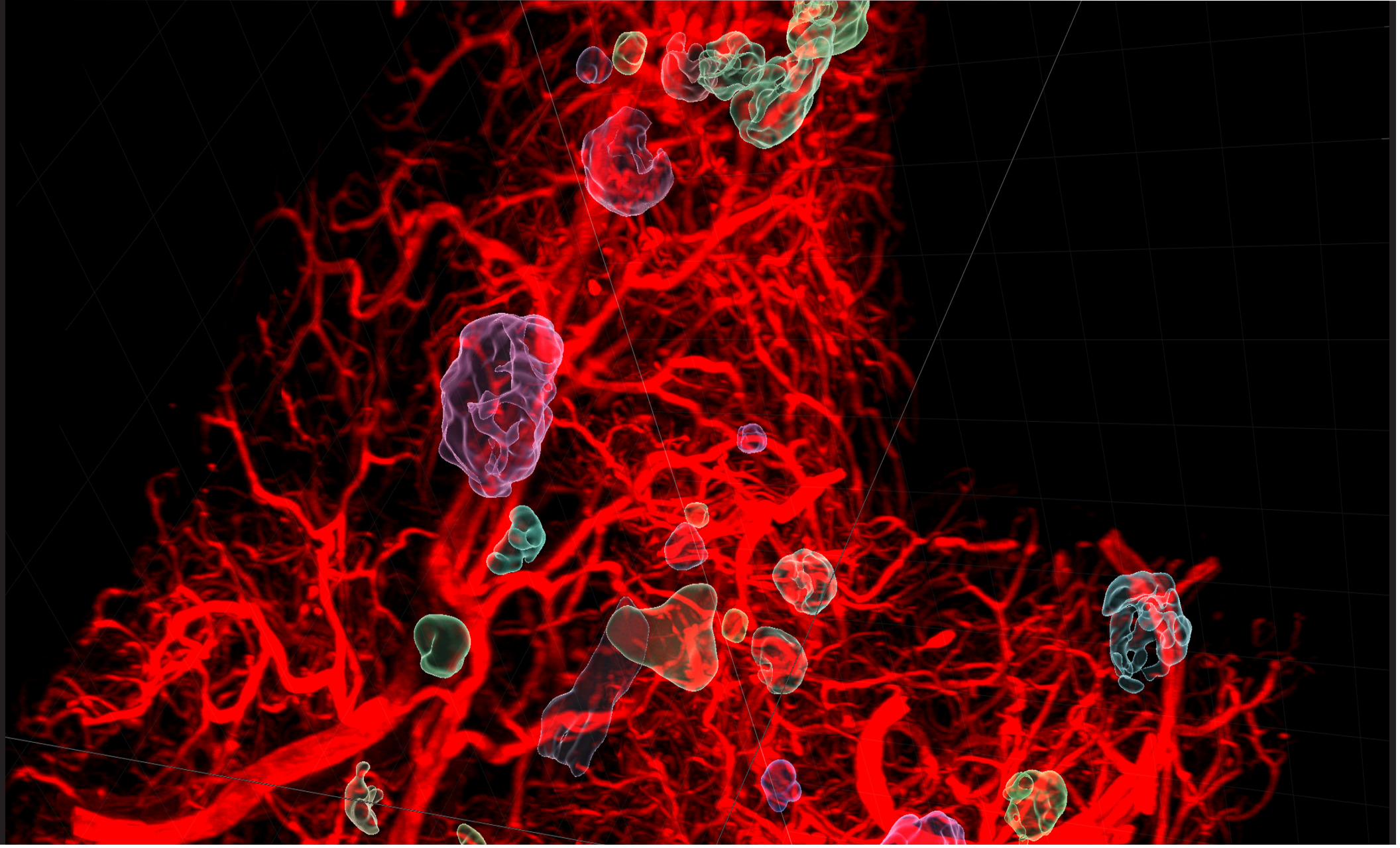
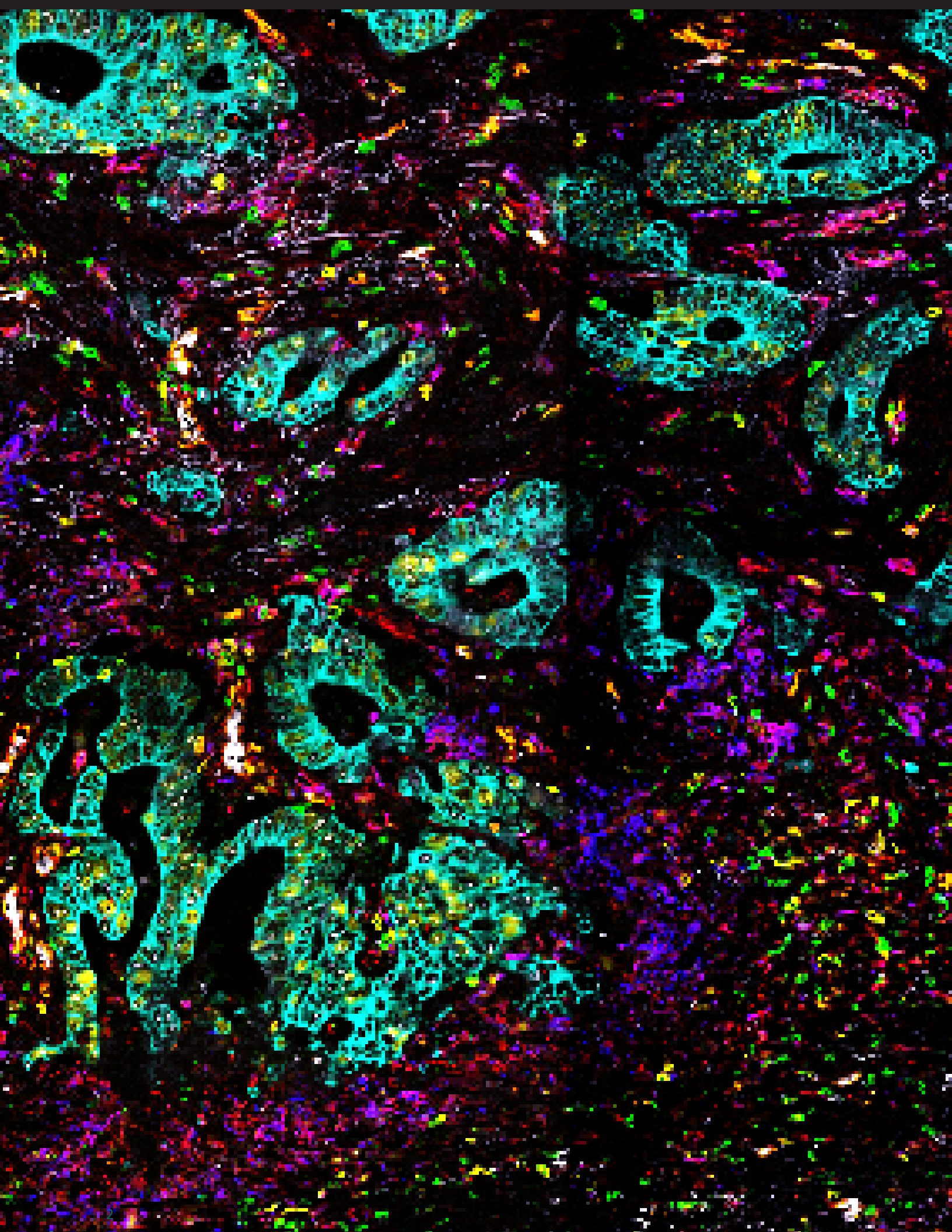
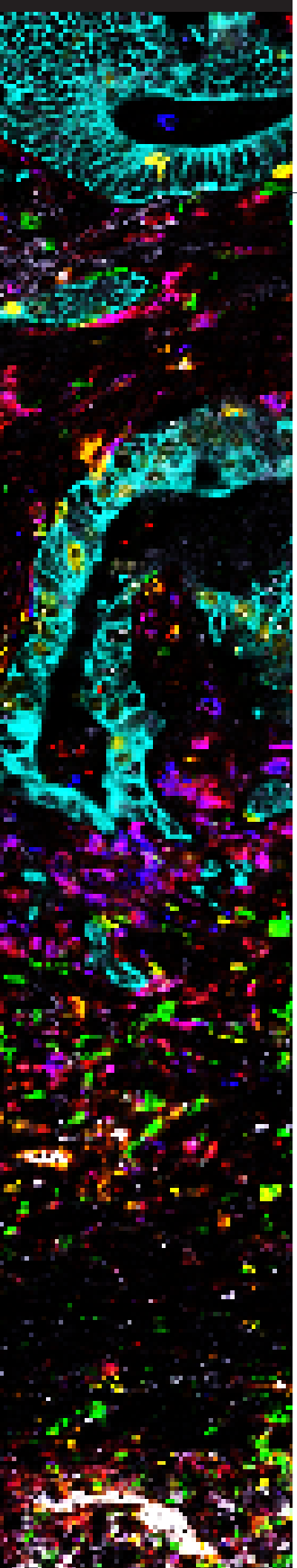


