gVXR qim3d

Qim
Center for Quantification of Imaging Data from MAX IV

CIL
CORE IMAGING LIBRARY

Follow us on LinkedIn:

https://linkedin.com/company/qim-center

Training and Mini-hackathon

LINXS, The Loop, Lund, 10 – 12 Nov, 2026

Franck Vidal, Gemma Fardell, Jakob Sauer Jørgensen & Felipe Matos

DTU

KØBENHAVNS UNIVERSITET

LUND UNIVERSITY

MAX IV

novo nordisk fonden

3D Imaging Centre (3DIM)

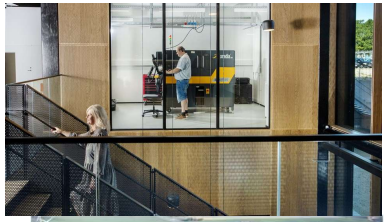
National competence centre for X-ray and neutron imaging

Center for Quantification of Imaging Data from MAX IV

Infrastructures

1. DANFIX (DTU)
2. MAX IV: DanMAX
3. ESS: BEER & ODIN
4. ESRF: Multiscale X-ray source
5. QIM (DTU, KU, LU): Data analysis centre

- Universities







University users

Hard materials (SOLID)
eg minerals and metals

Materials engineering
eg wind turbines and steel structures

Bio-imaging
eg organs, bones and plants

Natural & cultural heritage
eg fossils and museum objects

Research groups collaborating across universities on projects and use of the centre's facilities.

Partnerships

Industry

Hospitals

Museums

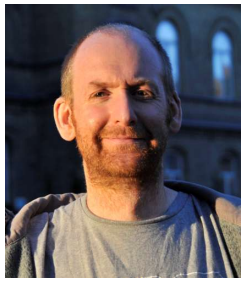
The competence centre supports use and implementation of 3D imaging in development and research of companies, hospitals and museums.

Research | **Innovation** | **Education**

The QIM Center

Management:


Jon Sporring, DIKU


Stephen Hall, Lund


Anders B. Dahl, DTU

Mission:

- Support MAX IV beamlines with data analysis
- Support local imaging facilities
- Ensure that image analysis is not a bottleneck in imaging

Other people involved:



Software:


Felipe Delestro, DTU

Science:


Jakob S. Jørgensen, DTU

Student programmers:


Akira, Christian, David, András


Jeppe, Heather, Sotirios, Víctor

Qim | Center for Quantification of Imaging Data from MAX IV

Imaging pipeline

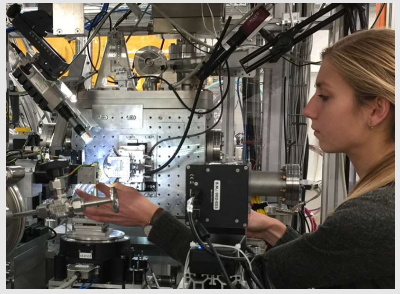
Imaging | Reconstruction | Segmentation | Quantification | Modeling

Sample → Projection data → Image → Label image → Structural information → Physical knowledge

