LOW-COST OPTOACOUSTICS ? PROSPECTS FOR MINIATURIZING AND DEMOCRATIZING OPTOACOUSTIC IMAGING SYSTEMS IN BIOMEDICAL RESEARCH AND THE CLINICS

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Optoacoustic (OA) imaging has demonstrated significant potential in biomedical research and is growingly employed in many biomedical applications, including cancer research, neuroscience, and cardiovascular biology, to name a few representative examples. Recent pilot clinical studies have further shown the great potential of OA for clinical diagnostics. State-of-the-art multi-spectral optoacoustic tomography systems can further spectrally distinguish tissue bio-chromes with high (sub-mm) spatial resolution at centimeter scale depths in living organisms. Also, three-dimensional imaging at frame rates of several hundred Hz has been achieved, which is often beyond what is possible with other imaging modalities. Overall, OA offers unique imaging capabilities with superb optical contrast over a wide range of spatial and temporal scales.

Despite the growing biological and clinical interest in the benefits provided by OA imaging, the existing system embodiments have severe limitations. Common imaging systems feature complex and expensive hardware architecture with a cost of a single scanner in the 100s of K$ range, making it hardly affordable for many researchers and clinicians interested in the technology, especially in the middle- and low-income countries. A more compact and affordable technology can also greatly facilitate the clinical translation of this imaging modality by enabling point-of-care testing. The complexity of these systems is mainly due to the use of wavelength tunable lasers providing sufficient energy per pulse at relatively high frame rates as well as data acquisition systems capable of digitizing a large number of time-resolved signals for each laser pulse emission.

The talk covers recent developments that could potentially result in an order-of-magnitude reduction of the size and cost of OA imaging systems, further enabling concurrent pulse-echo ultrasound imaging capabilities for handheld point-of-care applications with highly complementary multi-modal anatomical and functional information. One promising solution lies in the use of efficient and compact pulsed laser diodes and light-emitting illuminators. In parallel, new types of ultra-compact scalable digital acquisition solutions are being developed, capable of acquiring and transmitting data at rates superior to the existing technologies, at the same time performing on-the-edge smart processing to transmit reconstructed images to portable devices. Taken together, these new approaches hold promise for miniaturizing and democratizing the use of OA imaging technology in biomedical research and the clinics.