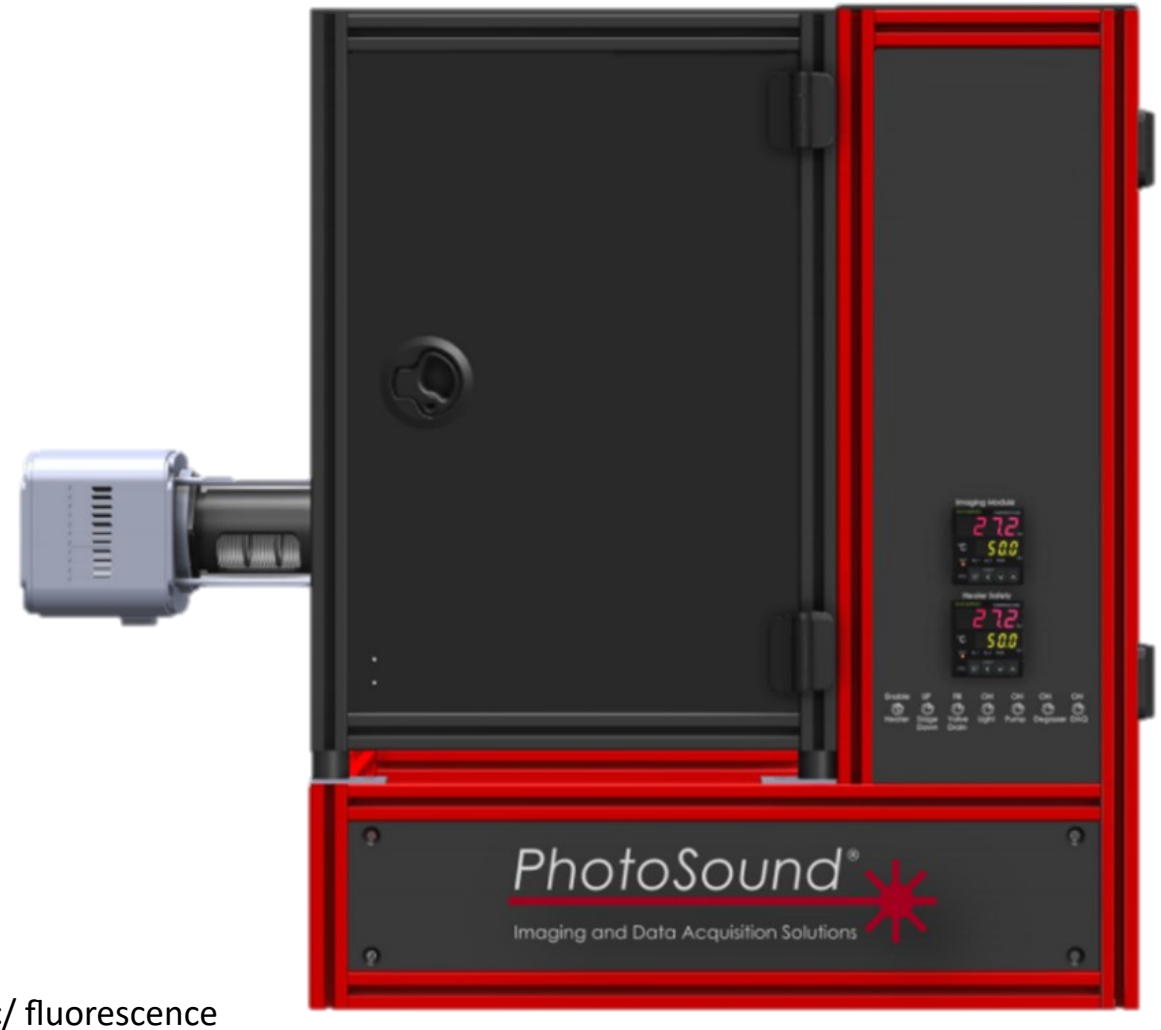
PhotoSound®
Imaging and Data Acquisition Solutions