Interpretation

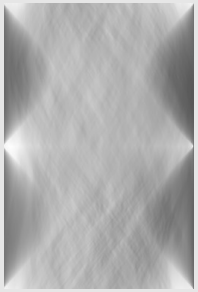
Analysis pipeline

Peripheral nerve Sample



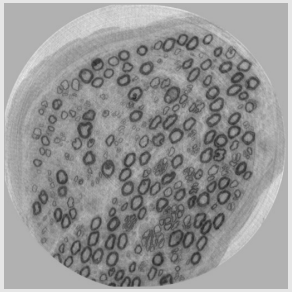
Scanning

Sinogram



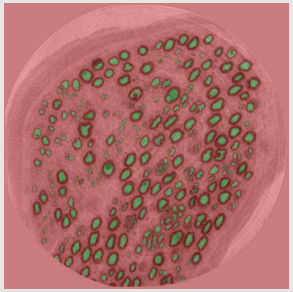
Recon-structing

Tomogram



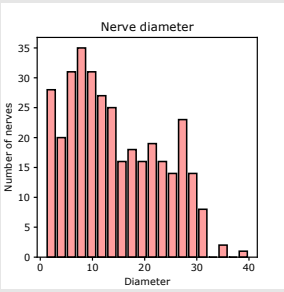
Seg-menting

Segmentation



Quanti-fying

Diameter distribution



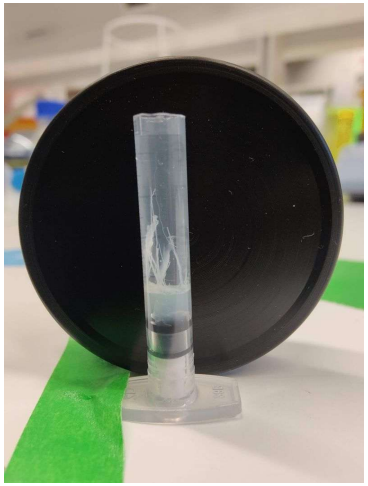
DanMAX beamtime case collaboration



- **Lead: Heather Geha**
- DanMAX beamtime
- Time-lapse CT - Growth of StrontiumPhosphate structures
- Data analysis needs:
  - stitching
  - segmentation
  - tracking
- **Ongoing collaboration with biweekly meetings**

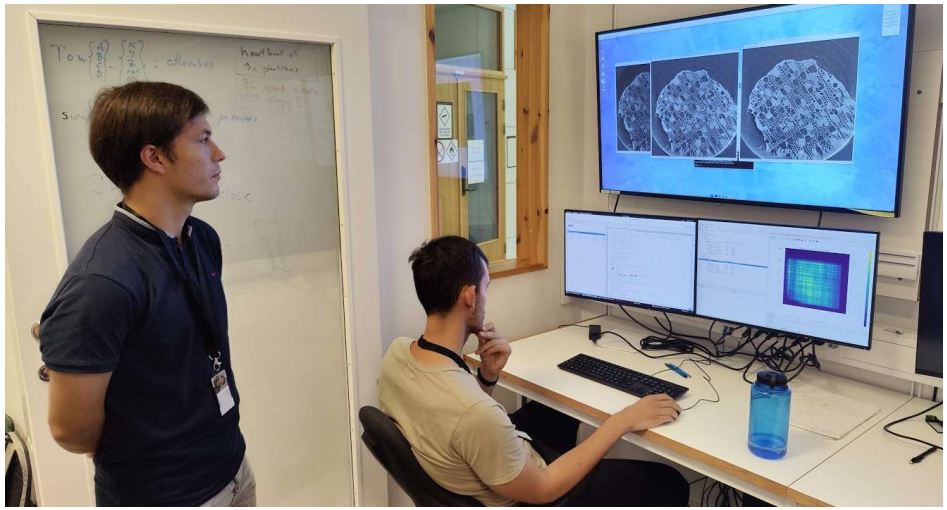








ForMAX beamtime case collaboration







Real-time observation of moisture imbibition and fiber wall compression in wood



Lead: Sotiris Touliopoulos

Prelim results recon+seg poster today

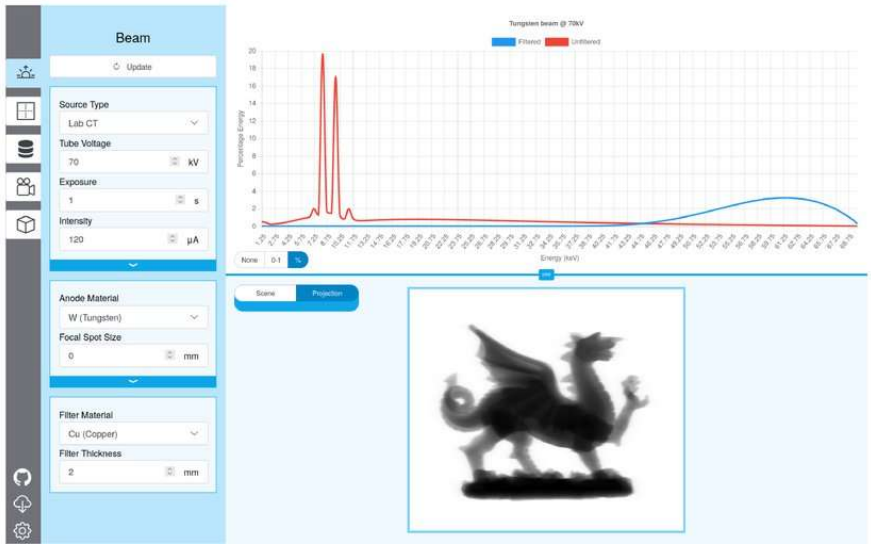
X-ray simulation with gVirtualXray (gVXR)

