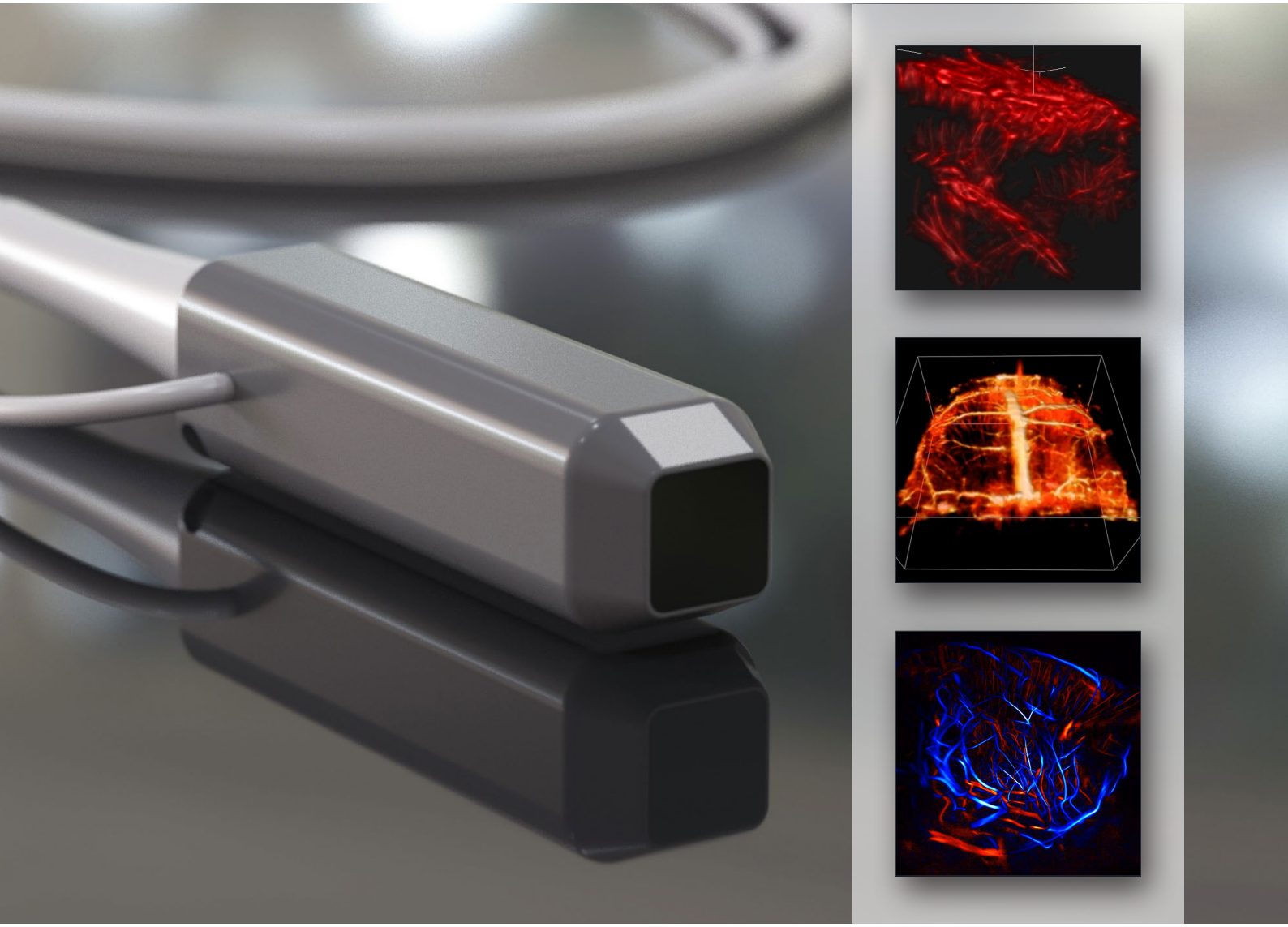
Iconeus

REVEALING THE BRAIN

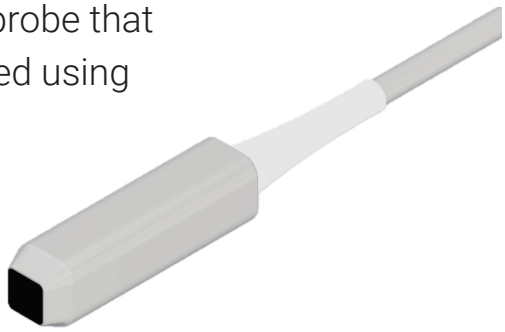
IcoPrime-4D RCA

High-contrast, low-artefact probe for volumetric brain imaging on the Iconeus One functional ultrasound platform



A revolution in volumetric blood flow imaging

IcoPrime-4D RCA is a compact, high-resolution probe that allows crisp 3D images of the brain to be captured using the Iconeus One functional ultrasound platform.



