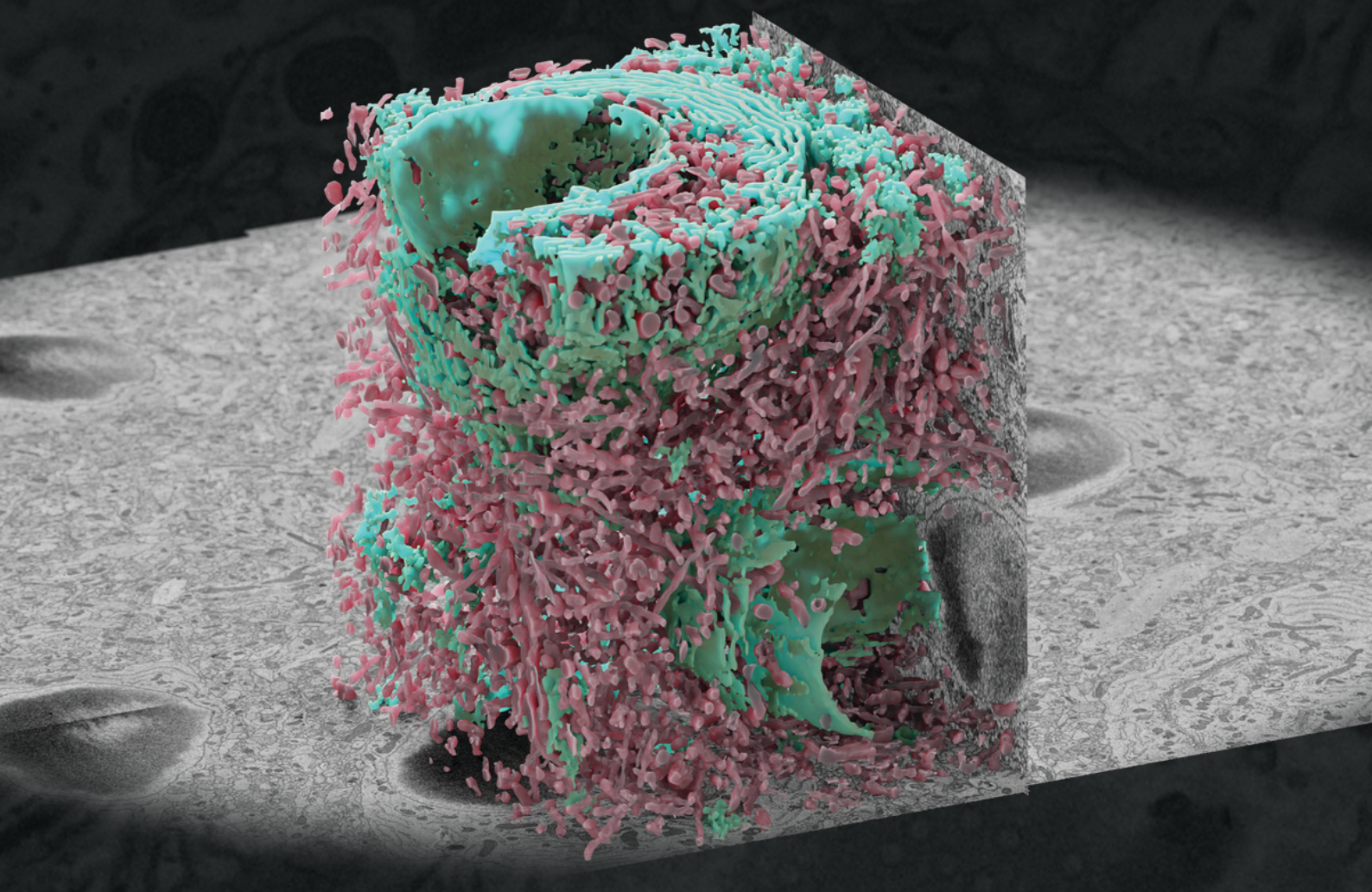