# DANISH BIOIMAGING INFRASTRUCTURE 2024







# DBI-INFRA ANNUAL REPORT 2024
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**COVER IMAGE:** Light sheet microscopy was used for high-speed volumetric imaging of a mouse pancreas. The 3D-rendered maximum intensity projection shows blood vessels (red) and the distribution of GFP-expressing beta cells. The sample was cleared using the EZ Clear method. Sample collected by Clara Prats and Jon Vergara Ucin, tissue clearing and light sheet fluorescence microscopy done by Sunny Dai, and 3D rendering performed by Richard De Mets.
**LEFT IMAGE*:*** Winner of the Danish BioImaging Microscopy Image Contest 2024.
Multiplex staining of colon cancer imaged by Xiang Zheng, NNF Center for Protein Reseach, UCPH.

# FOREWORDS FROM THE DBI-INFRA EXECUTIVE BOARD

> 2024 has been an exiting and busy year for the DBI-INFRA. A year of national consolidation and international recognition. We have defined an ambitious strategic plan towards bioimaging technology excellence and long-term sustainability, and we had the priviledge to be selected among world-class infrastructures to organize and host the CZI Molecule to Human boot camp.
>
> **Clara Prats, DBI-INFRA Director**


The DBI-INFRA Executive Board met at Aarhus University (August 2024) to co-define the DBI-INFRA Strategic Plan towards excellence and long-term sustainability. In the picture, from right to left, Michael Pedersen (Aarhus University), Morten Schallburg Nielsen (Aarhus University), Clara Prats (University of Copenhagen), Chris Dinant (Danish Cancer Institute), Torben Moos (Aalborg University), Jonathan Brewer (University of Southern Denmark), Mathilde Hauge Lerche (Technical University of Denmark), Michael Lisby (University of Copenhagen) and Pia Nyeng (Roskilde University). Not in the photo Jon Sporring (University of Copenhagen) and Anders Dahl (Technical University of Denmark).

# FOREWORDS FROM THE DBI-INFRA EXECUTIVE BOARD

*The DBI-INFRA has successfully implemented a national organization and governance that has brought together eight Danish research institutions with the common mission of strengthening the bioimaging ecosystem in Denmark.*
*Together, we have implemented new bioimaging technologies across Denmark, and created a unique and already internationally recognized image analysis core facility. This report summarizes the implementation status and news across the DBI-INFRA network of core facilities, and highlights some of the key 2024 activities and news.*

*2024 has been a busy year! We have organized and hosted the 7th Danish BioImaging Scientific Symposium, the CZI Molecule to Human boot camp, and Denmark hosted the European Microscopy Conference 2024. Our user base is steadily growing (1,555 users in 2024), our facilities support an increasing number of external users (both cross-institutional visiting academia and commercial users), and DBI-INFRA services have been used over 134,000 hours, contributing to over 150 scientific publications.*

*Finally, we have defined the DBI-INFRA Strategic Plan towards technology excellence and long-term sustainability (2025-2030), which includes four strategic pillars: 1) we need to integrate/connect technology and method development into our facilities, 2) we need to secure stable funds to support excellent open-access bioimaging infrastructures, 3) our services need to be visible and accessible to all bioimaging life science communities, and 4) we need a fund raising strategy aligned with our long-term financial sustainability plan.*

*On behalf of the Executive Board,*

*Clara Prats, DBI-INFRA Director*

# DANISH BIOIMAGING INFRASTRUCTURE

## VISION

“ all Danish life scientists should have access to state of the art bioimaging technologies to innovate and discover

## MISSION

“ To secure a Healthy Bioimaging Technology Ecosystem in Denmark – as an essential pillar of Danish Life sciences

# DBI-INFRA IN NUMBERS

11 Core Facilities, hosted by seven research institutions across Denmark

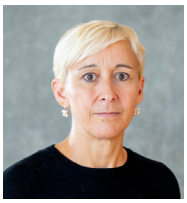
A total of 1.491 users, from which 619 were across institutions, and 43 affiliated to the private sector