Discover the Power of Light and Sound

TriTom™

Multimodal whole body *in-vivo* Imaging Platform

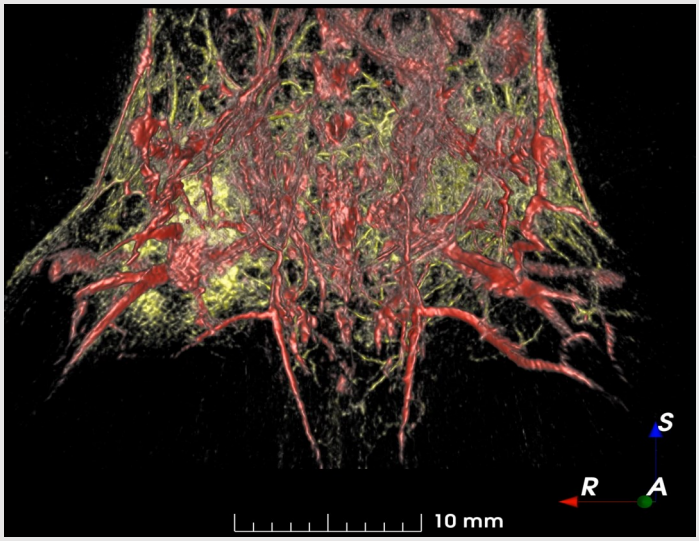


Co-registered photoacoustic/ fluorescence 3D tomography

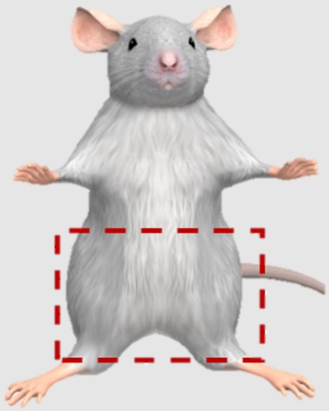
Molecular & functional imaging with high-resolution anatomical registration

Optimized for small murine research models

Co-registered Multimodality 3D Imaging

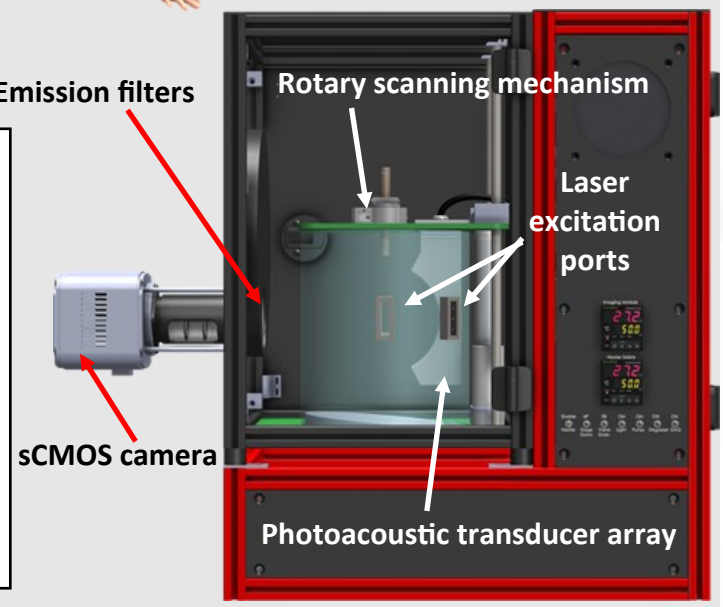


TriTom composite 890 nm + 532 nm imaging of a life mouse vasculature



True 3D anatomy with sub-millimeter spatial resolution:

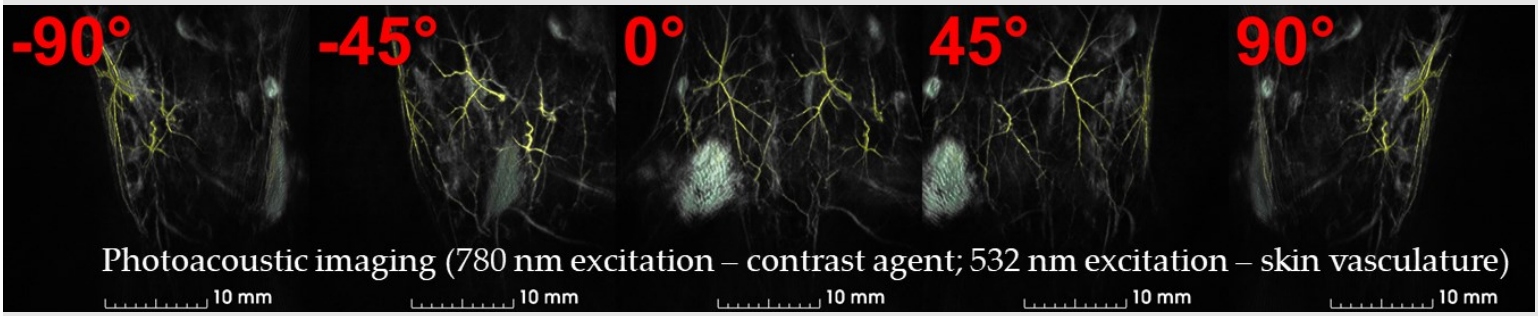
- 160 µm x 160 µm in transverse planes
- 160 µm x 470 µm in sagittal and coronal planes