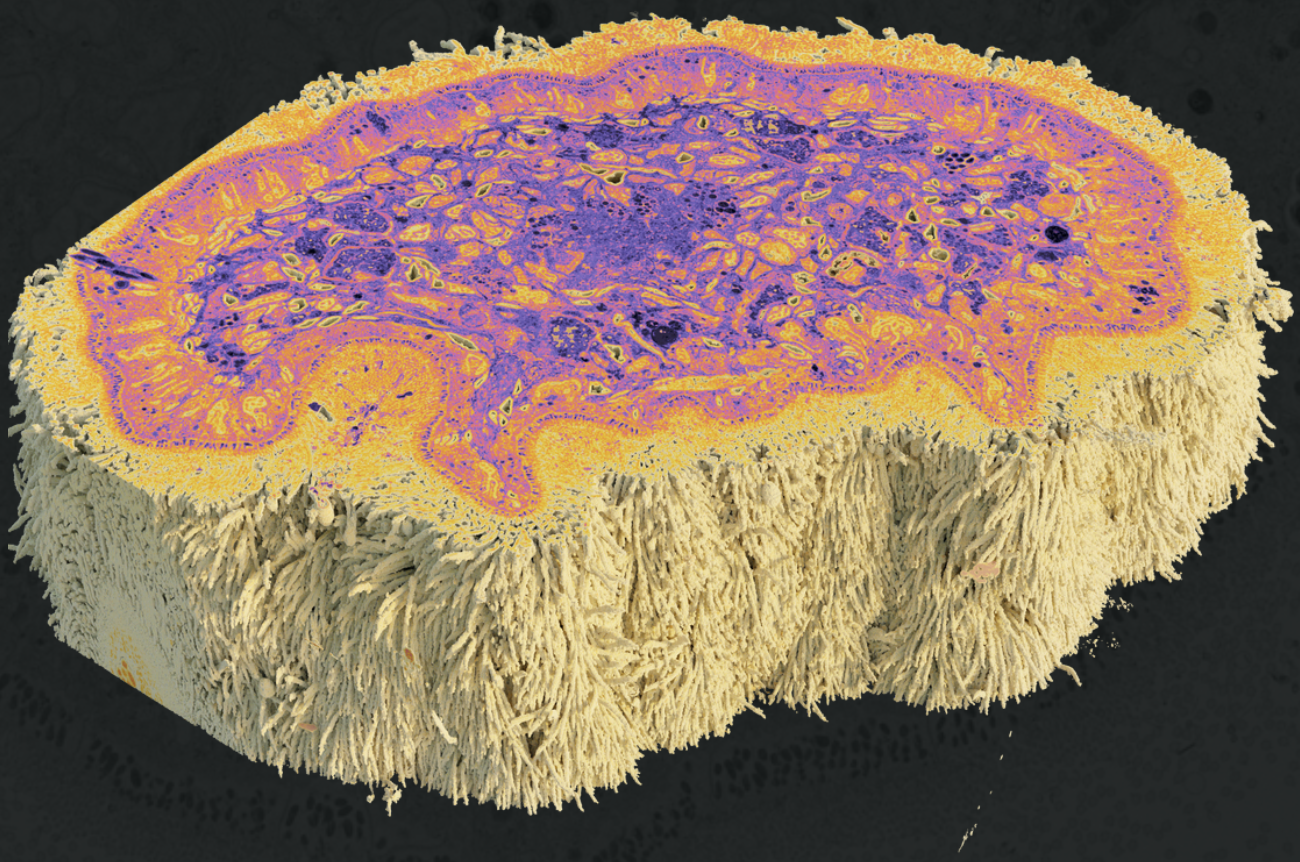
ConnectomX

