

Abstract

In photonics technology, Diffractive Optical Elements have found a large number of new applications in many different areas, covering the whole electromagnetic spectrum from X-ray Microscopy, to THz Imaging. Diffractive lenses such as the conventional Fresnel zone plates are essential in many focusing and image forming systems but they have inherent limitations mainly under polychromatic illumination. Fractal zone plates are a new type of multifocal diffractive lenses which have been proposed to overcome some of these limitations, .

In this PhD Thesis the design and the properties of new diffractive lenses based on different aperiodic structures are presented. These lenses improve the performance of conventional Fresnel zone plates and fractal lenses. Their focusing properties have been analyzed theoretically and have been verified experimentally using a dedicated setup based on the use of a liquid crystal spatial light modulator. New applications for these diffractive aperiodic lenses in the field of ophthalmology as intraocular lenses and in optical trapping are discussed.