(SD2022-320) Method to improve the sampling rate for photoacoustic imaging

Tech ID: 33126 / UC Case 2021-Z08-1

BACKGROUND

High-frequency photoacoustic tomography (> 20 MHz) is becoming increasingly important in biomedical applications. However, it requires data acquisition (DAQ) to have commensurately high sampling rate, which imposes challenges to hardwires and increases the cost of building a PA imaging system. For example, the sampling rate should be higher than 80 MHz to cover 100% bandwidth of a 26-MHz transducer (Nuquist limit). A commercial PA imaging system such as Vevo LAZR X (Fujifilm VISUALSONICS Inc. ON, Canada) with 80-MHz sampling rate can cost more than 990,000$ in the United States.

Many PA groups use clinical ultrasound DAQs, which are low cost but also have a low sampling rate, e.g., the iu22 system's sampling rate is 32 MHz.

TECHNOLOGY DESCRIPTION

To solve this issue, researchers from UC San Diego developed a method that can be used for more high-frequency PA applications when the sampling rate of an ultrasound DAQ is insufficient. The researchers developed a method using interleavesampled photoacoustic (PA) imaging for high-frequency imaging with a low sampling rate. This interleaved sampling method relies on adjusting the laser delay, which can be applied to any PA DAQ systems. This approach will allow more ultrasound DAQs, especially clinical DAQs, to be used for high-frequency PA imaging.

This technology provides a more cost-effective tool for researchers. Results from both phantom and in vivo experiments with a 30-MHz transducer show that interleaved sampling at 41.67 MHz provides much better imaging quality than the original 41.67-MHz single sampling rate.

APPLICATIONS

This method harnesses two acquisitions at a low sampling rate to effectively double the sampling rate which consequently reduces the frame rate by a factor of two. It modulates the delay of the light pulses and can thus be applied to any PA DAQ system. We perform both phantom and in vivo studies with a 30-MHz transducer. The results demonstrate that interleaved sampling at 41.67 MHz can capture high frequency information above 30 MHz but a conventional 41.67-MHz sampling rate cannot. The axial and lateral resolution are as high as 63 μm and 91 μm via interleaved sampling which are much higher than those of

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OTHER INFORMATION

KEYWORDS
Photoacoustic Techniques, Signal Processing, Biomedical imaging, data acquisition

CATEGORIZED AS
- **Optics and Photonics**
  - All Optics and Photonics
- **Imaging**
  - Medical
- **Medical**
  - Diagnostics
  - Imaging
- **Sensors & Instrumentation**
  - Medical

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conventional 41.67-MHz sampling (130 µm and 136 µm).

Applications include biomedical imaging and data acquisition.

ADVANTAGES

STATE OF DEVELOPMENT

INTELLECTUAL PROPERTY INFO

UC San Diego is protecting patent rights on this technology and is offering to license those rights for commercial development.

RELATED MATERIALS

- Fu L, Jokerst J. Interleave-sampled photoacoustic imaging: a doubled and equivalent sampling rate for high-frequency imaging. Opt Lett. 2022 Jul 15;47(14):3503-3506. - 07/15/2022

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