
Wavefront sensing technologies for bioimaging

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Abstract

Most people associate adaptive optics (AO) with astronomy because of its well-known role in bolstering the imaging power of telescopes and correcting for atmospheric distortion. A wavefront sensor (WFS) is one of the basic components of an AO system, for measuring the shape of the incident wavefront. However, the AO field and thus wavefront sensing technologies have had a growing number of applications in bioimaging, many of which are driven by ophthalmic needs. WFSs can be used to evaluate optical aberrations in the human eye, which is conceptually similar to the astronomy application. In this talk, I will demonstrate two wavefront sensing technologies. One is the so-called phase crossed-sine WFS (1-2), with a French name of PHASONG (PHase Analyseur de Surface d'Onde de Nouvelle Génération). PHASONG is based on a gradient phase filter (GPF) and a 2'2 lenslet array, provides an

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elegant and simple solution, high spatial resolution, high sensitivity and a wide dynamic range. Another is a novel 4D imaging technique based on a quadratically distorted (QD) grating, which had been applied for bioimaging much earlier (3-4). The QD grating, which behaves like a multi-focus "lens" but utilizes principle of diffraction instead of refraction, can be used in simple attachments for commercial microscopes to record widefield images focused simultaneously on multiple (3-9) specimen depths, without sacrificing spatial resolution.

Keywords: wavefront sensing, bioimaging, gradient phase filter, quadratically distorted grating