has been adapted to optical profilometry [4,5]. Numerical studies have been carried out to investigate the role of the polarization and the influence of long range interaction of the field within rough surfaces. Iterative reconstruction algorithms based on the Newton-Kantorovitch method [6] have been developed. It has been shown that super-resolution can be obtained with randomly rough metallic surfaces.
We will present inversions of experimental data acquired at 633nm with a tomographic diffractive profilometer setup. The experimental results remarkably confirm the theoretical predictions obtained with synthetic data. We compare the obtained resolution with that of conventional profilometers and we show that a resolution better than that of atomic force microscopes can be reached. This result paves the way to new research studies and to new applications.

2. REFERENCES