Transform any SEM into a Volume SEM

Serial Block-face Imaging with katana microtome





3D volume reconstruction of the flatworm macrostomum lignano showing surface structures (cilia, habdites, ultrarhabdites) and internal vesicles. Total volume: 160 × 120 × 75 µm. Acquired on a TESCAN CLARA SEM. Sample courtesy of Dr. P. Ladurner and W. Salvenmoser, University of Innsbruck, Austria.

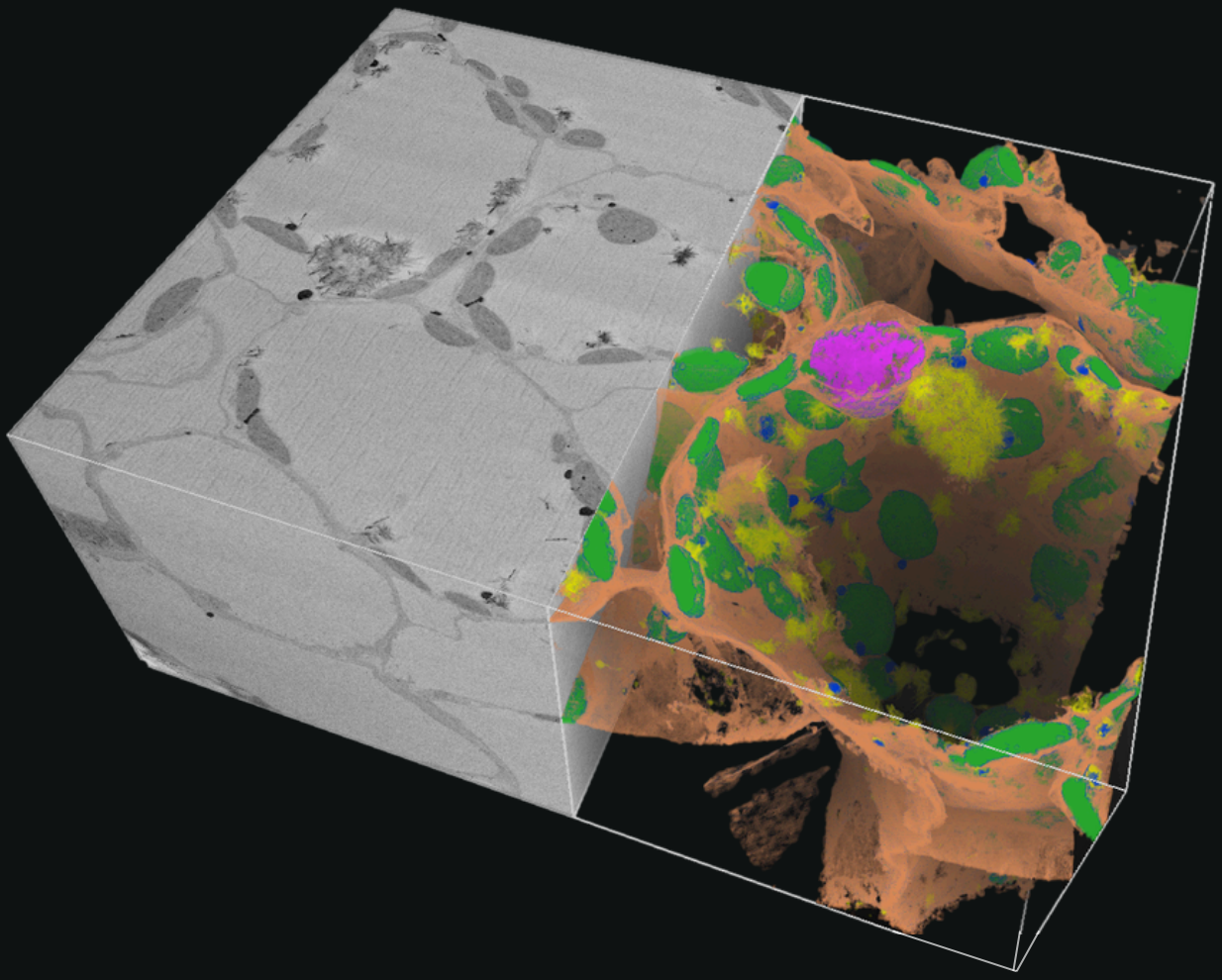
Our Story

Founded in 2018, ConnectomX emerged from the shared vision of two scientist friends who were fueled by a mutual passion for pushing the boundaries of volume electron microscopy. We envisioned a universal tool that could complement and enhance the capabilities of existing scanning electron microscopes (SEMs) across the globe.

katana microtome came to life with this vision and became the world's first universal in-situ ultramicrotome, designed to fit seamlessly with any SEM, transforming it into a volume SEM, achieving a Z resolution at 20 nm.

Our story, however, does not end with the creation of the katana microtome. It continues with our commitment to innovation and customer satisfaction. This understanding drives us to continuously improve, optimise, and push the boundaries of what's possible with volume electron microscopy.