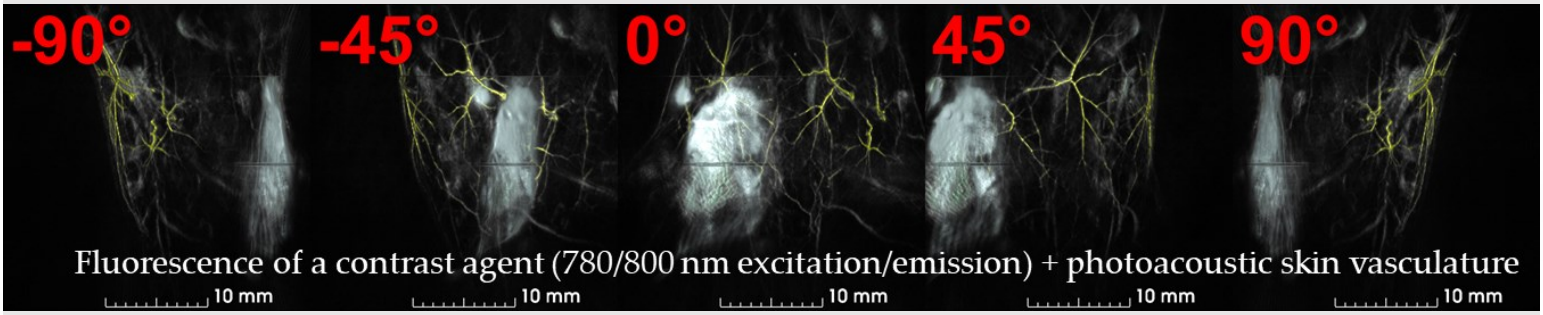


Enhance imaging benefits, eliminate shortcomings

- **TriTom™** utilizes simultaneous spectrally-selective optical and photoacoustic excitation and detection to create unparallel volumetric assessment of live organisms, organs, and tissues.