This next-generation probe overcomes the drawbacks that have hitherto hindered use of row-column addressed (RCA) transducers in blood flow imaging. Combined with the existing advantages of Iconeus One, the result is a dramatic enhancement in the performance of volumetric fUS scanning.

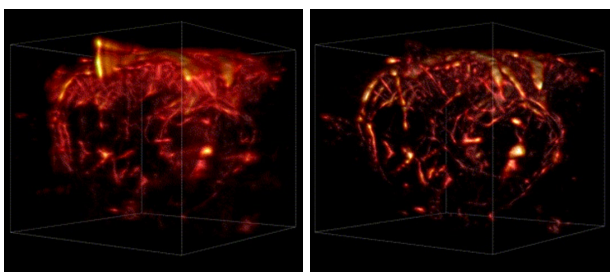
- **High resolution** – The small, isotropic voxels (down to just 100 × 100 × 100 µm) and low artefact levels help to reveal the brain vasculature with unprecedented detail.
- **Quick acquisition** – Thanks to its fast volume rate, a complete fUS volume can be acquired in as little as 400 ms.
- **Wide field of view** – IcoPrime-4D RCA integrates with the 256-channel model of Iconeus One, allowing volumes of 8.8 × 8.8 × 15 mm to be acquired.
- **Compact design** – The small cross-section of IcoPrime-4D RCA (just 13 × 13 mm) makes it suitable for range of experimental setups, including those requiring small cranial windows.

High contrast, reduced artefacts

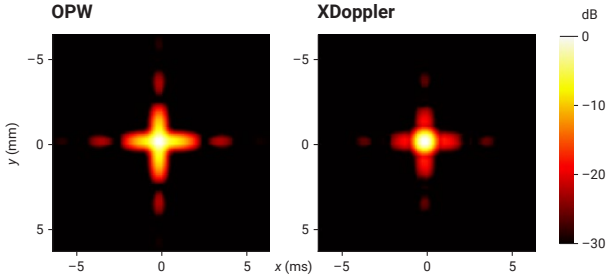
XDoppler: A breakthrough for blood-flow imaging

Traditional Doppler technologies used for blood flow imaging, such as the orthogonal plane wave (OPW) method used with RCA transducers, suffer from sidelobe artefacts and limited contrast. This makes it difficult to discern fine detail in 3D images of the brain.

Our patented XDoppler technology,[1] implemented on IcoPrime-4D RCA, cross-correlates the orthogonally-acquired volumes in RCA scans to eliminate these sidelobe artefacts. The result is that it outperforms OPW, providing consistently higher contrast and improved resolution across the field of view.[2]



In vivo imaging of an anesthetized rat brain (with craniotomy), showing the higher image quality achieved with XDoppler. The resulting sensitivity enhancement is particularly evident in deeper brain regions, where more blood vessels become distinguishable.



Point spread functions simulated from a single scatterer, showing the marked reduction of sidelobe artefacts and increased resolution with XDoppler.[3]

[1] *World Patent* WO2018050817, 2018. [2] *IEEE Transactions on Medical Imaging*, 2021, DOI: 10.1109/TMI.2021.3084865. [3] Note that this simulation was done with a 6 MHz probe – the length scale would be much smaller with a regular (15 MHz) probe.

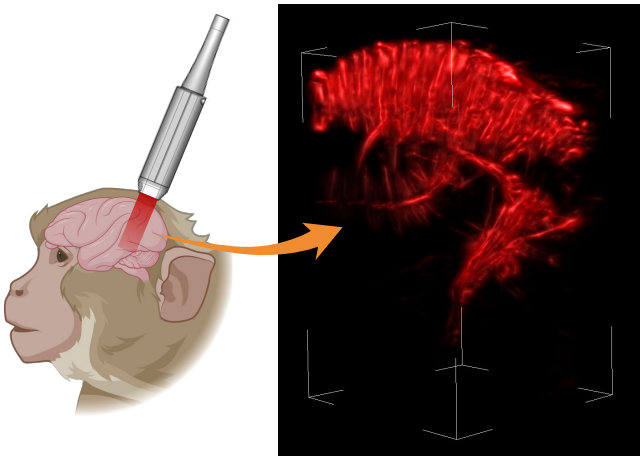
Pioneer new research into brain function

Volumetric fUS: A breakthrough in high-precision neuroimaging

Because of its integrated XDoppler technology, IcoPrime-4D RCA greatly enhances the possibilities for 3D imaging using Iconeus One.

With its rapid acquisitions and functional resolution of just 100 µm^3, this volumetric fUS (vfUS®) approach allows you to achieve insights that previously would have been impossible to obtain.

These include tracking changes deep in the brain, investigating dynamic activity, and mapping brain responses to various stimuli with greater precision than ever before.