Access and activity increase in 2024

12% ↗ in total users
37% ↗ in commercial users
47% ↗ in booked hours

> 164 scientific publications acknowledging access to DBI-INFRA facilities

# DBI-INFRA EXECUTIVE BOARD



Clara Prats
DBI-INFRA Director
EuBI board
University of Copenhagen

Morten S Nielsen
DBI-INFRA Deputy Director
Aarhus University

Torben Moos
Aalborg University

Jonathan Brewer
University of Southern Denmark

Jon Sporring
University of Copenhagen

Pia Nyeng
Roskilde University

Anders B Dahl
Technical University of Denmark

Michael Lisby
University of Copenhagen

Michael Pedersen
EuBI board
Aarhus University

Mathilde H Lerche
Technical University of Denmark

Christoffel Dinant
Danish Cancer Institute

# DBI-INFRA COORDINATOR

Sonia Diaz Houbak
University of Copenhagen

# DBI-INFRA INSTITUTIONAL BOARD

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Vice Dean for Research
University of Aalborg

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Danish Cancer Society | RESEARCH CENTER

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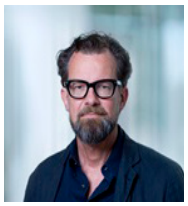

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Technical University of
Denmark

DTU

Susanne Sørensen
Dean of Natural and
Mathematical Sciences
Roskilde University

RUC

Uffe Holmskov
Vice dean for Research and
Innovation
University of Southern
Denmark

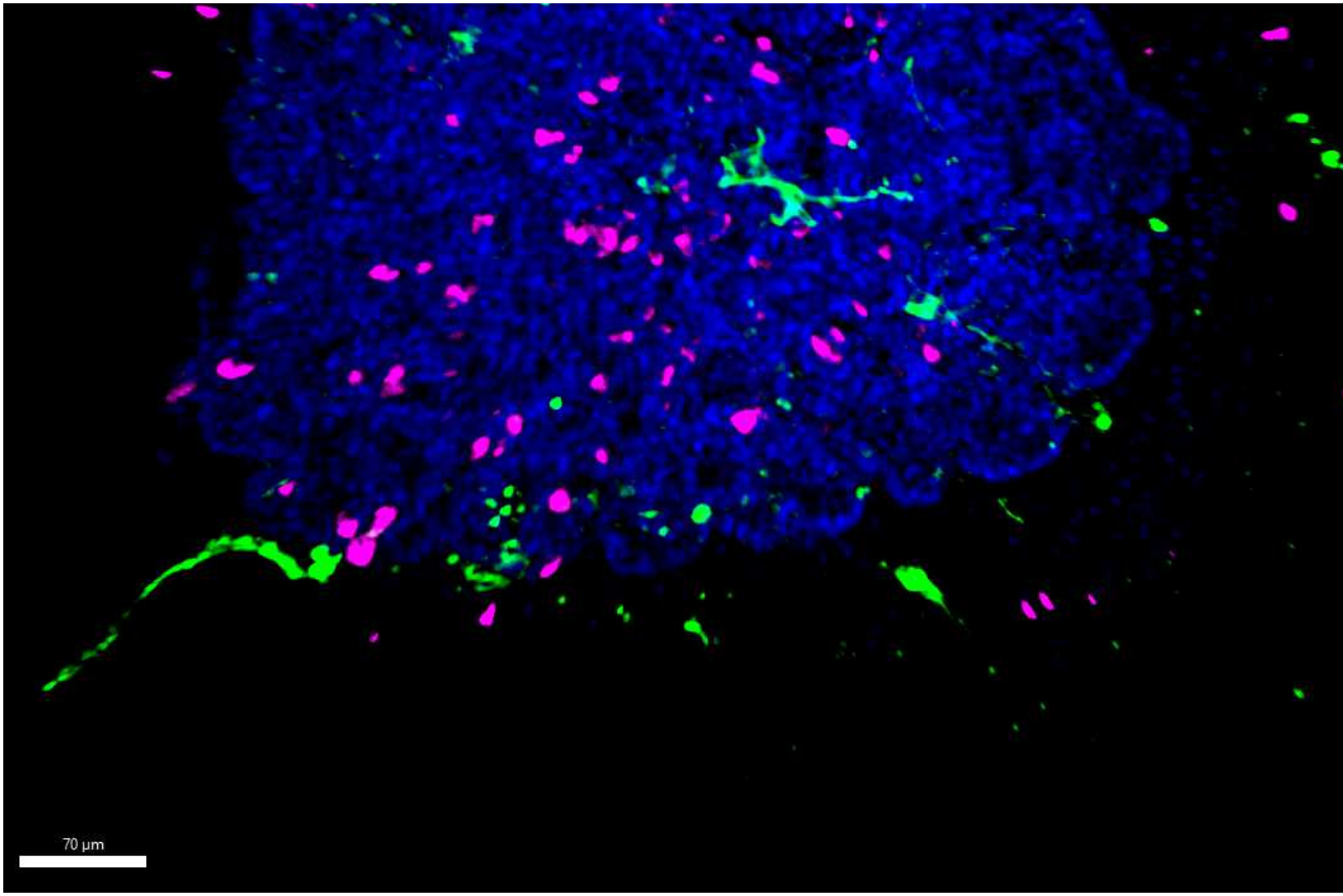
SDU

# DBI-INFRA TECHNOLOGY AND EXPERTISE

Overview of the palette of services, technologies and expertise DBI offers. DBI facilities are hosted by the main universities and surrounded by hilghly competitive research environments in the fields of zoology, pathology, metabolism, neuroscience, plant and yearst biology. To support the research in these fields, DBI offers access to a broad range of bioimaging technologies (dark green boxes), supported by the needed facilities and expertise (light green).

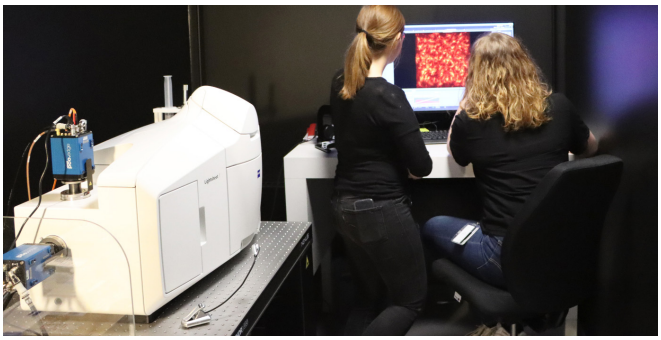
# DBI-INFRA NEWS FROM FACILITIES

- Aarhus BioImaging Core Facility- Aarhus University
- The Preclinical Center at Aarhus University- Aarhus University
- Core Facility of Integrated Microscopy- University of Copenhagen
- Microscope Core Facility at Roskilde University- Roskilde University
- Danish Molecular BioImaging Center- Aalborg University
- Danish Molecular Biomedical Imaging Center- University of Southern Danmark
- Center for Advanced Bioimaging- University of Copenhagen
- The Translational Imaging Center - Technical University of Denmark
- Core Facility for Bioimaging at the Danish Cancer Institute- Danish Cancer Institute
- Center for Quantification of Imaging Data from MAX IV- QIM
- The DBI-INFRA Image Analysis Core Facility



## BIOIMAGING CORE FACILITY - AARHUS UNIVERSITY

Under the implementation of the DBI-INFRA, the Bioimaging Core Facility at the Faculty of Health, Aarhus University has purchased a Carl Zeiss Light Sheet 7, which allows DBI-INFRA users to image large samples live with minimal phototoxicity, or fast imaging of large fixed and cleared samples.