- Open-source package for GPU enabled virtual x-ray simulation
- Relies on the Beer-Lamber law to simulate x-ray images in real time on a GPU
- Using rasterization over triangular meshes
- Used for a wide range of applications
  - Medical simulations
  - Optimisation problems and machine learning
  - Materials engineering
  - Additive manufacturing
  - Teaching
- Web interface WebCT



gVXR

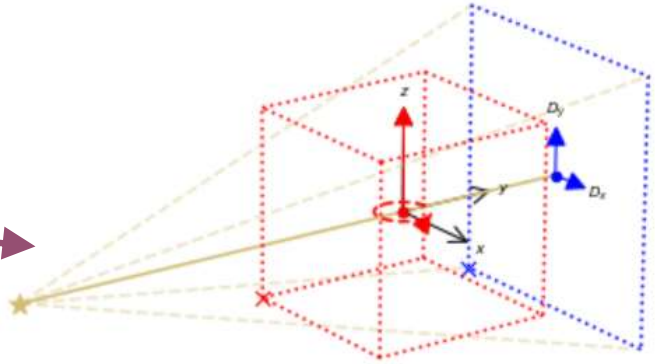




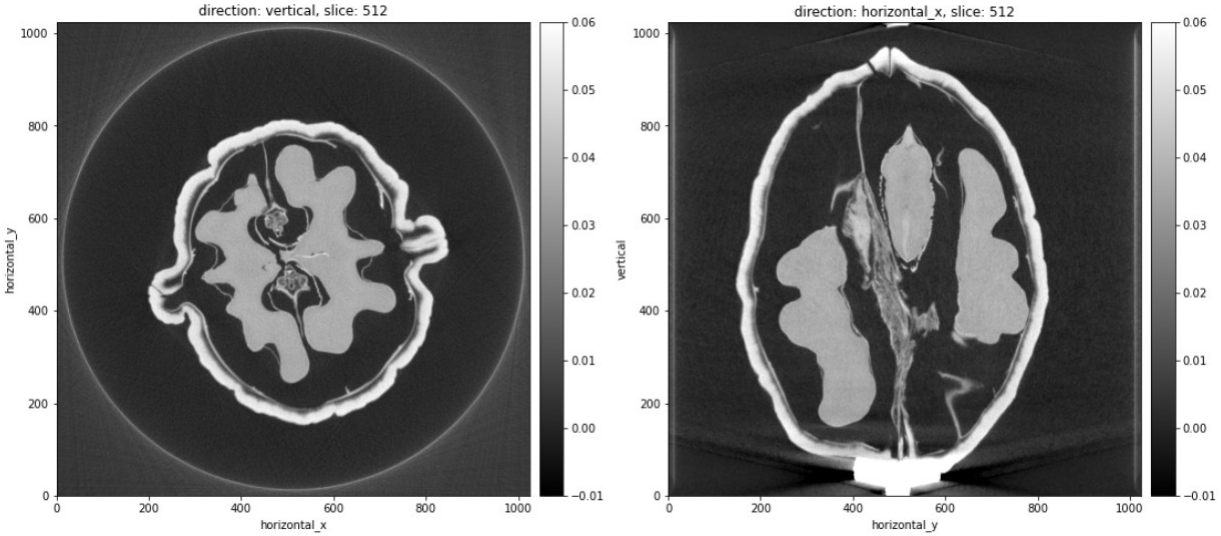
Vidal, *et al.* (2025) *Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms*, ***568***, 165804.

Core Imaging Library for CT and other inverse problems

```
data = ZEISSDataReader(filename).read()
data = TransmissionAbsorptionConverter()(data)
show_geometry(data.geometry)
recon = FDK(data).run()
show2D(recon)
```



- Data readers/writers
- Pre-processing tools
- TIGRE and ASTRA backends
- 2D, 3D, 4D, cone/parallel-beam data
- FBP and iterative recon methods
- Visualisation



ccpi.ac.uk/CIL

CIL
CORE IMAGING LIBRARY

Jørgensen et al. 2021: *Core Imaging Library - Part I: a versatile Python framework for tomographic imaging*, Phil. Trans. R. Soc. A, **379**, 20200193: https://doi.org/10.1098/rsta.2020.0192

What is the Core Imaging Library (CIL)?