ConnectomX is dedicated to make volume EM accessible to all



3D reconstruction of chloroplasts in tobacco seedling imaged on a JEOL IT700HR.
Sample supplied by Council for Agricultural Research and Agricultural Economy Analysis (CREA-DC) - Research Centre for Plant Protection and Certification, Italy

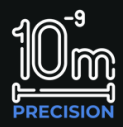
Serial-block Face SEM

Visualising biological structures at the nanometre scale is crucial for advancing our understanding of cellular, tissue, and organ function, paving the way for breakthroughs in treating disease and disorder. Serial block-face scanning electron microscopy (SBF-SEM) has revolutionised the acquisition of large volumes of 3D SEM data. In this technique, a microtome operates within the vacuum chamber of an SEM, using a diamond knife to repeatedly remove ultra-thin layers (as thin as 20 nm) from a sample block that has been stained with heavy metals and embedded in resin. After each section is removed, the exposed surface is imaged by detecting backscattered electrons. This automated in-situ process generates a series of electron micrographs, which can be used to reconstruct detailed 3D models of the sample.

SBF-SEM enables high-resolution, large-volume imaging

Universal Compatibility

With its compact design and a height of just 56mm, the katana microtome is designed to fit seamlessly inside the vacuum chamber of many SEMs. It can be installed or removed from an SEM stage in seconds, allowing for a fast and effortless transition from standard SEM to serial block-face SEM



The Z stage of the katana microtome has a precise and repeatable 1 nm resolution. This allows for accurate 3D reconstruction.

The diamond knife can produce an in-plane oscillation at large amplitudes to improve cutting performance. The built-in feedback loop allows for optimal frequency tuning.

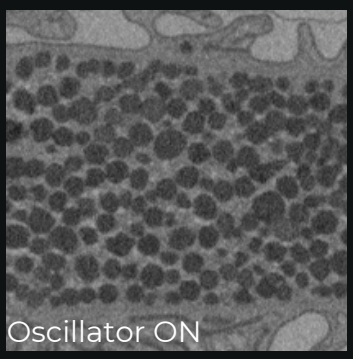
The General Z-travel range accommodates samples over 1 mm in height. An ultra-fast motor ensures hundreds of microns clearance between the sample and blade after each cut, reducing the chances of debris attracted to block surface.

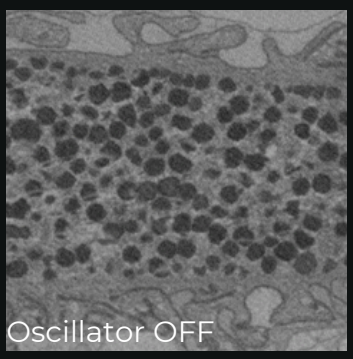
An open software and hardware interface make the katana microtome compatible with any SEM software. It is fully integration with SBEMImage and SEMSupporter. It can also be easily integrated with multiple image modalities to create correlative workflows.

Introducing the katana microtome

Ultrasonic Cutting

Think about the sawing motion used when slicing a loaf of bread. The cutting force is greatly reduced and we get a clean cut. In the same way by oscillating the diamond knife we can vastly improve the surface texture of the sample after each cut in SBEM. The FEA optimised knife design enables a piezo driven in-plane oscillation at an amplitude up to 150 nm at tens of kHz. The oscillation amplitude is constantly measured by a sensing piezo. The dual-piezo (driving and feedback) design of the knife holder provides constant monitoring of the knife oscillation and allows fine tuning to optimise cutting performance across a wide range of samples.