Molecular sensitivity of photoacoustics is enhanced by fluorescence

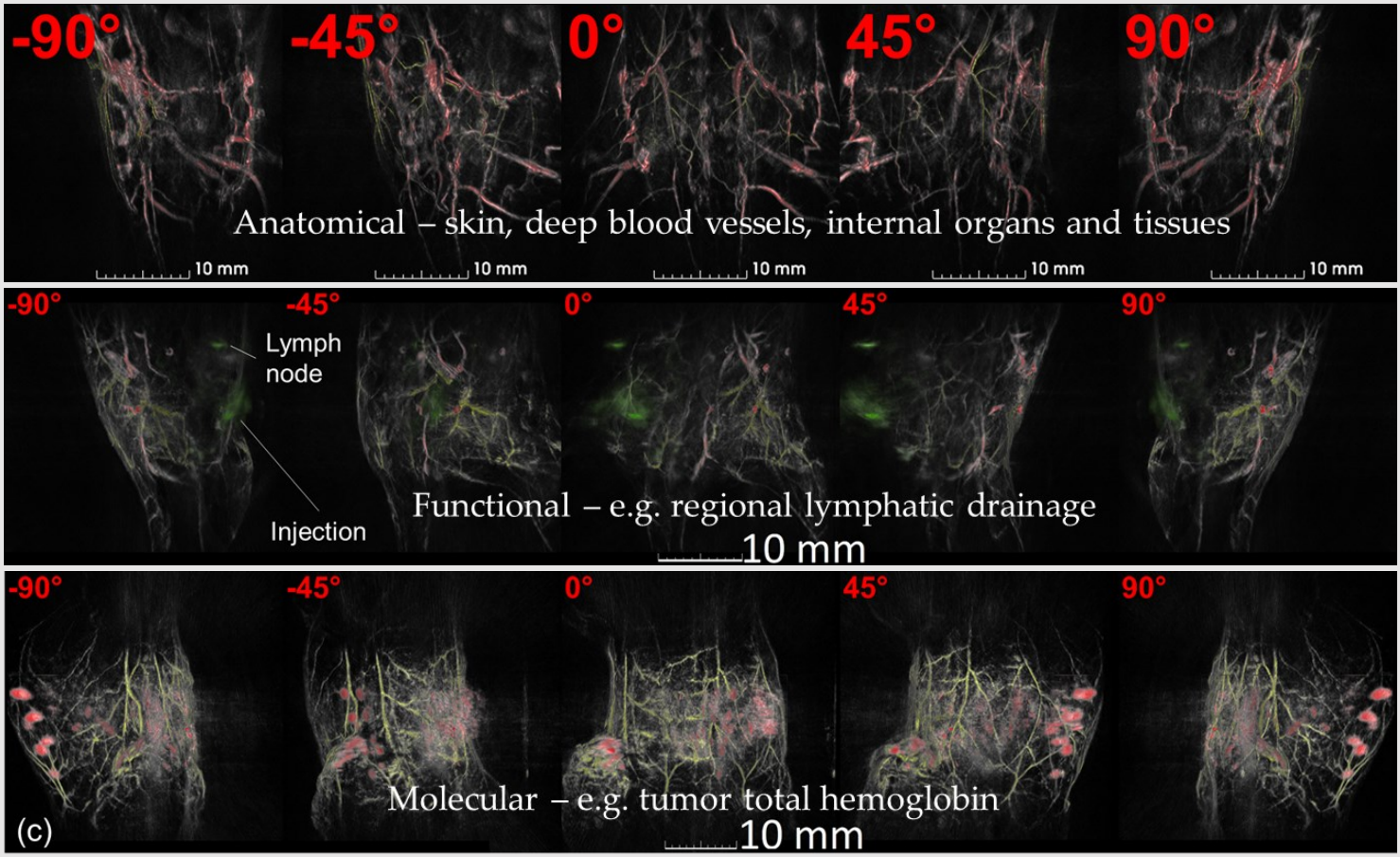




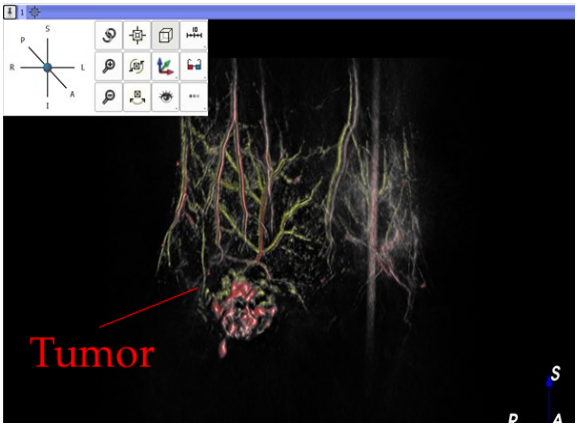
Mapping & anatomical registration of regional lymphatics by passive drainage of ICG; Radial views of a mouse model

TriTom Applications

Triple Analysis– anatomical, functional, and molecular

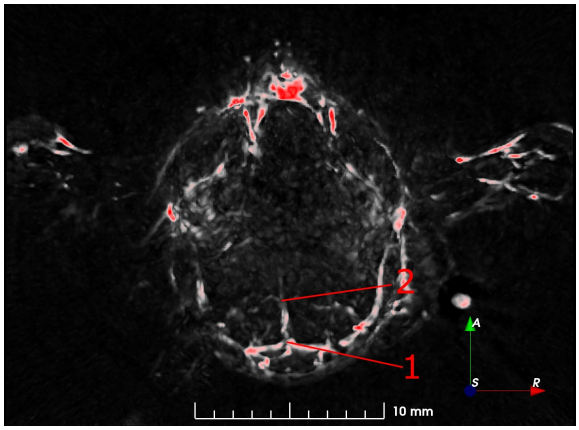


Cancer Research



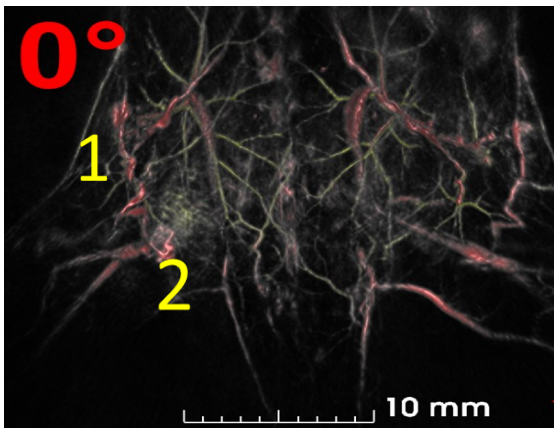
Composite skin & deep tissue 3D image. 532 nm skin excitation. 890 nm deep tissue excitation. Tumor size 10.6 x 4.7 x 11.6 mm3.

Neuroscience



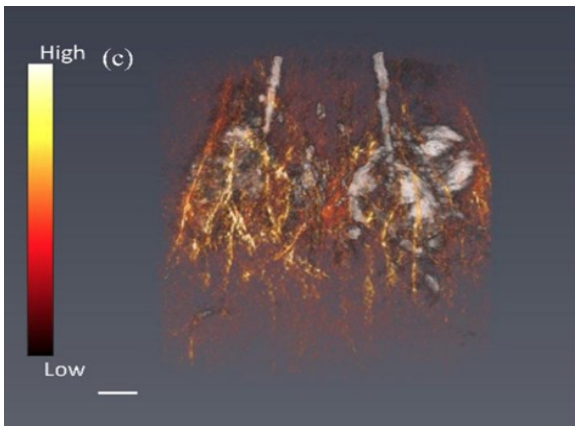
7 mm MIP axial slab of mouse's brain near the cerebellum/medulla. (1) confluence of sinus and (2) cerebral artery are marked.