Nina Burmeister, Manager to Bioimaging Core Facility giving suppor to a user.

## CLINICAL MEDICINE IMAGING FACILITY AARHUS UNIVERSITY

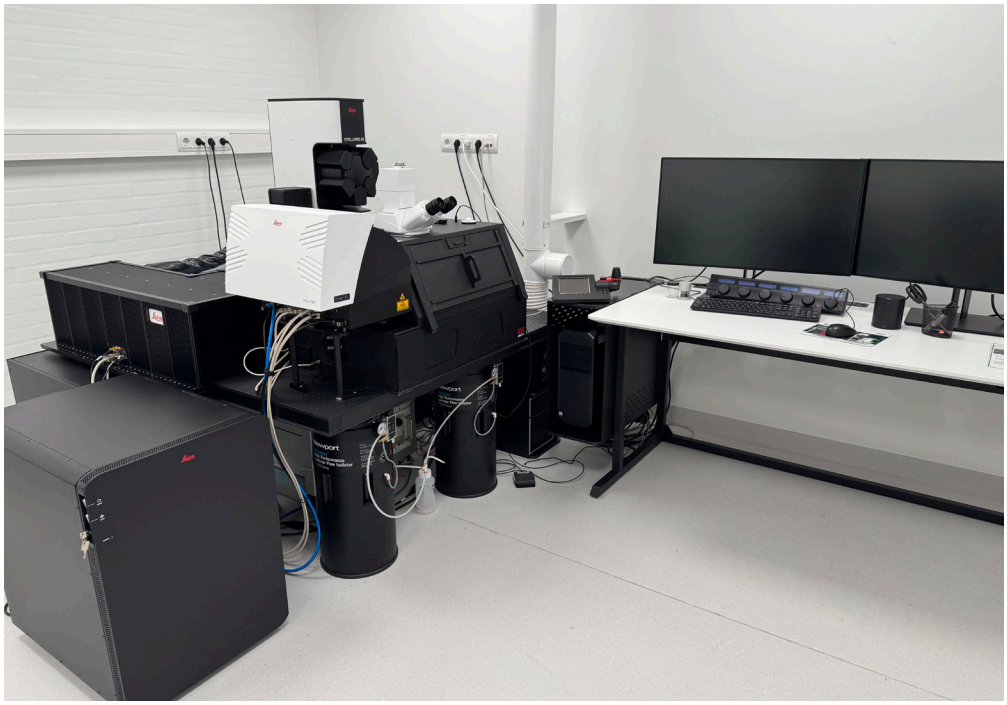
The Preclinical facility, Aarhus University, is located physically at the Aarhus University Hospital. The DBI-INFRA implementation at this site now include 3 technologies: an optical imaging lab, a microCT lab and an ultrasonography imaging lab.

The first, the optical lab, has been built during 2023 as home-built instrument, consisting of 1x laser-speckle contrast imaging system, and 1x optical coherence tomography system. The optical imaging lab is up a running from August 2023, and has been utilized for experimental studies during 2024. The microCT lab consists of a TEScan UniTOM system, and it is up a running from December 2023, and first experiments have been started in 2024. The ultrasonography lab has been established with dedicated rooms, equipped with an VisualSonics 2100 microultrasound system and clinically available ultrasound system. Experiments have been carried on from 2024.

## CORE FACILITY FOR INTEGRATED MICROSCOPY UNIVERSITY OF COPENHAGEN

In 2024, the Core Facility for Integrated Microscopy invested in establishing an intravital imaging core facility for in vivo longitudinal studies.

The Leica Stellaris 8 DIVE FALCON is a multiphoton, confocal, and fluorescence lifetime microscope. Equipped with Leica's most advanced filter-free non-descanned detection technology and a tunable femtosecond pulsed laser up to 1300 nm alongside a fixed line at 1045 nm, it enables the spectral freedom of multichannel fluorescence imaging. Together with the capability of imaging second and third harmonic generation signals, it expands the potential for deep in vivo experiments with label-free imaging. The Stellaris 8 DIVE FALCON is a fully integrated solution for Fluorescence Lifetime Imaging, enabling the investigation of cellular physiology and the exploration of dynamic interactions between proteins



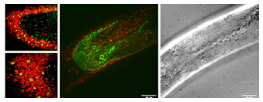
## THE MICROSCOPE CORE FACILITY
## ROSKILDE UNIVERSITY

Research project at RUC

The Olympus LSM FV1200S-IX83 was fully updated for live cell imaging in 2022. Since its upgrade the system has been used for several research projects with live cells and fixed tissues, including projects involving imaging of cancer cells, bacteria, organoids and whole organs.

Our Leica TCS SP5 multiphoton has been updated in 2024 with new computer and software. The multiphoton laser has been repaired. New objectives and filters have been installed, and the system is now fully functional. In conclusion, the equipment has been fully updated as planned, and we will start developing user workflows in January 2025. An Argolight slide and software have been purchased for quality control and calibration of our confocal systems.

## DANISH MOLECULAR BIOIMAGING CENTER
## AALBORG UNIVERSITY



DBI-INFRA has enrolled Aalborg University as a consortium member. It is a goal for Aalborg University to obtain full status as an equipment-funded participant in the DBI-INFRA.

Aalborg University harbors more than twenty research groups publishing research from an outset of morphology approaches. The research includes studies in several models, ranging from simple cellular systems to intact animals. For example, insects and mammalian primary cells cultured in 2D and 3D systems are studied for transport mechanisms using fluidic measures combined with cellular integrity. Small multicellular animals like C. elegans are used to study degeneration and regenerative capabilities of neurons in real time using proteins tagged with fluorescence. Rodent models are used to study blood flow and metabolism using fluorescent tracers. Left, Imaging of brain section using conventional confocal microscopy from mouse subjected to AAV2 viral gene therapy to increase production of NP-C2. Red, NeuN, Green, NP-C2. Yellow, overlapping colors (Rasmussen et al., Fluids Barriers CNS, in press). Middle+Right, Vesicular dis-localization in C.elegans. Middle: Mislocalized CED-1::GFP, caused by apa-2 RNAi in ced-6 mutant background, accumulate in vesicles without the early endosome marker RAB-7::mcherry. Right, corresponding DIC picture. Researchers at Aalborg University intend to achieve a significant upgrade of their infrastructure for microscopy and imaging based morphological analysis. By purchasing and implementing 2-photon imaging technology, studies of cellular interactions, simple networks and vascular branching can be performed not only at highest resolution and imaging depth, but also at high- through-put. The latter, because cellular models, organoids and small animals can be examined in high numbers in microfluidic systems with continuous monitoring of light emission.

