Photoacoustic Imaging Module for Medical Devices

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Technology description

The present invention includes a photoacoustic imaging module for medical diagnosis.
The module may be integrated into a wireless endoscope to create an internal imaging device.

Background

Photoacoustic Imaging (PAI) is a non-invasive medical imaging technique capable of viewing anatomical structures inside tissue. Photoacoustic Imaging works by flashing a short-pulsed near-infrared laser at low energy onto a target tissue. The long wavelength of near infrared light allows light to penetrate deep into the tissue. As the light is absorbed by tissue chromophores such as hemoglobin in blood, the tissue heats up and expands through a process called rapid thermoelastic expansion. This instantaneous tissue expansion creates ultrasonic waves which can be received by an ultrasound detector array placed outside the body. The received acoustic signals can be interpreted using beam-forming algorithms to generate 2D or 3D images of the target tissue. PAI takes advantages of the high contrasts of optical imaging and the spatial resolution of pure ultrasound imaging.
In photoacoustic imaging of humans and other animals with red blood cells, hemoglobin plays an important role in enhancing the image contrast because hemoglobin has a very high optical contrast when near infrared radiation is applied. As a result, high-contrast imaging of blood containing structures in tissue, such as tumors or blood vessels, is one of the unique characteristics of photoacoustic imaging.
By making use of this blood concentration/content related optical absorption, photo-acoustic imaging may be useful for identifying diseases and/or abnormalities related to blood, including bleeding and (early-stage) cancer tumors. Thus, doctors can use photoacoustic imaging to recognize many problems that are difficult to identify via other techniques, such as, for example, ultrasonic imaging. In addition to viewing anatomical structure, photoacoustic imaging is capable of detecting composition of tissue and functional activities of an organ based on blood related infrared absorption rate differences.

Technology Description

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Publications

A Monolithic Three-Dimensional Ultrasonic Transducer Array for Medical Imaging - http://www2.ee.ntu.edu.tw/~b0901072/files/A%20Monolithic%20Three-Dimensional%20Ultrasonic%20Transducer%20Array%20for%20Medical%20Imaging.pdf
A Miniature Capacitive Micromachined Ultrasonic Transducer Array for Minimally Invasive Photoacoustic Imaging http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=05471192.
Capacitive micromachined ultrasonic transducer arrays for minimally invasive medical ultrasound http://iopscience.iop.org/0960-1317/20/2/023001/pdf/0960-1317_20_2_023001.pdf
"Fabrication and characterization of surface micromachined CMUT with a bossed membrane", Ultrasonics Symposium, 2008. IUS 2008. IEEE http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4803574

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Advantages

Non-ionizing
Delivers dramatically improved image contrast over X-ray and Ultrasound
Operates at lower voltage and power extending battery life
Non-radioactivity
Allows for real-time acquisition
Affordable equipment cost
Allows for miniaturization in minimally invasive applications

Institution

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Inventors

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