IBEC

Institute for Bioengineering of Catalonia

Core Facilities

BioImaging

Photoacoustic Imaging System

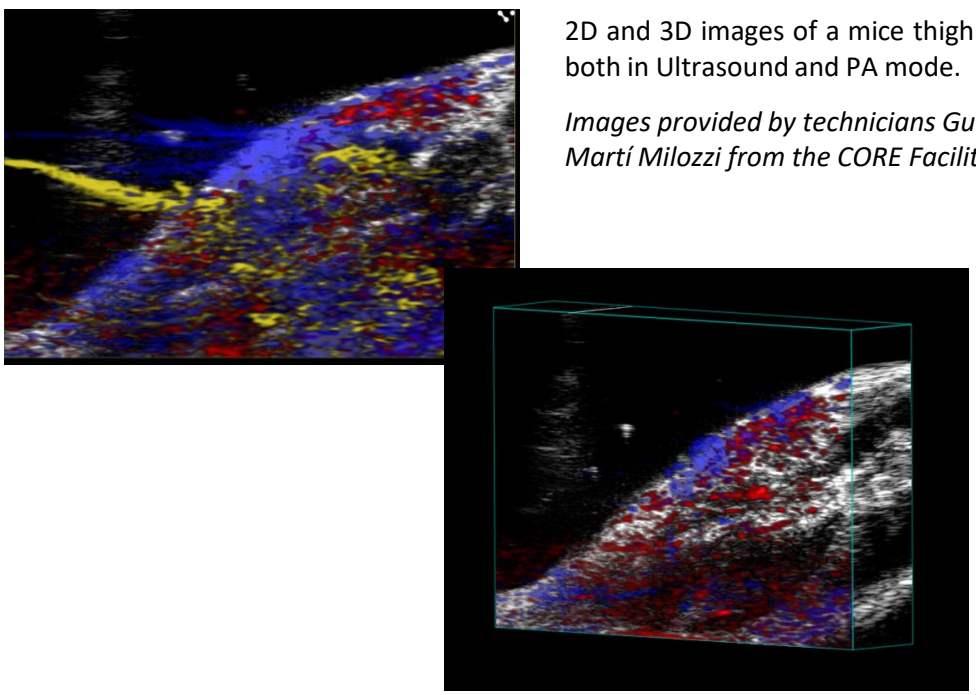
The Bioimaging Facility houses a Photoacoustic Imaging System, which is an advanced tool for biomedicine and microscience. This system allows for the acquisition of live 3D images of organs within a live animal. Additionally, it can determine the distribution of oxygenated and deoxygenated blood, as well as track injected contrasts or nanoparticles in real time.

Photoacoustic Imaging:

The **photoacoustic effect** relies on the properties of specific molecules capable of absorbing **near-infrared (NIR) and NIR-II wavelengths** (ranging from 600 to 2000 nm). When these molecules absorb light within their specific absorbance spectrum, they undergo **thermal expansion and contraction**, resulting in the generation of **acoustic waves** known as **photoacoustic waves (PA).**

The photoacoustic system is equipped with a **multi-wavelength laser** that emits light across the 600-2000 nm visual spectrum. Additionally, it includes **ultrasound transducers** that detect both the PA waves and the reflected ultrasound emitted by the transducer. This combination allows for the acquisition of **ultrasound imaging of organs**, while also providing precise localization of PA signals.

The photoacoustic system is also equipped with a 3D-motor that enables the acquisition of 3D images from organs or other elements that are imaged through the ultrasound transducers.



2D and 3D images of a mice thigh after contrast administration both in Ultrasound and PA mode.

Images provided by technicians Guillem Romero and Martí Milozzi from the CORE Facilities team at IBEC.

