Ultrasound Guided Optical Coherence Tomography, Photoacoustic Probe for Biomedical Imaging

Tech ID: 21076 / UC Case 2009-249-0

CONTACT

Alvin Viray
aviray@uci.edu
tel: 949-824-3104.

OTHER INFORMATION

CATEGORIZED AS

- **Biotechnology**
  - Other
- **Imaging**
  - Medical
- **Medical**
  - Devices
  - Diagnostics
  - Imaging
- **Research Tools**
  - Other
- **Sensors & Instrumentation**
  - Medical
  - Other
- **Engineering**
  - Other

BRIEF DESCRIPTION

The invention covers an imaging probe which integrates optical coherence tomography (OCT) and ultrasound imaging. Ultrasound guided optical coherence tomography (ultra-OCT) is a new imaging modality that integrates optical coherence tomography with ultra sound imaging.

FULL DESCRIPTION

Intravascular ultrasound (IVUS) is a medical imaging methodology that has been used to show the anatomy of the wall of blood vessels in living animals and humans by using a miniaturized ultrasound probe. IVUS can help physicians determine the amount of plaque from the cross-sectional image of blood vessels. In other words, IVUS can visualize not only the lumen of the coronary arteries but also the objects hidden within the wall, such as atheroma. However, because the reflection coefficient of the ultrasound of blood vessel is quite small, high sensitivity and larger bandwidth ultrasound probe are key factors of high-quality intravascular ultrasound images. Further, the outer diameter of the ultrasound probe should be less than 3 mm to fulfill the requirement of IVUS biomedical imaging applications. Therefore, the fabrication of a miniaturized ultrasound probe is another important issue for IVUS imaging.

Optical coherence tomography (OCT) is a recently developed imaging modality using coherent gating to obtain high-resolution surface images of tissue microstructure. OCT endoscope design uses a fixed gradient-index (GRIN) lens and prism as the optical tip. Rotational torque is transferred from the endoscope's proximal end to the distal tip. OCT can provide imaging resolutions that approach those of conventional histopathology and can be performed in situ and in vivo. In vivo images of living animals have been demonstrated by using motor-based scanning endoscopic probes known in the art.

Additionally, the imaging resolution of IVUS is much less than that of OCT. In particular, IVUS is able to visualize the coronary artery from the inside-out owing to its larger penetration depth than OCT. In direct contrast, OCT can provide high-quality, micrometer-resolution, and three-dimensional images which are superior to IVUS.

Therefore, what is needed is a novel imaging probe combining a high frequency IVUS transducer with a 3-D scanning OCT probe to obtain the high-resolution cross-sectional intravascular images.

The invention covers an imaging probe which integrates optical coherence tomography (OCT) and ultrasound imaging. Ultrasound guided optical coherence tomography (ultra-OCT) is a new imaging modality that integrates optical coherence tomography with ultra sound imaging.

The purpose of this system is to provide a means for high resolution imaging of biomedical tissue. The guidance of ultrasound imaging allows the area of interest to be found and thus a relatively smaller amount of flush agent will be needed, which provides a safer way to obtain intravascular OCT images. The combination of the two imaging modalities yields high resolution thanks to OCT and deep penetration depth due to ultrasound imaging.

The Ultra-OCT probe uses its ultrasound modality to acquire images and search along inside of the vessel first. When finding area of interest, a small amount of flushing agent is applied to create an imaging window for OCT. No blood occlusion is needed, and a smaller amount of flushing is required, thus ultrasound guided OCT is potentially safer than conventional intravascular OCT, and it provides much higher resolution than intravascular ultrasound (IVUS).

The invention will be used to develop a clinically useful endoscopic Ultra-OCT system that can provide high resolution optical imaging of internal organs and tissues such as vessels. OCT can provide high resolution cross sectional imaging that conventional endoscopy cannot. At the same time, a reduced dose of flush agent will be needed using this invention compared with conventional OCT imaging system. The current invention allows OCT to be used potentially anywhere that can be accessed by endoscopy. Examples of use include but are not limited to intravascular catheter vessel imaging, bladder cancer detection and other aspects in the field of urology, lung cancer detection and inflammation and other aspects in pulmonary medicine, arterial anastomosis other minimally invasive surgeries, cardiac cancer detection, gynecological diagnosis of endometriosis and cancer, and cancer and inflammation detection in the gastrointestinal tract.

Other functions can also be added to this invention to give arise to multiple applications; polarization sensitive OCT can offer the information on light polarization changing properties of tissue; Doppler OCT can yield quantification of blood flow velocity; imaging guided therapy can also be achieved by adding an therapeutic channel to the probe, etc. Any OCT modality now known or later devised can be employed in the combination.

Thus, in summary the illustrated embodiment of the invention is an imaging probe for a biological sample which includes an OCT probe and an ultrasound probe combined with the OCT probe in an integral probe package capable of providing by a single scanning operation images from the OCT probe and ultrasound probe to simultaneously provide integrated optical coherence tomography (OCT) and ultrasound imaging of the same biological sample.

RELATED CASES

2009-249-0

SUGGESTED USES

Imaging probe combining high frequency IVUS transducer with a 3-D scanning OCT probe to obtain the high-resolution cross-sectional intravascular images. Examples of use include but are not limited to intravascular catheter vessel imaging, bladder cancer detection and other aspects in the field of urology, lung cancer detection and inflammation and other aspects in pulmonary medicine, arterial anastomosis other minimally invasive surgeries, cardiac cancer detection, gynecological diagnosis of endometriosis and cancer, and cancer and inflammation detection in the gastrointestinal tract.

ADVANTAGES

The present invention provides a means for high resolution imaging of biomedical tissue. The guidance of ultrasound imaging allows the area of interest to be found and thus a relatively smaller amount of flush agent will be needed, which provides a safer way to obtain intravascular OCT images. The combination of the two imaging modalities yields high resolution thanks to OCT and deep penetration depth due to ultrasound imaging.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,764,666	07/01/2014	2009-249

UCI Beall
Applied Innovation

5270 California Avenue / Irvine,CA
92697-7700 / Tel: 949.824.2683