- CIL is an open-source Python library for solving **Imaging Inverse Problems**
- Special emphasis on tomography applications with **challenging data sets**: low-count, non-standard geometries, incomplete, multi-channel – multi modal
- **Highly flexible** and modular set of tools for different imaging problems
- **Near-math** specification and solution of **optimization problems**
- **Simple** to get started – **powerful** enough for large, real applications



- Funded by the **C**ollaborative **C**omputational **P**roject in Tomographic **I**maging **(CCPi) + ALC**
- Goals:
  - bring together the imaging community,
  - maximise return on investment in software development and
  - ensure longevity, sustainability and re-use of code.



Phil Withers, Manchester
Bill Lionheart, Manchester
Jakob Jørgensen, DTU
Jay Warnett, Warwick

qim3d Python package

qim3d

Designed for Quantitative Imaging in 3D using Python.

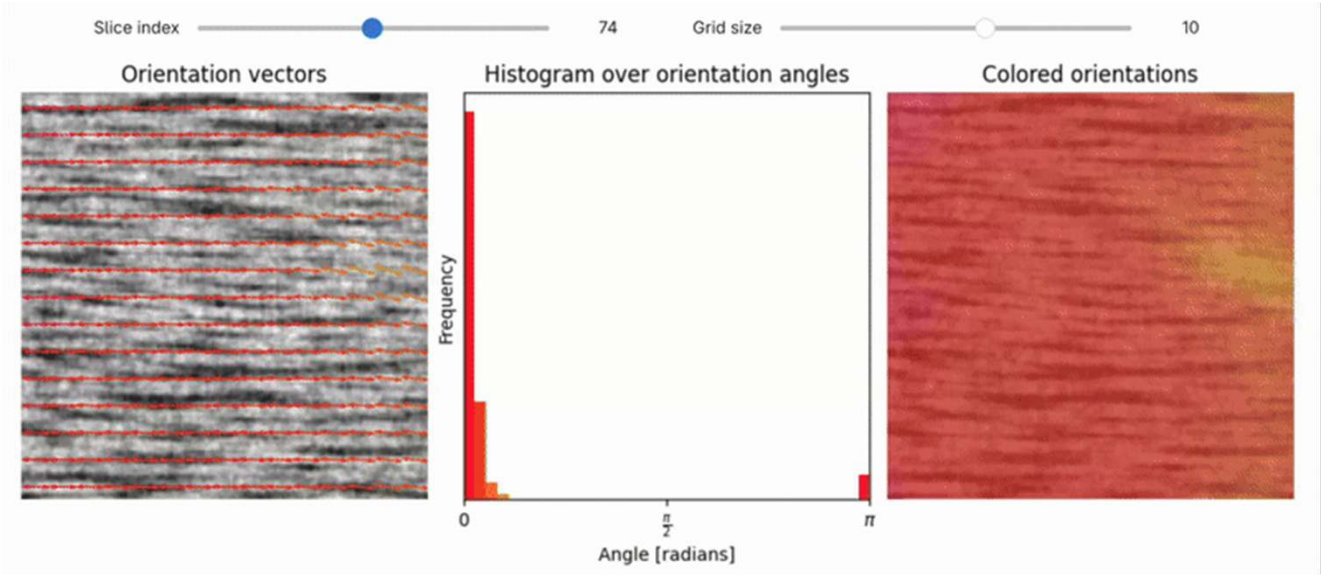
Range of features, including 3D data loading and manipulation, image processing and filtering, data visualization e.g. interactive and 3D rendering, and analysis of imaging results.