Functional Imaging



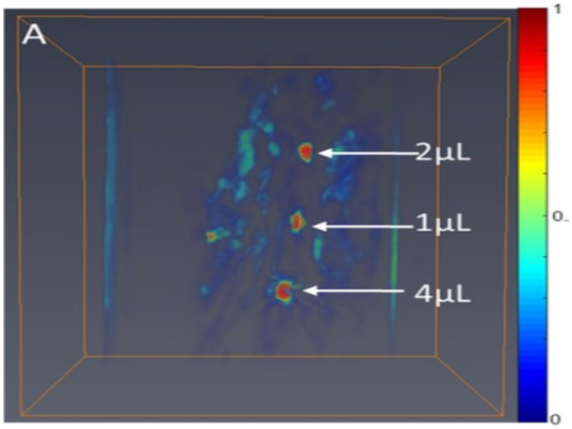
Lower abdomen of a healthy mouse. Red – deep blood vessels, 890 nm excitation scan. Yellow – superficial vasculature (skin), 532 nm excitation scan. 1 – right subiliac lymph node. 2 – injection site (right mammary fat pad)

Developmental Biology



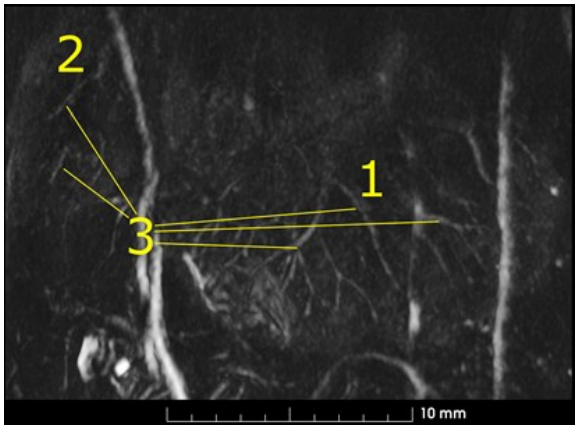
Pregnant mouse, gestational day 12 shows a composite skin / deep tissue photoacoustic image.

Stem Cell Research



3D photoacoustic image of the spinal cord with injected cells denoted by arrows.

Anatomical Details of Internal Organs



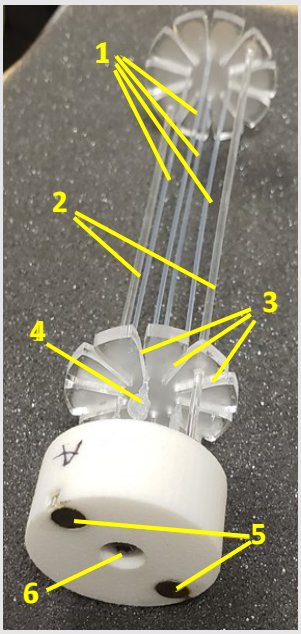
PAT maximum intensity projection of mouse liver. (1) left lobe of liver; (2) right lobe of liver; (3) hepatic vein branches.

Development of Contrast Agents

Crossectional (axial) views of 0.8 mm inner diameter of the microcuvettes with IRDye800CW samples.

Accessories

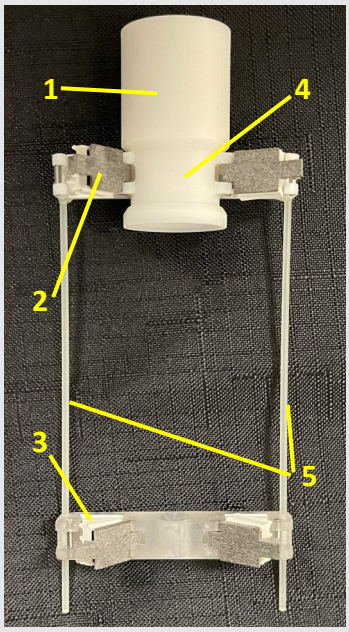
Cylindrical cuvette holder (development of contrast agents)



- **High throughput:**
  ⇒ Interrogate up to 10 samples per scan
  ⇒ Preparation time < 5 min
- **Save your valuable samples!**
  ⇒ Tiny 50 µL sample volumes
- **Convenient & repeatable procedure:**
  ⇒ Radially oriented slots consistently hold samples in place, allow quick setup and removal of cuvettes

(1) Four Ø 0.8 mm cylindrical cuvettes with samples
(2) Plastic support rods
(3) Radial slots for quick setup and removal of cuvettes
(4) Silicon sealant applied to the ends of the cuvettes
(5) Magnetic connects
(6) Port for administering liquid scattering background

Mouse holder (*in vivo* imaging)