# DBI-INFRA NEWS FROM FACILITIES

## DANISH MOLECULAR BIOIMAGING CENTER
## UNIVERSITY OF SOUTHERN DENMARK

### DBI-INFRA has allowed the Danish Molecular Biomedical Imaging Center DaMBIC to purchase a large-fomat Nikon multiphoton microscope

In 2024, DaMBIC saw significant improvements, with the addition of the Nikon Two-Photon Microscope. This advanced tool has rapidly become essential to our operations, logging over 1800 hours of use. It supports a broad range of scientific projects, from enzyme engineering to studies on neurodevelopmental disorders. The Two-Photon Microscope has enhanced our ability to conduct detailed biological research, providing deep insights into cellular and tissue structures

**Jonathan Brewer**
Head of DaMBIC

> "The integration of Nikon AX Confocal/Multiphoton system into our facility has not only increased our research capabilities but also broadened the range of techniques available to our scientists".

In October 2024, Hans Blom, manager of the Advanced Light Microscopy facility in Stockholm, Sweden, visited the Danish Molecular Biomedical Imaging Center (DaMBIC) with support from the BNMI job shadowing program. Read more on BNMI website https://shorturl.at/K7J23

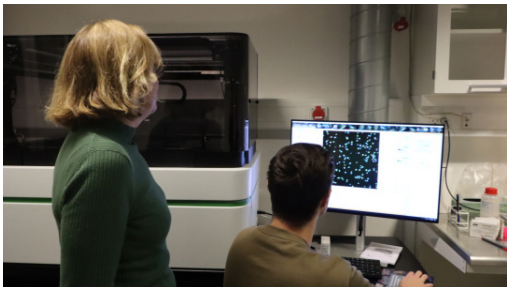
On the Image: Morten Frendø Ebbesen (DanMIC) and Hans Blom share knowledge on how to run the MINFLUX microscope.

## CENTER FOR ADVANCED BIOIMAGING (CAB)
## UNIVERSITY OF COPENHAGEN

Under the DBI-INFRA implementation, CAB has investmented into two new state-of-the art microscopes, the high-content spinning disk microscope and a transmission electron microscope (TEM), the Talos microscope.

**Nynne Christensen**
Center for Advanced Bioimaging (CAB)
Manager.

> "The microscope was installed 16 months ago and currently 19 internal and 4 external users and a biotech company collect data using the system."

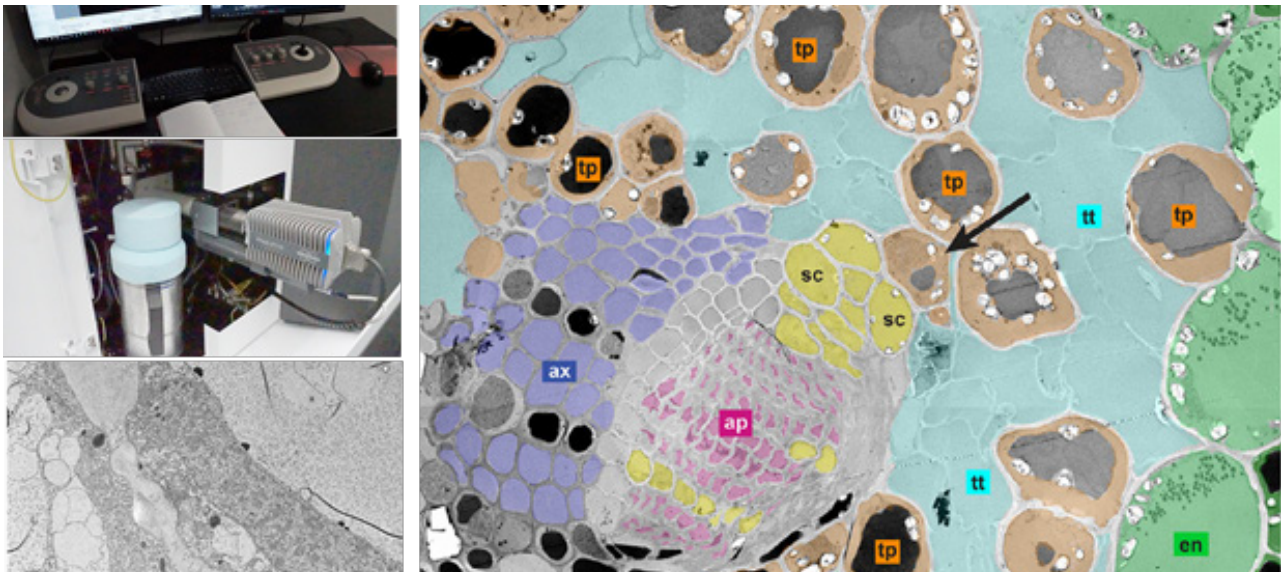


The HCS system is being used to elucidate the key genes and pathways involved in meiotic recombination by conducting a genome-wide yeast screen using a modified version of a yeast gene knock-out library. Using the HSC has been a key component making it possible to gather data and quantitatively analyze morphological phenotypes based upon fluorescent markers, further extending genetic interaction studies.

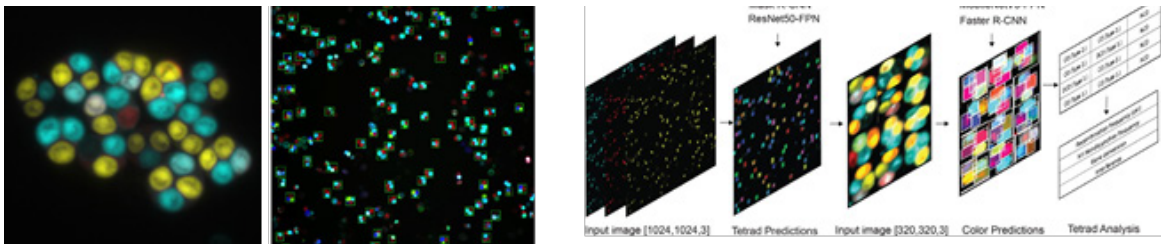
We have developed a custom image analysis pipeline that performs instance segmentation and classification of cells in large volumes of high-resolution microscopy image data (Szücs B, Selvan R, Lisby M. High-throughput classification of S. cerevisiae tetrads using deep learning. Yeast. 2024 Jul;41(7):423-436. doi: 10.1002/yea.3965). The results from this project will help our understanding of meiotic recombination in yeast and humans and will further elucidate the underlying factors behind oocyte aneuploidy and crossover interference.