https://docs.qim.dk/qim3d/

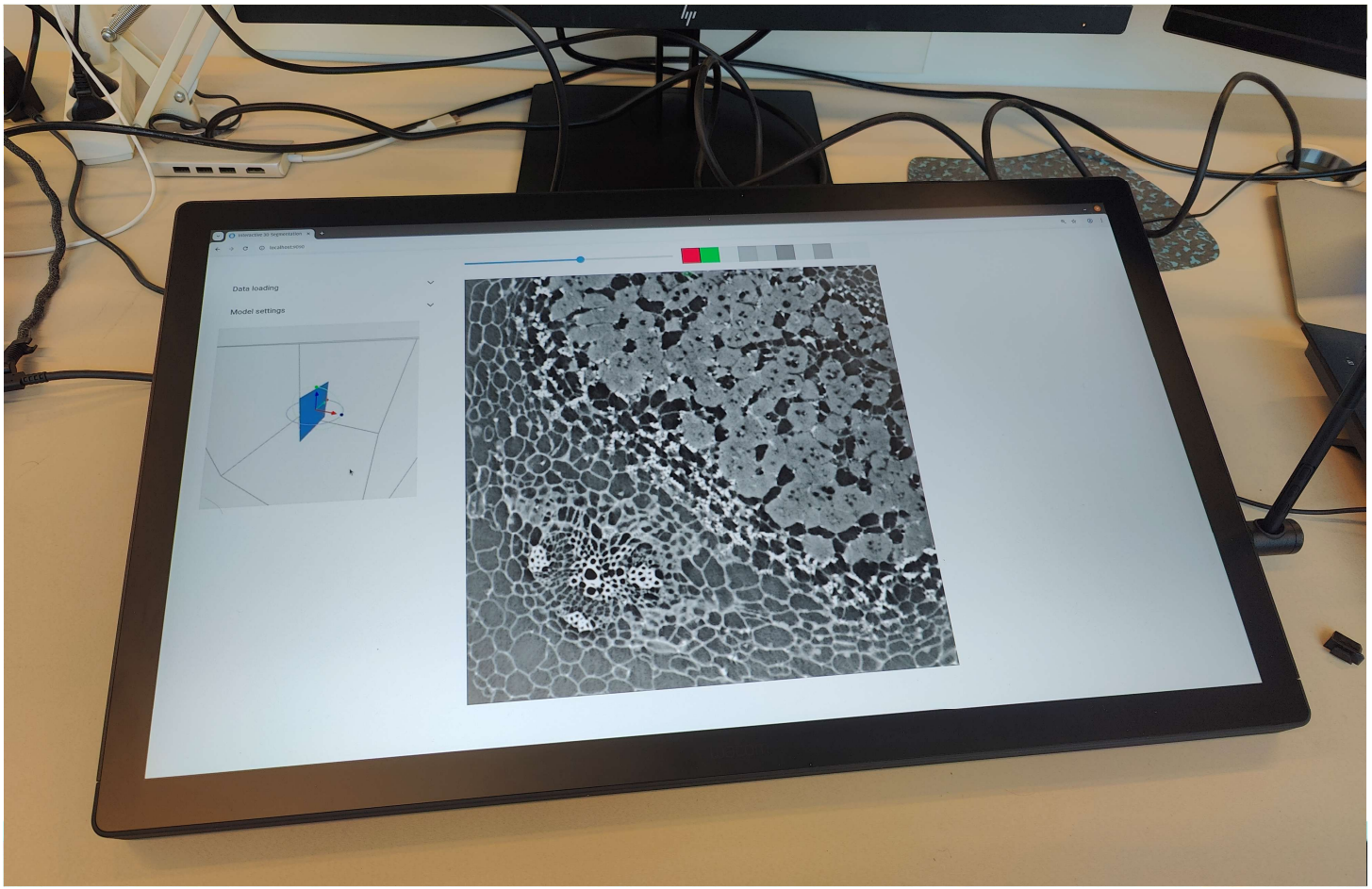
Structure tensor example – glass fibre composite

```
import qim3d

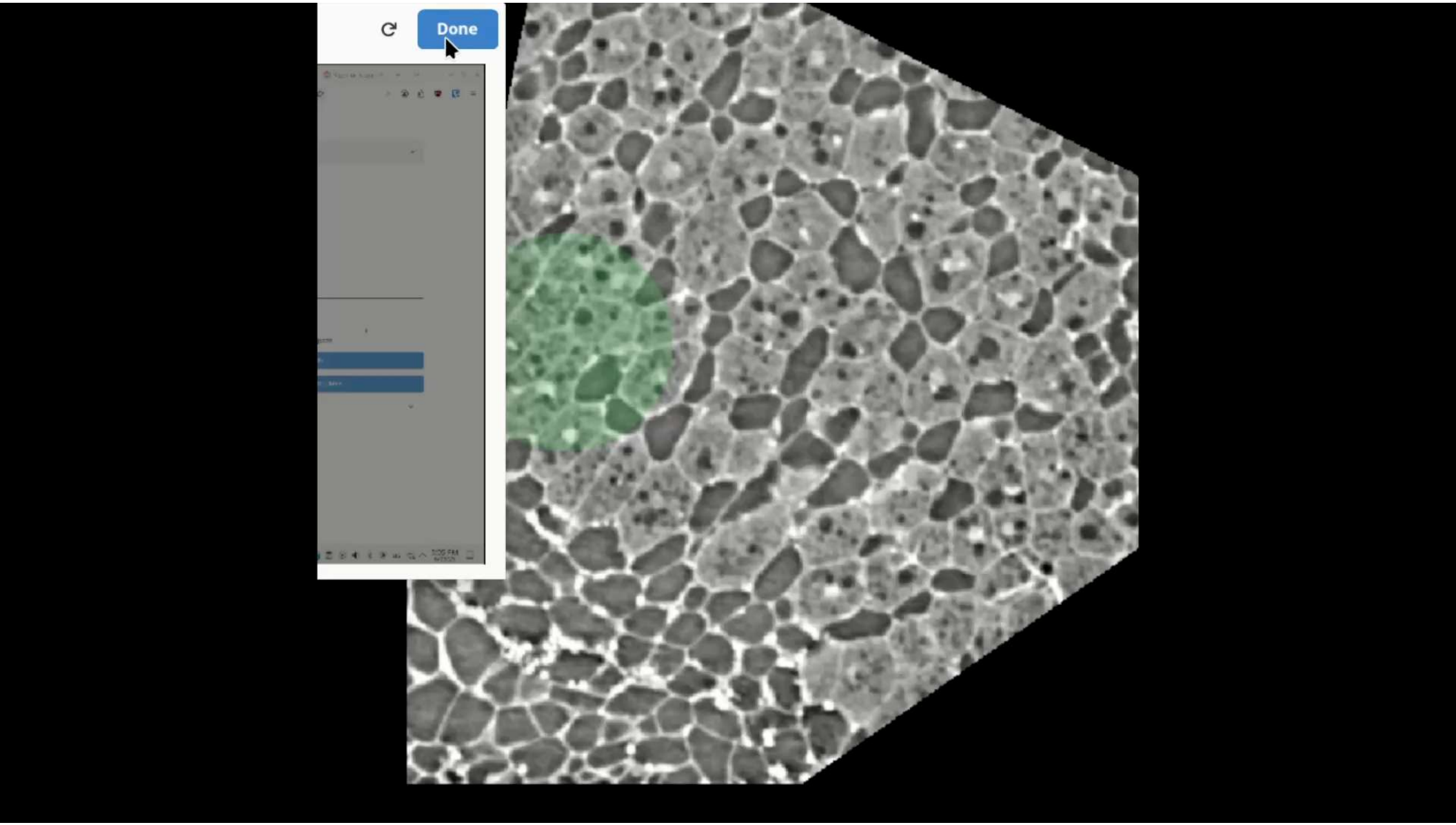
vol = qim3d.examples.fibers_150x150x150
val, vec = qim3d.processing.structure_tensor(vol,
                visualize=True, axis=1)
```