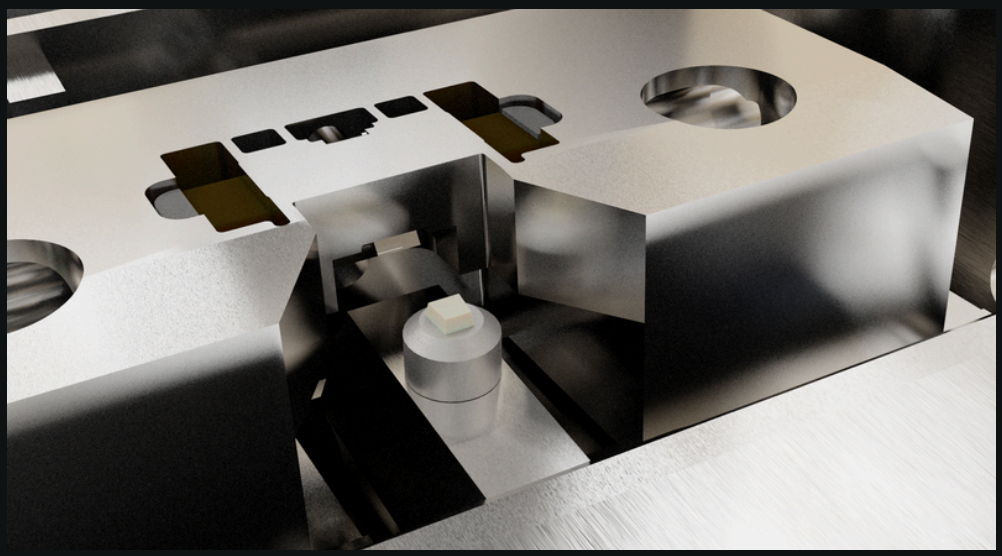


Images of pigment granules in a pigment sac of a squid skin chromatophore sample. Imaged on a Zeiss Sigma VP at 1.9 kV in variable pressure mode using katana at 25 nm cutting thickness. Sample courtesy of Dr Alan Kuzirian at Marine Biology Laboratory, USA. The images shows that when the oscillator is turned off, the pigment granules (black dots) are missing in the image which indicates they are being pulled out by the knife during cutting. This behaviour is not seen when oscillator is turned on.

Easy to Use

For those new to ultramicrotomy, locating the cutting plane can be a challenging and nerve-wracking task. To simplify this process, our Digital Viewer is specifically designed to assist users in carefully and precisely guiding the sample toward the cutting plane, ensuring the diamond knife remains undamaged. The Digital Viewer is positioned over the microtome, allowing the entire approach process to be performed directly on the SEM stage, without the need to remove the microtome.

Equipped with a high-frame-rate CMOS camera and a high-resolution lens, the Digital Viewer delivers a crisp, low-latency image of both the knife and the sample. A series of internal mirrors continuously tracks the knife's movement, keeping the diamond blade in clear focus and stationary on the screen, providing users with precise, real-time feedback throughout the cutting process.