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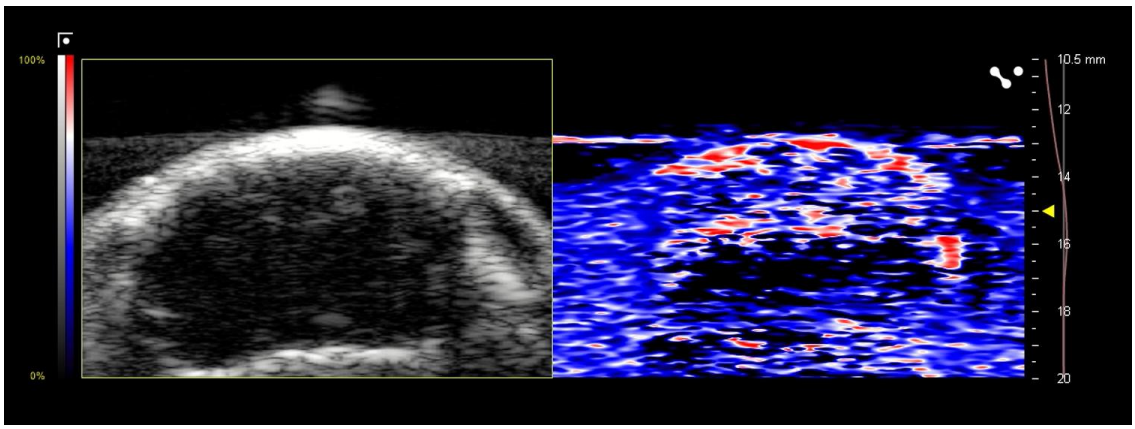
Blood oxygenation imaging:

The ultrasound transducers enable the acquisition of traditional ultrasound images of organs in small animals. Since deoxyhemoglobin and oxyhemoglobin exhibit distinct near-infrared (NIR) absorption spectra, they can emit photoacoustic (PA) waves that are detected by the photoacoustic system. This capability allows for real-time monitoring and three-dimensional image acquisition of organ oxygenation by measuring the levels of deoxy- and oxyhemoglobin. The same approach can also be applied to study the oxygenation of tumors.



On the left, an ultrasound image of a mice brain. On the right, PA image of the brain oxygenation with a contrast on the oxyhaemoglobin (red) and deoxyhaemoglobin (blue).

Image provided by technicians Guillem Romero and Martí Milozzi from the CORE Facilities team at IBEC.

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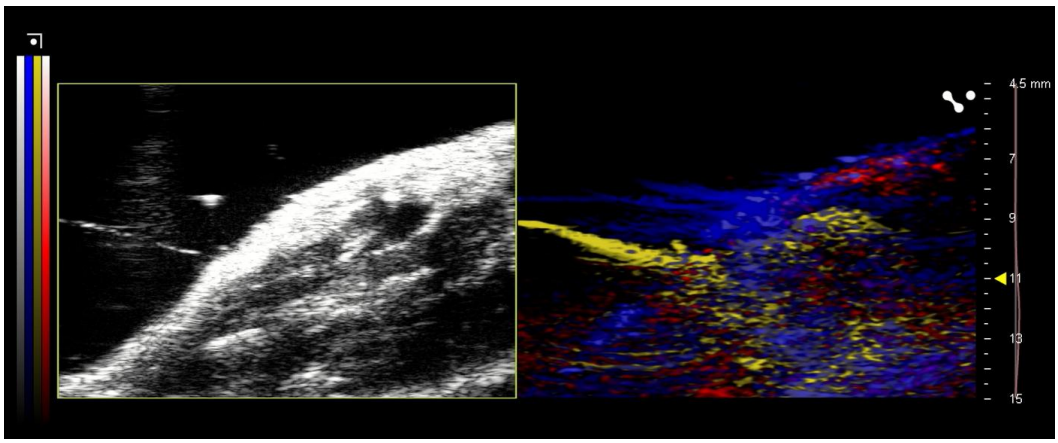
Contrast imaging/multiplexing:

The photoacoustic system is equipped with a linear unmixing algorithm capable of recording the near-infrared (NIR) absorption spectrum of contrast agents and other substances. These contrast agents can then be injected into a microfluidic device for study or into a live animal using the system's precise guided needle.



PA images on top of the ultrasound images of a mice's quadriceps muscle during the injection of ICG as a contrast agent.

Image provided by technicians Guillem Romero and Martí Milozzi from the CORE Facilities team at IBEC.

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