Courtesy of Adrien Bertolo and Mickael Tanter, Physics for Medicine Paris

Volumetric fUS image of the primary visual cortex (V1) obtained in an anesthetized non-human primate, showing the fine level of detail that can be achieved with IcoPrime-4D RCA.

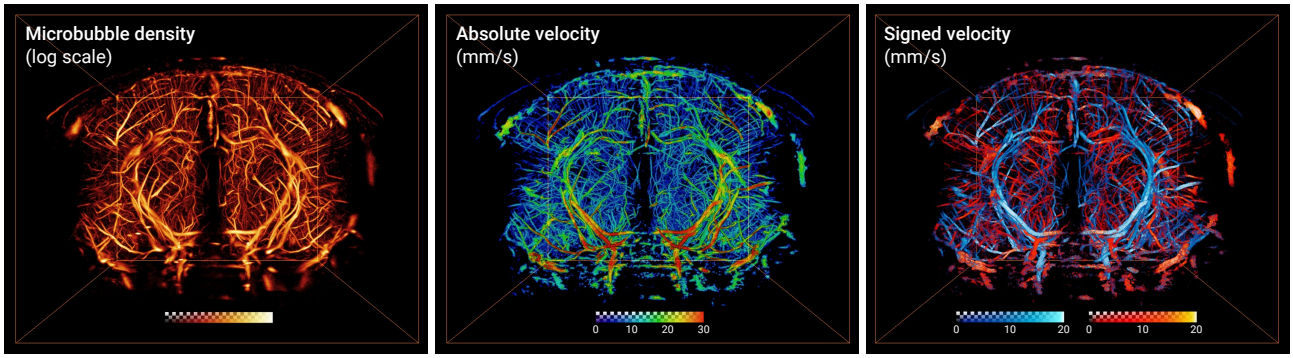
Map vascular networks with amazing detail

Volumetric ULM: Pinpointing microbubbles with 5 µm resolution

The capabilities of IcoPrime-4D RCA can be taken further by coupling it with our existing ultrasound localization microscopy (ULM) method. ULM involves intravenously injecting microbubbles, substantially boosting the contrast and therefore the resolution.

With IcoPrime-4D RCA, you can now extend ULM from two to three dimensions – a groundbreaking capability that enables you to reconstruct the intricate web of blood vessels in the brain with an astonishing resolution of 5 µm.

You can also measure absolute blood flows (in mm/s) in every direction within the brain. This opens the door to a more comprehensive understanding of blood flow dynamics, which could transform our understanding of brain function and contribute to new opportunities in research and diagnostics.



Courtesy of Adrien Bertolo and Mickael Tanter, Physics for Medicine Paris

3D renderings of vULM maps obtained non-invasively in the anesthetized mouse brain, showing vessel density, absolute velocity and signed velocity (blue = up, red = down), overlaid onto the Allen Mouse Brain Atlas.

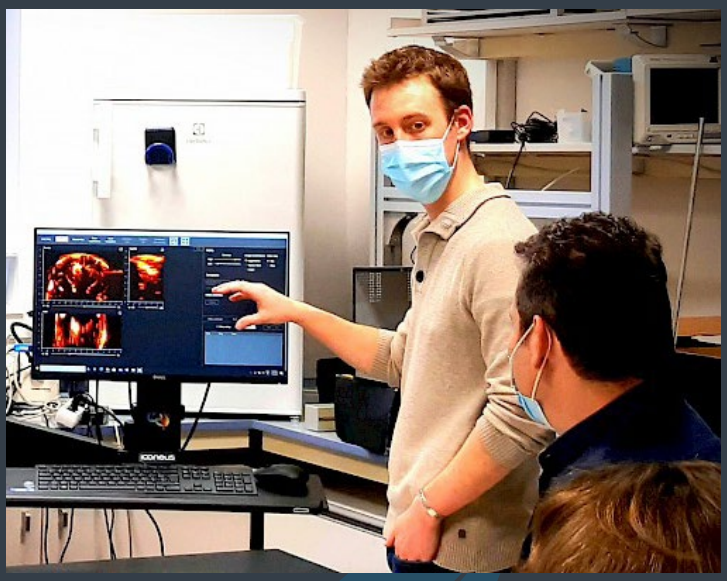
About Iconeus

Welcome to the future of brain imaging

We're Iconeus – a Paris-based company helping researchers to gain new insights into neuroscience using our groundbreaking functional ultrasound technology.

Our team of over 30 neuroscientists, software engineers and ultrasound physicists is dedicated to ensuring functional ultrasound achieves its full potential, by helping you integrate it into your research.

We look forward to hearing from you!



ICONEUS

REVEALING THE BRAIN

Visit our website:

www.iconeus.com

contact@iconeus.com

25 boulevard Romain Rolland, 75014 Paris

Images are non-contractual.
Not for clinical use. Not for veterinary diagnostics.

0007_2_ENG_090125