Technical Specifications

MICROTOME

1 nm Z stage resolution at closed-loop

1.3 mm Z travel range

1.5 mm wide Diatome diamond blade at 45 degree

Knife oscillation amplitude up 200 nm with tunable frequency up to 100 kHz

Minimum working distance 3 mm from sample to detector

Dimension: 135 x 66 x 56 (H) mm

COMPATIBILITY

Any SEM that can fit 56 mm under the pole piece

Automation with all SEM software

SBEMImage integration with selected Zeiss, TESCAN and Hitachi SEMs

Integration with JEOL SEM Supporter

Open interface with other imaging modalities to create correlative workflows

ELECTRONICS

ARM Cortex® M7+M4 dual core with remote upgradable firmware

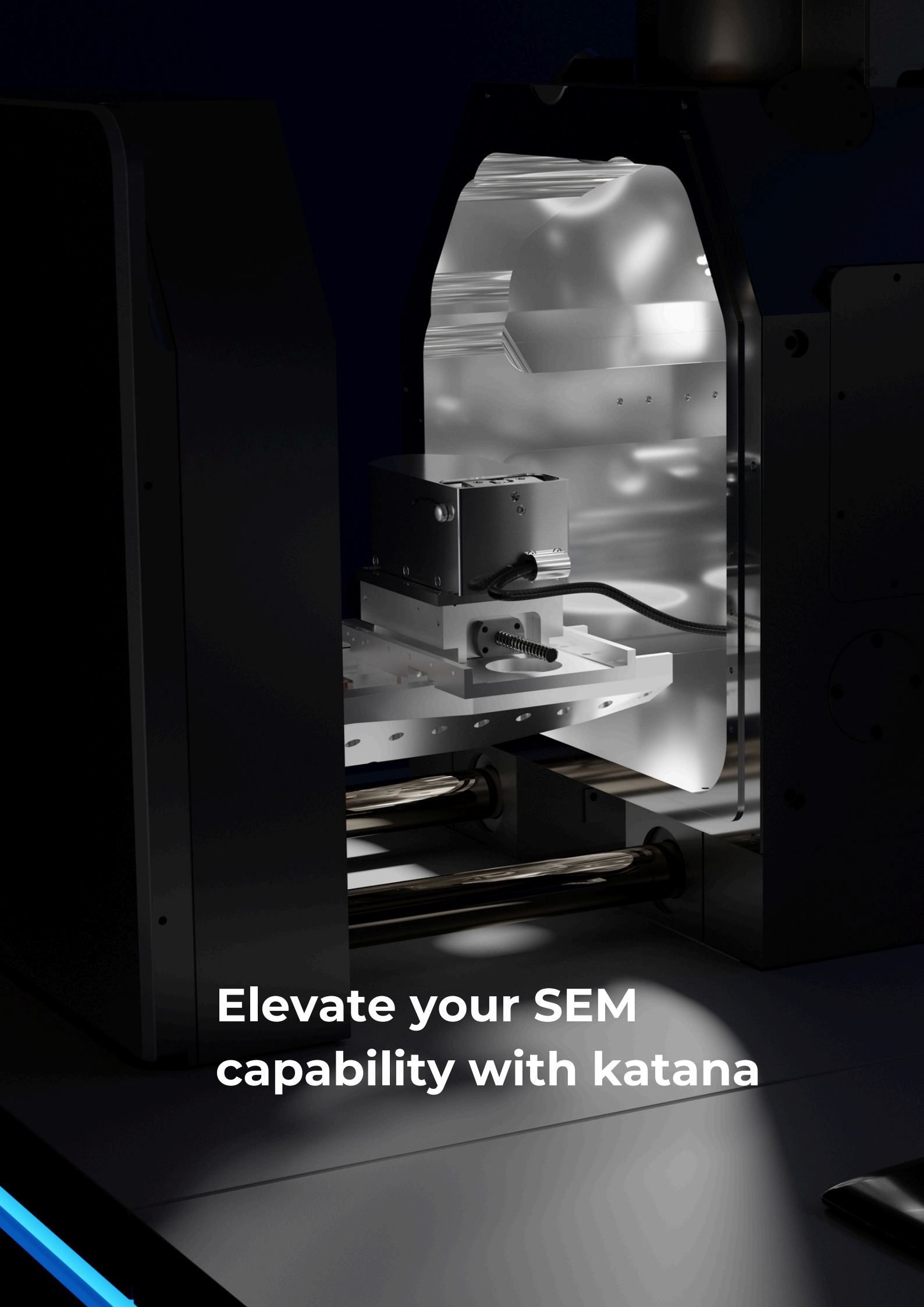
Connect to microtome via a single feedthrough cable