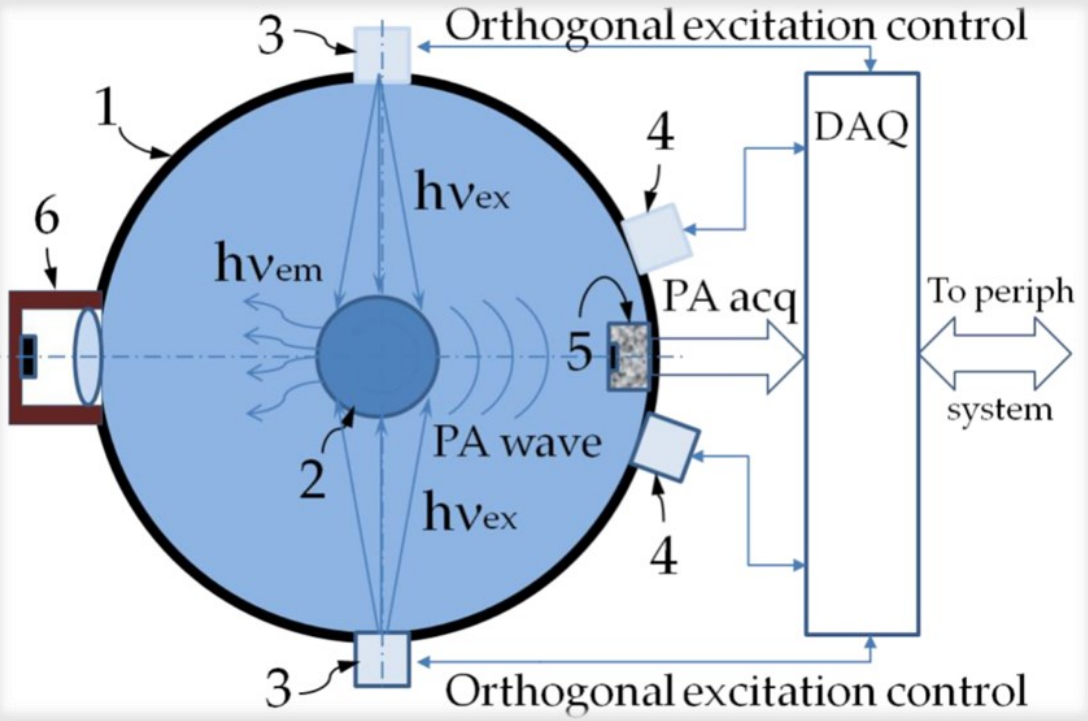
- **Reliable gas anesthesia**
  ⇒ Delivered through the hollow shaft
- **Convenient & repeatable procedure:**
  ⇒ Mouse's front and hind legs and the head are fixed in a consistent position with minimal stress
  ⇒ Preparation time < 5 min

(1) Hollow shaft to fix the mouse holder inside TriTom while reliably delivering anesthesia gas
(2) Cushioned attachment slots for mouse's front legs
(3) Adjustable support block for mouse's hind legs with cushioned attachment slots
(4) Bite bar
(5) Plastic support rods

Additional options include:

- Phantom kits
- Animal anesthesia system
- Animal heating pad
- Animal holder

Patent Protected Technology



Perfect co-registration of imaging modalities

Both PA & FL are initiated simultaneously using pulsed high-efficiency laser light

Both PA & FL are enabled for molecular imaging by the tuning excitation wavelength during the scan. Tuning is necessary for multi-spectral imaging.

Excitation Source

Excitation source: **Tunable OPO laser**

Wavelength tuning range covering all popular visible, NIR I and NIR II fluorophores and nanoparticles:

⇒ 660 – 1064 nm (standard)

⇒ 460 – 659 nm (extended visible excitation)

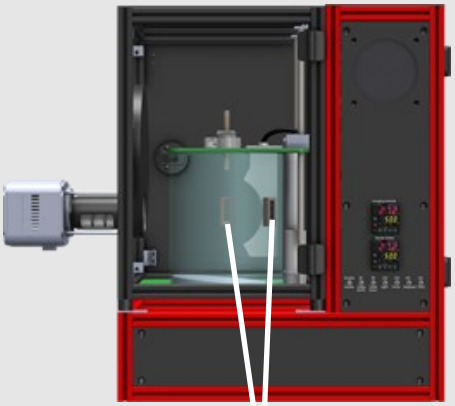
⇒ 1065 – 1300 nm (extended NIR II excitation)

Up to 250 mJ peak energy @ 700 nm

10 Hz or 20 Hz pulse repetition frequency

Excitation linewidth < 0.5 nm (equivalent to 1,280 excitation filters!)

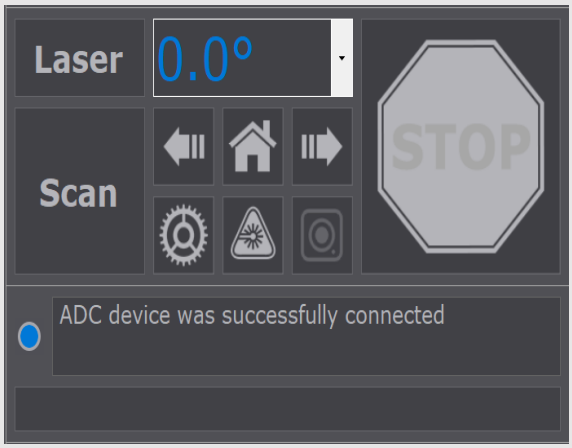
Integrated energy meter (quantitative imaging)



Photoacoustic and fluorescence excitation through the same ports (4)

Software

The **TriTom**[TM] imaging software suite provides a streamlined experience from simultaneous acquisition of optical and photoacoustic data to final reconstruction and co-registration of volumes.

