Imaging Platform Based On Nonlinear Optical Microscopy For Rapid Scanning of Large Areas Of Tissue

Tech ID: 27435 / UC Case 2016-756-0

BRIEF DESCRIPTION

Researchers at UCI have developed a nonlinear optical microscopy (NLOM) instrument for the rapid and non-destructive imaging of wide areas and large volumes of biological tissue. Imaging can be performed either *ex vivo* or *in vivo*, and with sub-micron resolution at higher scanning speeds than previously possible.

SUGGESTED USES

» Optical microscopy and micro-spectroscopy of biological samples, for biological and biophysical research

» Non-invasive imaging of the skin, for medical and cosmetic industries

FEATURES/BENEFITS

» *Increased field-of-view*: The proposed invention allows for >5 times larger fields-of-vision than standard methods.

» *Faster*: Imagining scans are obtained ~15 times faster than standard methods.

» *High resolution*: Despite the increased FOV and scanning speed, the microscope still allows for >µm resolution.

» *Non-destructive*: Imaging is non-destructive and non-invasive and can be performed both *in* and *ex vivo*.

FULL DESCRIPTION

Nonlinear optical microscopy (NLOM), or multi-photon microscopy (MPM), is an imaging technique which utilizes nonlinear interactions between light and matter to characterize the material of interest. It is often preferred over standard optical microscopy as it allows for more straightforward 3D imaging, affords higher signal-to-noise ratios (better imaging contrast), is entirely label-free, and is less likely to induce damage in biological samples.

Two of the most common methods of NLOM for tissue imaging are two-photon excited fluorescence (TPEF) and second harmonic generation (SHG). Here, a focused laser beam is raster scanned across the sample to create high resolution images; imaging contrast arises directly and naturally from SHG of collagen and TFEP of other tissue components, such as elastin, keratin, and melanin. As such, NLOM techniques may have important applications in clinical settings, including label-free, *in vivo* cancer detection and the characterization of skin damage and aging effects. For NLOM to be truly useful in clinical settings, however, it must be able to quickly provide high-resolution images of large tissue areas (on the order of tens of mm^2). Typically, the field of vision (FOV) of a NLOM setup is limited to about 0.5 x 0.5 mm^2 and additionally has a relatively long pixel dwell time (~20 µs per pixel). In these setups, several small area

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OTHER INFORMATION

CATEGORIZED AS

» **Optics and Photonics**
» All Optics and Photonics
» **Imaging**
» 3D/Immersive
» Medical
» **Medical**
» Diagnostics
» Disease: Cancer
» Disease: Dermatology
» Imaging
» Screening

RELATED CASES

2016-756-0

scans would have to be collected and stitched together, a process which is highly time consuming and altogether unfeasible for clinical use.

To make NLOM techniques more amenable to clinical applications, researchers at UCI have developed a novel microscope setup, which, in addition to retaining the requisite sub-micron resolution, is capable of rapid (<1 µs/pixel dwell time) imaging of large tissue areas (800 x 800 mm^2). The system consists of a resonant scanning mirror, pulsed imaging laser, relay lens system, galvo mirror, beam expander, and microscope objective, all of which are optically coupled in series. The resonant scanning mirrors, which operate at ≥4 kHz rate, steer the beam in the x-direction quickly while the galvo mirror displaces it along the y-axis. The relay lens system and beam expander compensate for optical any aberrations (imaging artifacts), and the objective has a high numerical aperture such that it achieves sub-micron resolution. Here, large area images can be obtained in ~0.1 s, making the system highly compatible with clinical applications.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,595,770	03/24/2020	2016-756

RELATED MATERIALS

» Mihaela Balu et al., Rapid mesoscale multiphoton microscopy of human skin, 7 Biomed. Optics Express 11, 4375-4387 (2016). - 10/03/2016

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