specification sheet

fast-em
Fast Imaging by Delmic

FAST-EM specifications sheet

Ultra-fast automated multibeam electron microscope

delmic

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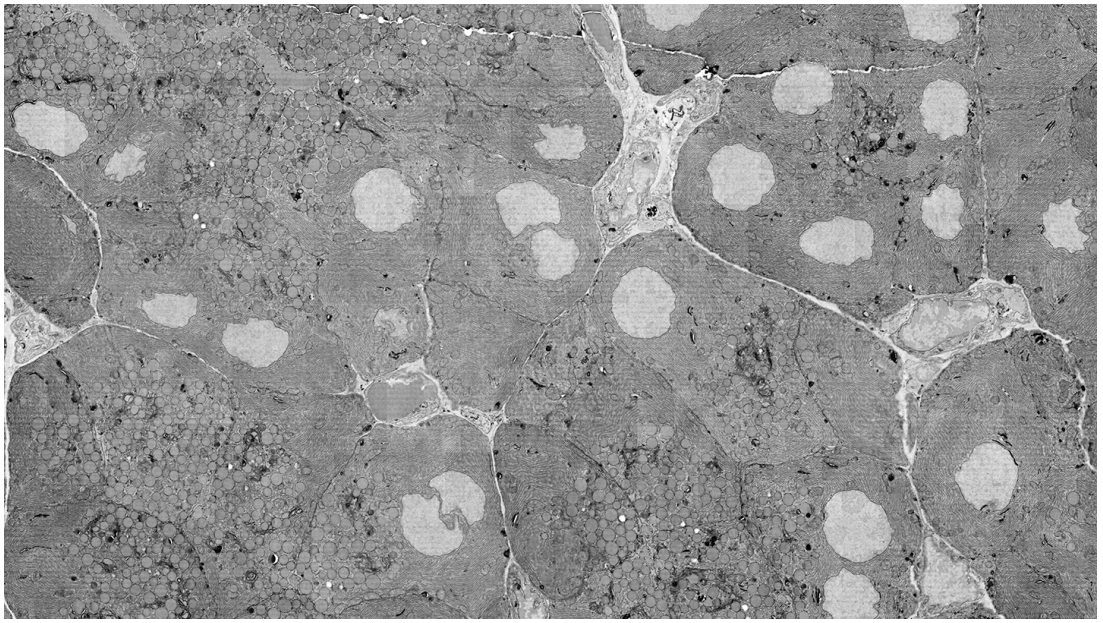
Introduction

FAST-EM is an ultra-fast automated multibeam electron microscope (EM) designed to make complex and large EM projects simple and efficient. Thanks to its automated acquisition, this high-throughput system is ideal for imaging large or multiple samples for quantitative analysis. Delivering powerful insights while keeping the workflows simple, this system allows users to shift their focus from microscope operation to data analysis.

FAST-EM can be used to explore cell architecture, the interaction of neuronal circuits, and the analysis of any biological material. It is extremely beneficial for large volume 3D imaging, large scale 2D imaging and, in general, as a tool that can significantly speed up daily microscopy work.



Key benefits

Image faster

High acquisition speed by using 64 electron beams and short dwell times

Focus on data analysis

Leave the system to automatically acquire complex datasets without constant supervision

Achieve high sustained throughput

Minimize the overhead during imaging with robust automation

Get the details and the big picture

Collect nanoscale detail while retaining larger context of the sample

Workflow at glance

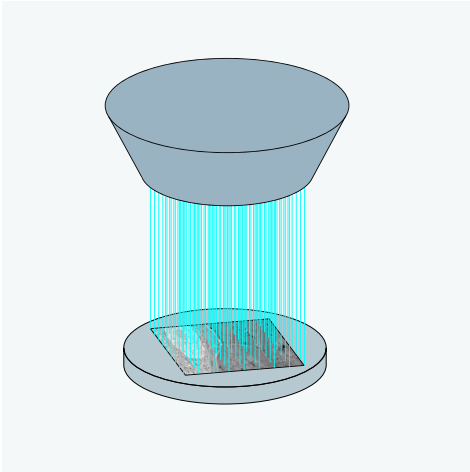
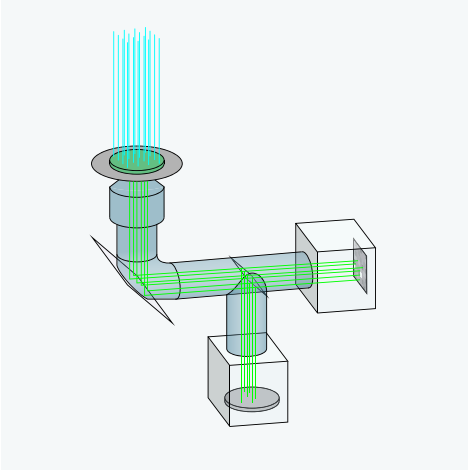


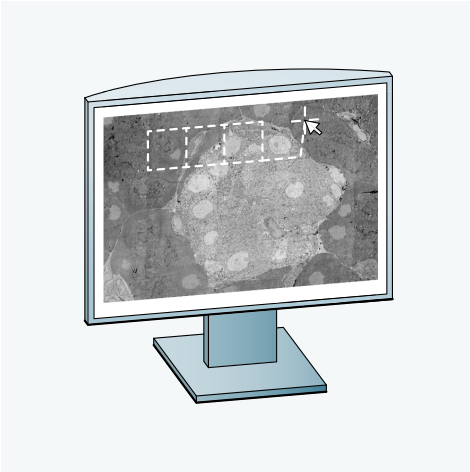
Image with 64 beams

To achieve high-throughput imaging, FAST-EM uses 64 electron beams. These beams are scanned over the sample in parallel, and signals are recorded using a fast and highly sensitive Silicon Photo Multiplier (SiPM) array. This approach achieves significantly higher acquisition speeds.



