An Optical Coherence Elastography Method

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BRIEF DESCRIPTION

Researchers at UCI have recently developed a non-invasive tissue diagnostic procedure that is simpler and more easily implemented than standard methods.

FULL DESCRIPTION

Elastography, which allows for the elastic properties of soft tissue to be imaged and characterized, is an important tool in tissue diagnostics. These measurements work by inducing a vibration in the tissue, leading to the propagation of a shear wave. The shear wave, which carries information about tissue density and composition, is then detected. For most applications, the tissue vibrations are generated by acoustic radiation force (ARF) from sound waves and detected through optical coherence elastography (OCE), which uses near-infrared light to image and characterize the tissue. So-called ARF-OCE measurements that marry these two techniques are preferred due to their high imaging resolution, quick speed, and ability to penetrate into and collect information from sub-surface tissue. Typically, measurements are set up such that the excited shear wave propagates along the direction parallel to the optical detecting beam.

These ARF-OCE methods suffer from two main drawbacks, both arising from the shear wave propagation direction. First, as the shear waves attenuate rapidly within tissue, there is a very limited range from which they can be detected in the direction parallel to the optical beam. This makes ARF-OCE difficult to implement for live imaging of small and thin tissues, such as the cornea. Secondly, this requires significant post-processing by Doppler OCT methods, in part to correct for the bulk motion of the tissue during the measurement. Recently, researcher at UCI have developed a modification to the standard ARF-OCE technique that instead generates shear wave propagation in the direction perpendicular to the detecting beam. This makes the overall geometry more convenient to implement in cornea imaging and characterization. It also is less sensitive to bulk motion of the tissue, and therefore can utilize the much simpler Doppler-variance-based data processing techniques.

ADVANTAGES

§ Shear wave propagates in the direction parallel to the detection beam

§ Technique is more compatible with imaging and characterizing optical tissue than conventional (parallel shear wave) methods

§ Requires less post-processing & is less sensitive to bulk sample motion

STATE OF DEVELOPMENT

Researchers have successfully used this technique to measure shear wave propagation in a bilayer tissue "phantom" (replica tissue) as a proof-of-concept. The next step, which researchers posit will be completed within the next year, is to use this method to detect shear waves in actual ocular tissue.

RELATED MATERIALS

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OTHER INFORMATION

CATEGORIZED AS

- **Imaging**
  - Medical
- **Medical**
  - Diagnostics
  - Imaging

RELATED CASES

2015-510-0

» Zhu, J. et. al. Imaging and characterizing shear wave and shear modulus under orthogonal acoustic radiation force excitation using OCT Doppler variance method. Opt. Lett. 2015, 40, 2099. - 05/01/2015

» Qi, W. et al. Phase-resolved acoustic radiation force optical coherence elastography. J. Biomed. Optics. 2012, 11. - 11/17/2012

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,548,479	02/04/2020	2015-510

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