High Speed and Low Dose Electron Microscopy for King's College, London

A cryo preserved Euglena gracilis, prepared by cryo FIB-SEM tomography, imaged at 25% subsampling.

This case study shows how King's College London used SenseAI software to significantly speed up imaging, reduce the beam dosage (and therefore sample damage), improve contrast and obviate the requirement for a data science or computer science resource.
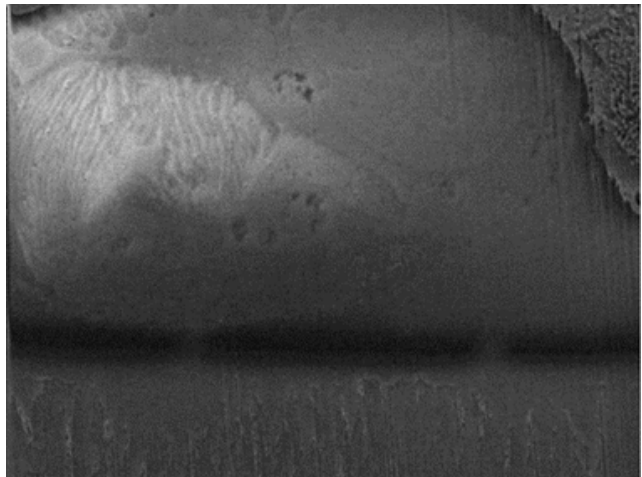
KING'S COLLEGE

The Centre for Ultrastructural Imaging ("CUI") is the central electron microscopy unit at King's College London, one of the most advanced EM hubs in Europe. It has expertise in life science and biological samples using Cryo-FIB (Focused Ion Beam for cryogenically prepared samples). These techniques are difficult to perform and are significantly limited in scope because: the electron beam is likely to melt the frozen samples or otherwise destroy their structure; and the time to acquire datasets is a significant roadblock, with acquisition times typically taking many hours (12-24+).

The CUI was looking for ways to enhance their imaging whilst also reducing the barrier to entry from a cost and skills point of view.

The same image processed by SenseAI software, with reduced charging, reduced electron dose, and reduced acquisition times.

CHALLENGES

- **Complex Materials:** materials are complicated and difficult to image using an electron microscope. Imaging and analysis of these materials takes great care and accuracy.
- **Acquisition Time:** Conventional volume imaging techniques are time-consuming, limiting the pace of research.
- **Beam Damage:** All electron microscopy suffers from beam damage, but this effect is predominantly limiting for the imaging of cryogenically frozen biological materials; the materials are very sensitive and also likely to be melted.

OBJECTIVES

- Implement an advanced electron microscopy imaging control software to improve accuracy and increase acquisition speed.
- Unlock new potential imaging options for users to fine-tune imaging to the specific materials of interest, giving much need flexibility.
- Reduce beam damage to samples.
- Provide researchers with a single platform to streamline imaging workflows.

SOLUTION

SenseAI implemented their EM imaging platform software, which provided fast and low-dose high-resolution imaging for biomaterials using dual beam cryo focused ion beam scanning electron microscopy.

SenseAI's team collaborated closely with the CUI's researchers to understand their requirements and ensure the solution aligned with their research objectives. SenseAI's software seamlessly integrated with the CUI's existing electron microscopy equipment.