The system software is continuously upgraded, especially the analysis software to accommodate development within image analysis. Together with Revvity the analysis software has also be tailored to include components that help CAB user groups specific questions. In this way it is now possible to program the system to perform multiple different experiments at specific intervals on the same plate.

In addition, CAB has invested in a state-of-the-art Scanning / Transmission Electron Microscope (TEM). The Talos microscope is fully controlled by software (Pic TEM control); only change of specimen is done manually. In addition to using conventional ultrathin sectioned (see pics Plant organelles and Pine needle vascular cell contacts) or negative contrasted specimens, it enables tomography by tilting the specimen 70 degree in either direction, i.e. 140 degree). Moreover, stitching of large specimen areas is possible (see pic pine vascular tissue. In the scanning mode, a thin electron beam scans the specimen which allows both bright field and darkfield imaging. This mode is of importance for the use of the EDS detector (pics Talos with EDS detector and/or EDS X-ray detector) for analytical microscopy where element spectra are captured and quantified by the X-ray detector. The instrument currently has 10 internal and 2 external researchers that have received training. The stitching function was already important in the cited reference (Pic to the right)




*Left upper images show control panel and X-ray detector. Left lower image shows a cell-to-cell contact in a pine needle. Right image shows vascular tissue of a pine needle from Mai MH, Gao C, Bork PAR, Holbrook NM, Schulz A, Bohr T (2024) Relieving the transfusion tissue traffic jam: a network model of radial transport in conifer needles. New Phytol 244: 2183-2196:*




*Top figure shows images of the Yeast screens, and the image analysis pipeline developed by the DBI-INFRA Image Analysis Core Facility*

## TRANSLATIONAL IMAGING CENTER TECHNICAL UNIVERSITY OF DENMARK

The Translational Imaging Center (TIC) at DTU has made significant advancements in 2024, driven by strategic capital investments and impactful activities across its four sub-facilities.

These achievements have enhanced our ability to support cutting-edge research and foster collaboration with both academic and commercial users. A major highlight of 2024 was the successful completion of our first large-animal (pig) imaging session using the clinical MRI scanner. This marks a significant expansion of TIC's imaging capabilities, bridging the gap between small-animal and large-animal studies. The project has opened new opportunities for preclinical research requiring models closer to human physiology, particularly in cardiovascular, neurology, and transplant research. This achievement has already sparked interest from external collaborators and industry partners, further elevating TIC's profile.

Key milestones include the full operationalization of the Small Animal MicroCT/BLT/FLT sub-facility, which has seen its user base grow steadily over the past year. Similarly, the MRI sub-facility has experienced increased use in education and external collaborations.

The year also marked the delivery of the Small Animal PET-SPECT-CT system, which is undergoing testing and SOP development at a temporary site. Its anticipated integration in 2025 promises transformative multi-modality imaging capabilities. Additionally, the newly launched Ultrasound sub-facility has begun addressing the growing demand for real-time, high-resolution imaging for both internal and external users.
Finally, a significant workforce enhancement was achieved with the addition of a dedicated full-time imaging specialist. This investment has improved user support, service development, and operational efficiency, ensuring that TIC remains a hub for translational imaging and collaborative innovation.

Ultrasound imaging of phantom for teaching purposes.

Large animal (pig) being prepared for imaging in clinical MRI scanner.

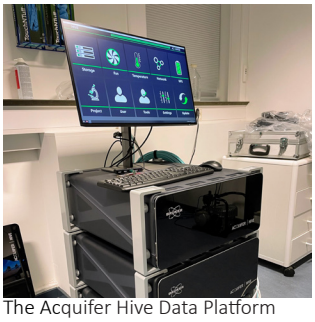
# DBI-INFRA NEWS FROM FACILITIES

## THE CORE FACILITY FOR BIOIMAGING
## DANISH CANCER INSTITUTE

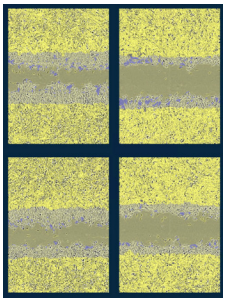
At the Danish Cancer Institute (DCI) we manage 12 bookable imaging systems which are being used by approximately 80 active users. We focus on fluorescence and brightfield microscopy and manage both widefield and confocal systems of different types.

With the implementation of DBI-INFRA in 2022 we acquired a Zeiss Cell Discoverer 7 with LSM900 (CD7) automated high-throughput imaging system. Since its installation in February of 2023, it has been booked an average of 100 hours per week. This makes it the most-used system in our facility, followed by another high-throughput screening system and a spinning disk confocal at 65 hours per week. The CD7 has been a very robust system, not requiring much maintenance even with the amount of use that it has seen.

One of the most pressing challenges that come from so much activity on a high resolution high-throughput imaging system is data processing and storage. To deal with this challenge we purchased an Acquifer HIVE Data platform. This data storage and compute system allows multiple users to perform fast image processing and analysis in parallel. We regularly see concurrent use equivalent of at least 5 regular analysis workstations on this system. We also acquired a Sartorius Incucyte Live-Cell Analysis System. This is an in-incubator imaging system that allows for long-term tracking and analysis of cells with triple-fluorescence colour imaging in multiple concurrent experiments. The system is optimal to studying cell growth, cell death, interaction, wound-healing, 3D cell culture monitoring, drug screening and more.



The Acquifer Hive Data Platform



> "The Incucyte SX5 helps us make more informed decisions about cancer treatments and develop new ways to fight the disease."

**Lina Vardouli**
Lab Manager

# CENTER FOR QUANTIFICATION OF IMAGING DATA FROM MAX IV - TECHNICAL UNIVERSITY OF DENMARK AND UNIVERSITY OF COPENHAGEN (QIM CENTER)

Under the implementation of the DBI-INFRA, the QIM center is developing algorithms for quantitative image analysis and is building an image analysis platform to support bio-imaging analysis.