Enable shorter dwell times

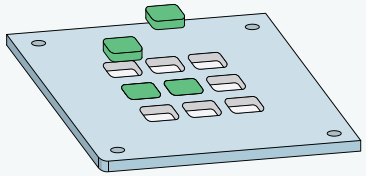
The FAST-EM system uses Scanning Electron Transmission Microscopy (STEM) for image formation. This is achieved by placing samples directly on a scintillator screen. Scintillators produce localized cathodoluminescence when struck by electrons, which is captured using optical microscopy. The resulting light is then detected on the Silicon Photo Multiplier (SiPM) array, and processed to form the final gray-scale image.



Automation software

Projects for FAST-EM are easily created and managed using robust automation and easy-to-use software.

The reliability of the microscope and the software allow the operator to leave the system running without constant babysitting.

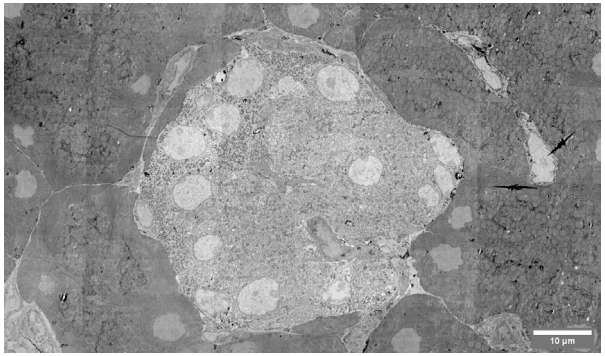


Load multiple samples at once

One of the aspects of EM workflows that introduces overhead into a project is sample exchange, which means that the operator has to supervise the system. FAST-EM allows loading of up to nine substrates at the same time, where each substrate can hold tens or even hundreds of sections. This allows for up to 72 hours of continuous imaging.

System specifications

Electron optics		
System base		Thermo Fisher Scientific Apreo 2
Emitter:		Schottky field emission source
Emitter stability:	Per 24 hours	3%
High tension range:		2.5-10 kV
Beamlet current:		400-800 pA
Total current:		25.6-51.2 nA
Electron beam resolution:	(35-65% edge)	4 nm
Nominal working distance:		5 mm
Single beam mode:		Yes
Scanning and detection		
Multiprobe arrangement:		Square, 8 x 8 array
Beamlets:		64
Dwell time:		400 ns minimum, adjustable
Pixel size:	During field acquisition	4 nm
Field of view:	At 3.2 µm pitch	25.6 x 25.6 um
Detectors	Multibeam	Transmission detector with 64 silicon photomultiplier cells
	Single-beam	Segmented in-lens backscattered electron detector
		Upper in-lens secondary electron detector
Sample and stage		
Type		3 axes motorized (XYZ)
Stage position readout		Laser interferometry for nanometer-level positioning accuracy
Travel range XY		50 × 50 mm
Typical substrate size		14 x 14 mm*
Max simultaneous substrates	When using 14 × 14 mm substrates	9 – for a total of ~850 1*1 mm sections



Resin-embedded rat pancreas tissue imaged in FAST-EM. Sample courtesy of Ben Giepmans' lab (UMC Groningen)

* *Other sizes available*

System specifications

Imaging workflow		
Usable samples	Directly on scintillators	Resin sections (maximum thickness of 150 nm), nanoparticles, vesicles, viruses
	On TEM grids**	Resin sections (maximum thickness of 150 nm), nanoparticles, vesicles, viruses
Unattended run-time		72 hours
Use cases	Routine data collection	Semi-automated imaging of user-defined ROIs and section arrays
Sustained throughput	During megafield acquisition at 400 ns	100 megapixels/second
Data format		One 16-bit TIFF per field image, stored per project
Software		
Microscope control		Linux-based acquisition control
Acquisition support		User guidance for basic operations
System health monitoring		Continuous logging of crucial system features
Automatic calibrations		Detector gain, detector alignment, autostigmation, autofocus, global alignment of components
Vacuum and support hardware		
Vacuum pumps		Turbomolecular pump, scroll pump (backing)
Operational vacuum		≤ 3 × 10^{-5} mbar
Network storage connection		10 Gbit Ethernet (10GBASE-SR using LC Duplex OM3 MM fiber)
Optional components		
High performance storage module		Scalable high-speed storage for data analysis and data sharing
Support Infrastructure		Standalone water chiller
		Acoustic enclosure for backing pump
Consumables		14 × 14 × 0.15 mm scintillator substrates

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** *Requires TEM grid mount*