Columns 2-4 below are SenseAI reconstructions of Column 1 with a 10x reduction in electron dose and acquisition time.
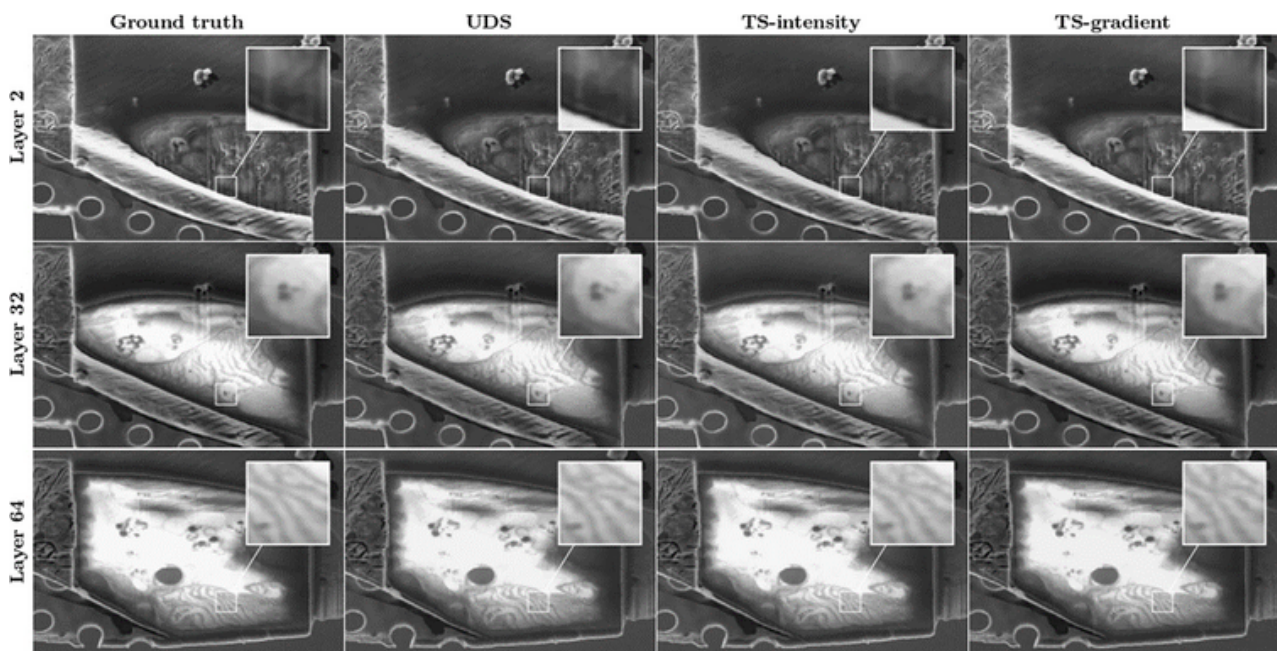
RESULTS

- **Enhanced Imaging Accuracy:** SenseAI's control of the imaging process improved imaging accuracy and enhanced imaging contrast for biological materials.
- **Faster Imaging:** Researchers experienced a 5x speeding up in imaging without any loss in data quality, allowing them to accelerate research timelines and better optimise researchers own schedules.
- **Reduced Damage:** The software significantly reduced electron beam damage and sample devitrification (by 80%), reducing image artefacts and increasing data collection consistency.

ABOUT THE CENTRE FOR ULTRASTRUCTURAL IMAGING (CUI), KING'S COLLEGE LONDON

The Centre for Ultrastructural Imaging is the central electron microscopy unit at King's College London, offering microscope services for both internal and external collaborators from academic, commercial and industrial fields. They are equipped with some of the most advanced electron microscopy equipment in Europe, with leading expertise in specimen preparation and imaging for performing cryo-electron microscopy.

CONCLUSION

By implementing SenseAI, CUI gained far deeper insights into their complex material structures, streamlined imaging workflows, and accelerated research progress.

"SenseAI has made a significant impact on CUI's electron microscopy practice, and we are delighted with the results.

"The quality of the imaging is superior as well as the speeding up and automation. This has helped us to further our ambitious research, to serve our internal and external users, and move the state-of-the-art forward"

PROFESSOR ROLAND FLECK
Director of Centre for Ultrastructural Imaging

SEE SENSEAI IN ACTION EITHER LIVE AT LIVERPOOL UNIVERSITY OR IN AN ONLINE DEMO

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