Analytical Instrumentation, Methods & Materials

Optical System for Correction of Tissue-Induced Aberration

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WARF: P07259US

Inventors: Andrew Sheinis

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a system that corrects for optical distortion to enable higher resolution imaging of structures deep within tissue.

Overview

Confocal microscopy is used to view biological tissue through intervening tissues or structures. Multiphoton confocal microscopy uses a focused beam of photons to provide high-resolution images of tissue *in vivo* at depths up to 600 µm. Beyond this depth, the intervening tissue causes too much interference.

To view tissue at greater depths, one possible solution is adaptive optics, a technology commonly used on astronomical telescopes to reduce the effects of rapidly changing optical distortion. Adaptive optics works by measuring the distortion and compensating for it by using either deformable mirrors or liquid crystal devices (LCDs) with variable refractive properties; however, LCD devices are slow and provide low contrast, and deformable mirrors are expensive and cannot provide a large phase-shift that would allow high-resolution imaging of structures deep within tissue.

The Invention

A UW-Madison researcher has developed a new mono-chromatic method of correcting for the optical distortion caused by intervening tissue. Variations in the optical properties of the tissue lead to aberrations in the wavefront of the beam of light from the microscope system. This method is based on a reflective correction of the wavefront error. A computer-generated reflection hologram is projected in real time via a micro-mirror array, which adjusts the phase of the light to produce the exact opposite of the wavefront errors expected from the sample. The two cancel each other out, producing images corrected for aberrations.

Applications

- Multiphoton confocal microscopy
- Laser surgery

Key Benefits

- Provides an improved method of compensating for optical distortion in medical imaging procedures that use multiphoton confocal microscopy
- Cost-effective for many additional applications
- System may be readily added to existing multiphoton microscopes or other optical instruments without the need for modification.
- Capable of handling large amounts of optical power, making it suitable for use in laser surgery, as well as microscopy
- Enables a new class of technologies in areas including correction of phase distortions in astronomical systems, mega-channel phase-controlled communications switches, and 3-D color holographic television

- Because the amplitude of the phase shift is orders of magnitude greater than surface deformations available in deformable mirrors, this technique can accommodate phase distortions that occur when imaging structures deep within tissue.
- Useful for known and unknown biological materials

Tech Fields

- Analytical Instrumentation, Methods & Materials : Microscopy

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846