The DBI INFRA Image Analysis Core Faciliyt and QIM teams regularly meet and share knowledge on challenges and methods when assising users with their image analysis challenges.
The QIM Center is engaged with many national and international facilities and organizations within bioimaging. In 2024 the Center participated in several workshops, seminars, and appearances, including at the MAX IV user meeting, the ESRF user meeting, the Danish Bioimaging Scientific Symposium, the Globias workshops, the Human Organ Atlas Hub meetings, and at LINXS hackathons.
In 2024 the QIM Center was offered as a support option when applying for beamtime at the synchrotron facility in Lund, MAX IV, and is planning recurring workshops for the interested MAX IV users. The Center continues the work on the QIM Platform, an analysis platform and library for 3D images, where data, tools, and computational resources are gathered in one place. The work on dataset creation continues.
In 2024, the QIM Center published a large 3D dataset, BugNIST, and hosted a Kaggle Challenge to engage the Machine Learning community in developing new methods for developing new algorithms for analyzing µCT images.

**https://platform.qim.dk/**

## Links

https://arxiv.org/abs/2304.01838

https://link.springer.com/chapter/10.1007/978-3-031-73411-3_2

https://www.kaggle.com/competitions/bugnist2024fgvc

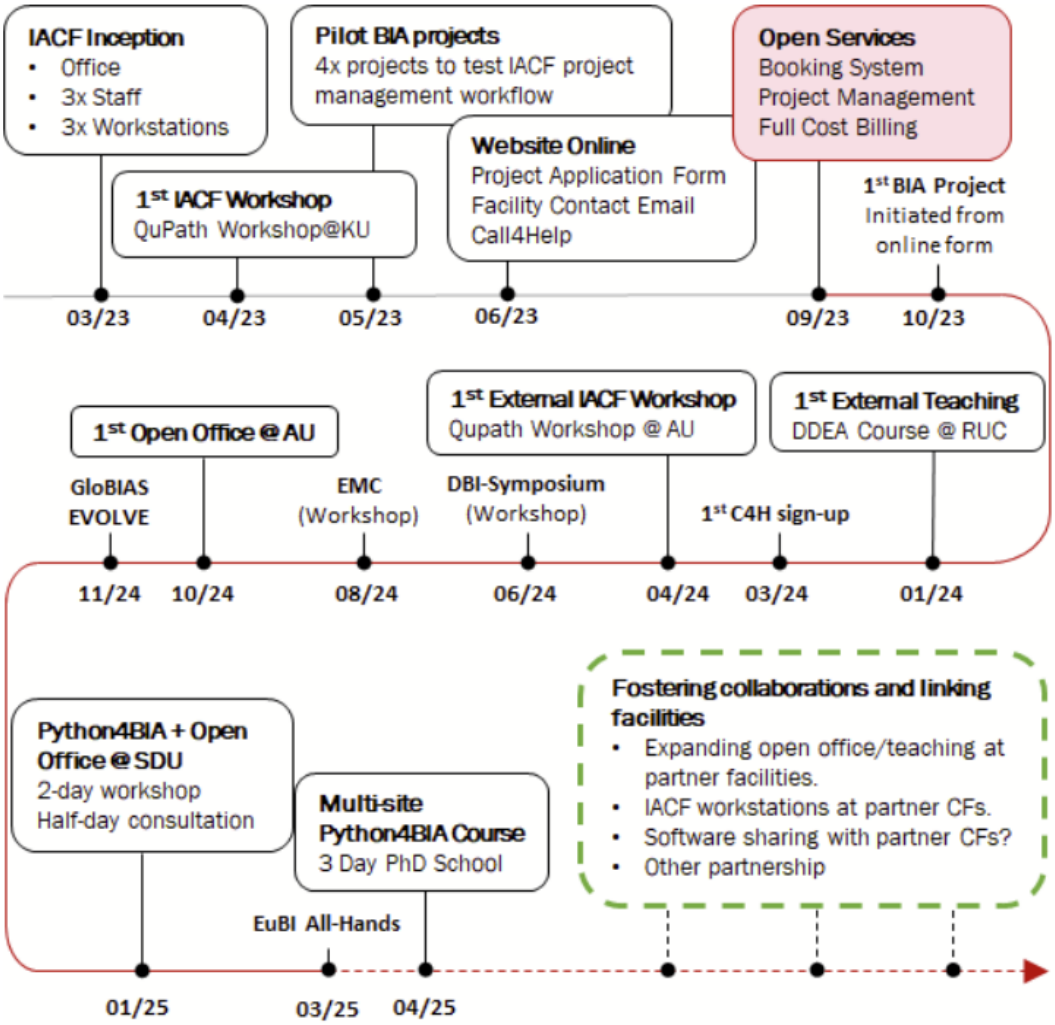
ECCV publication on the BugNIST dataset: BugNIST--a Large Volumetric Dataset for Object Detection under Domain Shift

*In the image, Anders Dahl during a presentation.*

# DBI-INFRA IMAGE ANALYSIS CORE FACILITY

The DBI-INFRA has implemented a nation-wide image analysis core facility (DBI-Infra IACF) to bridge computer and life sciences. The IACF provides open access and remote-ready services to ensure that users at any DBI-INFRA TCF have access to the computing power, software tools, and image analysis expertise needed to extract quality data from their image based data sets. 2024 has been a year of changes at the IACF, with the previous head of the facility, Sébastien Tosi, departing from the team in March. Two new staff members, Julia Mertesdorf and Peidi Xu, joined the team in January and July respectively, bringing the team back up to full capacity and providing complementary skills in deep-learning methods for computer vision and medical image analysis. Despite the temporary reduction of staff capacity, the IACF has continued to grow its services steadily. Since operations began in mid-2023, the facility has served 57 users across academic institutions in Denmark, and (co-)organised 11 training events in both local and international courses and workshops.

In this report, we present the outreach activities and training courses organised by the IACF this past year, and report on our participation in scientific events to build networks and foster collaboration. We also spotlight 4 selected projects in the facility to showcase our recent bioimage analysis services.



# DBI-INFRA IACF TEAM

Need Help with BioImage Analysis? The DBI-INFRA Image Analysis Core Facility (IACF) offers open access to its services from anywhere in the world!. An interdisciplinary team, composed by Tricia Loo, Julia Katharina Mertesdorf and Peidi Xu, is ready to assist you with image analysis consultations and much more.

*The IACF team is composed of Tricia Loo, center in the photo, Julia Katharina Mertesdrof on the right and Peidi Xu on the left.*

## Tricia Loo Yi Jun, BioImage Analyst and Programmer

Tricia Loo Yi Jun has an academic background in biological sciences, and gained proficiency in programming and image analysis while completing her PhD in mechanobiology. During her research, she became involved with bioimage analysis support within her lab, and organised peer-led workshops on this topic. Tricia hopes to continue enabling opportunities for biology, imaging and computing to come together through the IACF's services and infrastructure.