QIM tool example: Insegt3d segmentation






Done

Programme of the day

Tuesday 10 Nov 2026

09:00 Welcome
09:15 gVXR lecture and exercises
10:30 Coffee break
10:50 gVXR continued
12:00 Lunch – **set up posters**
13:00 ESS tour / free time to explore
15:00 Coffee break
15:20 gVXR open-ended
17:00 Posters and Pizza – snacks, soft drinks and pizza provided
19:00 End of programme (help tidying up much appreciated!)

Cloud platform for exercises

Instructions sent by email – let us know if you did not receive.

New cloud provider – first time used today

If difficulties – let’s work together to make the best of it.

Possibly work together in pairs/small groups on single cloud account

ESS Tour today at 13

13:00 here at LINXS: Safety video
13:10 Walk to ESS with guide
13:20 Get PPE – Personal Protection Equipment
13:30 Tour of ESS
14:45 Walk back to LINXS
15:00 Coffee break at LINXS

If you did not sign up, but would like to join – register before 11:00 with Jakob!

Visitors who have undergone a medical treatment involving a radionuclide intake or injection could trigger the radiation portal and will then not be allowed on site.

Visitors must bring their **EU IDs or Passport (recommend)**.

Visitors must wear long trousers and flat shoes.

QIM areas:

- Reconstruction
- Segmentation
- Quantification
- Reproducibility

Center for Quantification of Imaging Data from MAX IV

Follow us on LinkedIn:

https://linkedin.com/company/qim-center

How we can help:

- Software tools: qim3d, CIL, …
- Computational support for facilities and researchers
- Computational infrastructure
- Training events
- Collaborative projects and method research

Contact: info@qim.dk **or direct** jakj@dtu.dk **qim.dk**