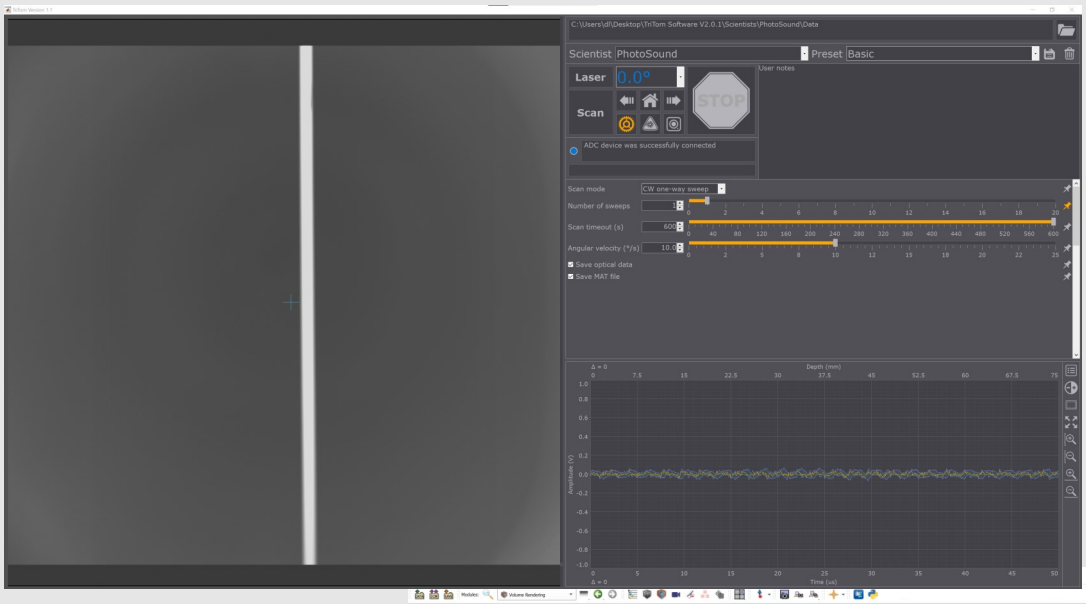


- Iconographic design of the main control screen
- Modular user-centric graphic Interface
- Optical frames
- Scan metadata
- Open data formats

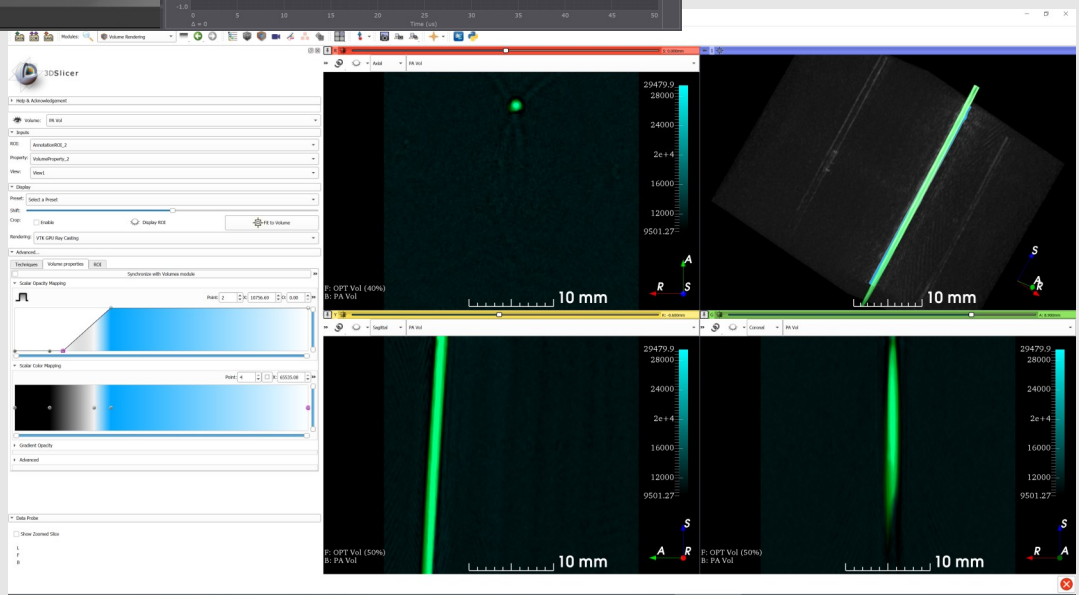
MATLAB

3DSlicer

IPASC International Photoacoustic Standardisation Consortium



TriTom image & signal monitoring interface



3D slicer — visualization and image processing software

Technical Specifications

Tunable Laser System		
Wavelength Range [nm]	460-1300	*Single output, continuous tuning*
Pulse Width [ns]	3 - 5	*FWHM*
Linewidth [cm-1]	< 10	
Repetition Rate [Hz]	10/ 20	
Pulse Energy [mJ] *before fiber bundle transmission*	> 120 mJ @ 700 nm > 10 mJ @ 500 nm	
Pulse Energy Fluctuations [%]	< 2	*StDev*
Energy meter	*Real-time pulse energy measurements stored in data header*	
Fast wavelength switching	[470, 659] nm, [660, 1300] nm	
Dimensions [in (cm)]	26.5 (67.2) x 17.1 (43.4) x 34.9 (88.7)	
Weight [lbs (kg)]	150 (68)	
Input Power	208 or 240 V 10 A 50 / 60 Hz	

