

Abstract Submitted
for the TSF12 Meeting of
The American Physical Society

Challenging subjects behind using a liquid crystal display as an optical lens JAVAD R. GATABI, WILHELMUS GEERTS, Department of Physics, Texas State University at San Marcos, DAN TAMIR, Department of Computer Science, Texas State University at San Marcos — Adjustable lenses are widely used in compound optical systems, including cameras and microscopes. Different techniques are used to build lenses with adjustable focusing. One of the recent techniques uses a liquid crystal spatial light modulator (LC-SLM) to generate the adjustable lens phase function. LC-SLMs provide a robust capability to design fast adjustable optical components without any movable mechanical parts. This paper presents a general method to design a compound lens with an adjustable focal length using a LC-SLM for a laser lithography application. The article describes the challenging matters behind using phase modulators in an imaging system. The maximum and minimum accessible focal lengths have been calculated for different LC-SLMs, taking into account the modulator resolution, bit depth and aperture size. A new type of random aberration caused by bit depth limitation is introduced and its dependency on the focal lengths is discussed. The proposed theoretical model to determine the lens parameters is compared with numerical and experimental data. The experimental results agree well with the theory. The focusing capabilities of a Holoeye LC-SLM will be demonstrated.

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Date submitted: 25 Sep 2012

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