Dimension: 184 x 107 x 59 mm

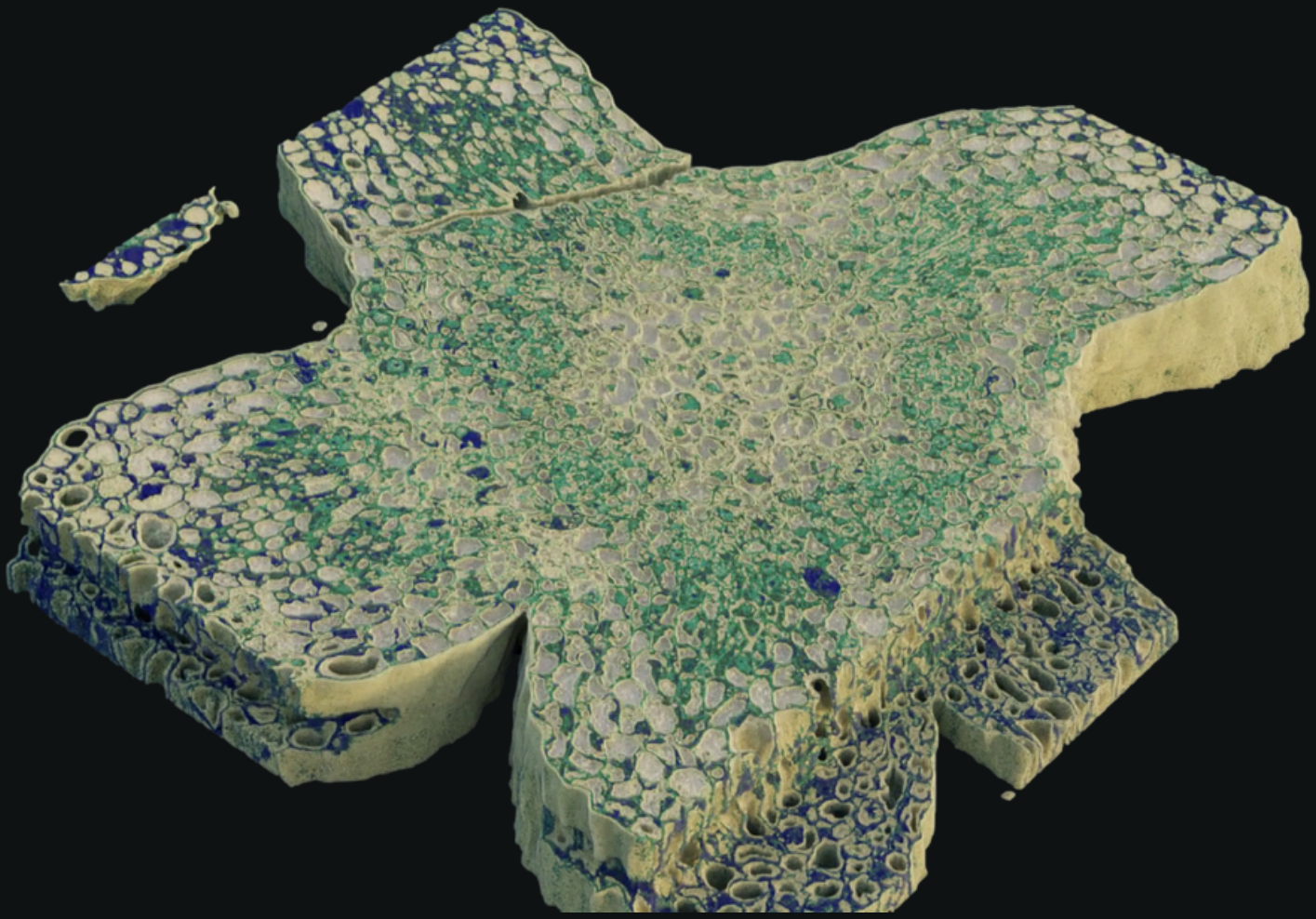
DIGITAL VIEWER

40fps 2.3MP CMOS industrial camera with USB 3.0 connection

Tracking mechanism to ensure knife edge always centred and focused



Elevate your SEM capability with katana



3D reconstruction of arabidopsis shoot apical meristem with highlighted vacuoles and cell walls. The purpose is to study the formation and maturation of plant cells structures in the shoot apical meristem of Arabidopsis thanalia in order to understand the plant cells growth and differentiation process. Imaged on a JEOL IT700HR. Raw data and sample provided by Dr Isabelle Bonne, Mr Sim Aik Yong and Mr Lu Tong Beng at Yong Loo Lin School of Medicine, National University of Singapore and Anna Liew, JEOL Asia Pte. Ltd.

See the unseen, slice by slice

Correlative Microscopy

The versatility of the katana microtome allows integration with various imaging modalities, making it a crucial component in correlative workflows. This capability not only enhances throughput by precisely targeting regions of interest, but also enables the simultaneous study of a sample using multiple techniques. Users are using katana in combination with the following imaging techniques:

- Florescent Light Microscopy
- Focused Ion Beam (FIB)
- Energy-dispersive X-ray Spectroscopy (EDX)
- Electron Backscatter Diffraction (EBSD)
- X-Ray Microscopy (XRM)
- Atomic Force Microscopy (AFM)

Versatile multimodal integration

Applications

The katana microtome allows for high-resolution visualisation of 3D biological structures, advancing our understanding of cellular mechanisms and tissue functions. This technology is also instrumental in studying the ultrastructure of material samples. Scientists are applying the katana microtome in diverse research areas, including:

- Neuroscience
- Cell biology
- Battery research
- Semiconductor
- Metallurgy
- Polymer science

3D insight from life to materials Science

Get In Touch

Recognised by Nature as one of the "Seven Technologies to Watch in 2023," volume electron microscopy (volume EM) is set to become an essential tool for biologists and materials scientists.

Ready to embark on your volume EM journey with the katana microtome?

Visit us at connectomx.com or reach out by email at hello@connectomx.com.

You can also find us on X: @connectomx3d.

Start your volume EM journey today

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