Fiber Bundle		
Input / Output Configuration	1:4 Circular/Linear	*Over 2500 individually randomized fibers*
Axial Excitation Spot Size [mm]	30 (50, 80)	standard (optional)
Length [m]	2	

Photoacoustic Transducer Array		
Configuration	Curved	*Cylindrical focusing*
Number of Elements	96	*No dead elements*
Element Size [mm^2]	1.3 x 1.3	*Measured along centerline*
Element Pitch [mm]	1.4	
Active angular aperture [deg]	0.1	
Radius of curvature [mm]	118	
Central Frequency [MHz]	6 ± 10%	*T/R measurements, Optimized sensitivity in receive mode*
Bandwidth @ -6 dB [%]	≥ 55	*T/R measurements*
Acoustical Matching	water	*1.5 MRayl*
Transducer Material	PEEK	*Housing is connected to ground to prevent RF noise pickup*
Utilization	*Continuous immersion under 0.5 m of water between 10 to 40°C*	
Shielding	*Metalized inside, partial metalized outside (e.g. flash of gold)*	

Fluorescence Emission Filters		
Optical Filter Wheel	Motorized	*USB 2.0 PC connection*
Clear Aperture [mm]	25	
Standard Optical Filter Emission Ranges [nm]	11 filters covering emission range between 483 nm and 850 nm, 1 blocked, 1 open, and 1 custom slots	

Fluorescence Detector		
Detector Type	sCMOS	*High sensitivity cooled scientific camera*
Bit Depth	16-bit	
Sensor Size [in]	1.2	
Number of Pixels	2048 x 2048	
Pixel Size [µm]	6.5 x 6.5	
Quantum Efficiency [%]	20 - 95	*200 - 1000 nm*
Readout Noise [e-]	1.2	*Low readout noise for high frame rate applications*
Dark Current [e-]	0.03	*For 100 ms or shorter exposures*
Dark Signal Nonuniformity [e-]	0.2	
Max Frame Rate [fps]	35	Full resolution
Cooling [°C]	-15	Peltier cooling
PC Connection	USB 3.0	

LEGION™ ADC Data Acquisition Unit		
Channels	256	
Programmable Gain [dB]	46 - 91	*Measured using oscilloscope with 50Ω input*
Analog Bandwidth	40 kHz - 25 MHz	
Resolution	12-bit	
Sampling Rate [MSPS]	40	
Min Input Impedance [kΩ]	1	
Max Frame Rate [Hz]	200	*Up to 400 Hz using 128-channels only*
Points / Frame / Channel	4096	
Trigger Connections	*2x SMA Electrical / 2x Optical*	

Computer (typical specs are provided, subject to change without notice)		
Form Factor	Desktop	*Mini ITX case with handle*
Processor	Core i5-10600	*6 Cores / 12 Threads 3.3 - 4.8 GHz 12 MB 65 W*
Graphics	Geforce RTX 2070 Super	*2560 CUDA cores 1605 - 1770 MHz 8 GB GDDR6 215 W*
Memory	16 GB	*DDR4 3200 MHz*
Storage	2 TB	*M.2 NVMe PCIe 3.0 SSD*
Imaging Monitors	*Two 27" Monitor, resolution 2048x1080*	
Operating System	*Microsoft Windows 10 Pro 64-bit*	
Dimensions [in (cm)]	14.8 (37.5) x 7.83 (19.9) x 12.3 (31.2)	
Weight [lbs (kg)]	20 (9.1)	
Imaging Software	*Advanced TriTom imaging suite (multimodality 3D imaging, molecular spectral imaging, molecular unmixing); 3D slicer visualization & image analysis*	

About PhotoSound ®

PhotoSound Technologies, Inc. (Houston, Texas USA) develops new imaging products and technologies for life sciences. A 3D imaging platform for in vivo preclinical research and drug discovery (TriTom™) is implemented on patented PhotoAcoustic Fluorescent Tomography (PAFT) technology, which utilizes simultaneous spectrally-selective optical and photoacoustic excitation and detection to create unparallel volumetric assessment of live organisms, organs, and tissues. A MoleculUS™ system is developed for clinical research that can benefit from co-registered ultrasound and molecular photoacoustic imaging. We also offer a variety of OEM electronic components for multi-channel parallel data acquisition.

All PhotoSound technology solutions are designed and built by experts in biomedical imaging systems, photoacoustics, ultrasound, optics, electronics and tunable lasers. Our employees are committed to provide every customer with the highest quality products and services, short delivery times and competitive pricing. Visit us at www.photosound.com to learn more about our products and proprietary technologies.

PhotoSound Technologies, Inc. | *Imaging and Data Acquisition Solutions*

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