## Julia Katharina Mertesdrof, BioImage Analyst and Programmer

Julia Katharina Mertesdorf (on the right) joined the IACF team in 2024 after completing her master's degree in Computer Science at the University of Freiburg. She specialized in computer vision and self-supervised deep learning methods for image and video representation learning. With a strong interest in applying computational methods to biomedical data, Julia is eager to support life scientists by developing customized workflows and offering training in advanced image analysis techniques.

## Peidi Xu, BioImage Analyst and Programmer

Peidi Xu (on the left) joined the IACF team in July 2024 after completing his PhD in computer science at DIKU (Department of Computer Science, University of Copenhagen) working on modeling of renal blood vessels and simulation of renal blood flow. With a consistent background in computer science and interdisciplinary research in life science during his PhD, he is eager to use his computer skills to help bridge the gap between life and computer science.

# DBI-INFRA IMAGE ANALYSIS CORE FACILITY

The common goal of the IACF services is to help life scientists become autonomous in addressing concrete BIA needs within their research projects, by focusing on three axes: open consultation, skill training, and on-demand software customisation and development. IACF bioimage analysis services have been publicly available since September 1st 2023, and can currently be accessed from the facility's webpage: https://www.dbi-infra.eu/iacf

## OPEN CONSULTATION

The IACF provides free and open consultations through two programmes:

- **Call-For-Help** is a bi-weekly online consultation that anyone can register for from the IACF webpage.
- **Image Analysis Open Office** is a one-day in-person consultation event that the IACF has pioneered in 2024 as part of its outreach program. This event, which can be held at any DBI-INFRA TCF, allows for users to get an in-person consultation with IACF staff that may otherwise be inconvenient for them to travel to.

In both cases, open consultations mean that they take place in a publicly accessible space, such that others interested in learning about the BIA problem being discussed may attend as members of the audience. The outcomes of the consultations are to provide useful advice in-terms of analysis strategies, techniques and tools that can be applied to the problem, or relevant resources for the asker. The consultation may then lead into user registration for on-demand software training, or custom software development for more unique problems.

## SKILL TRAINING

On October 9th, 2024 the IACF conducted the first pilot Open Office Consultation at the BioImaging Core Facility at Aarhus University. This outreach activity aimed to extend IACF's in-person services to other bioimaging nodes in Denmark and increase awareness of the support offerings. These consultations were organized by topic and open to all, allowing participants to share and learn from one another's challenges and suggested solutions. During each session, participants briefly presented their biological research, past methods and analysis approaches and current challenges. The IACF team provided tailored advice on bioimage analysis strategies and suitable software tools to address the challenges.The event received positive feedback from the Aarhus bioimaging team and participants; several attendees expressed interest in follow-up consultations, software training and potential project collaborations. Requests for a second Open Office have already been made and in response, this format was repeated in January 2025 at the University of Southern Denmark in Odense, in conjunction with a Python4BIA workshop. The IACF team aims to expand these open consultations to other bioimaging facilities across Denmark in 2025.

## SKILL TRAINING

The IACF regularly conducts focused workshops (1-2 days) targeting either specific BIA techniques or software tools, that aims to get participants familiar and ready to apply the skills learnt in their research. For students interested in learning bioimage analysis from the ground-up, the IACF organises PhD training schools (~5 days) to cover theoretical underpinnings, introductory programming, the standard usage of BIA tools and best-practices in documenting and publishing BIA research. The course includes hands-on sessions, group projects and supervised sessions where students work on their own images.

The facility also provides on-demand training in requested software, from open source tools to commercial programmes available at the IACF. Training sessions are customised to the unique needs of each project, along with advice on how to best address the user's research goals.

On-Demand Software Customisation and Development
When pre-existing BIA solutions are not readily available, or do not work easily out-of-the-box, the IACF provides on-demand software customisation to build specialised workflows for the user. Users are provided with code documentation and instructions along with the code. They are then are instructed by the IACF staff on how to use the resulting tool independently during training sessions.


Images above:
The one-day QuPath workshop held in April 2024 and hosted by the Bioimaging Core Facility at Aarhus UnIversity. A hands-on workshop tailored for life scientists and bioimaging facility staff to learn how to quantify histology and multiplexing images

# DBI-INFRA IMAGE ANALYSIS CORE FACILITY

## IMAGE ANALYSIS SERVICE PROVISION

In addition to the above services, the IACF also has infrastructure to address the hardware or software needs of life scientists, and provides personal training/support to help them become independent users. The IACF has three dedicated image analysis workstations for user access, each equipped with AMD Ryxen 9 7950X 16-Core processors, 128GB RAM and GeForce RTX 4090 graphics card. All workstations run the same disk image and come equipped with a software stack including programming scripts developed by the IACF and compatible runtime packages.
The IACF is physically located at the DBI-INFRA Hub (UCPH Faculty of Health and Medical Sciences), but its services are accessible from anywhere. Together with the IT department at UCPH, the IACF team has set up a local network to which it can add new workstations and flexibly grant access to registered users. Workstations and personal training/support from staff can be booked autonomously by registered users from the IACF booking system (https://unicop.agendoscience.com). All workstations and training/support sessions can be accessed in-person, or remotely through VPN connection and video conferencing.

## PROJECT MANAGEMENT, OPEN SCIENCE AND FAIR IMAGE-BASED DATA SHARING

Documents generated by the IACF are organised on Notion databases to simplify project management and enable efficient communications within the facility. Shared project documents, accessible by both users and facility staff, are created on Google Docs to align expectations with researchers, and record all project requests, progress, and changes. To further streamline project management, the IACF makes use of custom automations (via Notion, Make and Google App Scripts) to link user registration forms with project document creation (Tally), automate emailing and bookings (Agendo, GCal), and update users on project document changes via email notifications. To promote best practices in scientific reproducibility, the IACF is committed to sharing relevant developed scripts and tools alongside detailed documentation with our Github workspace, including representative sample data, compatible parameters, and the specification of runtime environments. The IACF is also exploring emerging solutions for BIA workflow management such as Nextflow or Galaxy; or advanced solutions such as publishing workflows in HPC-backed workflow management systems such as DeiC UCloud.
Finally, the facility collaborates with DeiC and Euro-Bioimaging to steer and promote the development of national and international FAIR image-based repositories. These repositories may also be used as data sources by the workflows packaged in the aforementioned WMS to ensure the highest reproducibility standards.

# DBI-INFRA IMAGE ANALYSIS CORE FACILITY

## ACTIVITIES AND SERVICE PROMOTION

The DBI-INFRA IACF has actively promote its infrastructure and services through the DBI-INFRA social media channels, posters hanged in strategic locations, live talks/posters, and as (co-)organizers of the following events.

### Scientific and Professional Meetings

- QIM Workshop: Human Perception and Advanced Visualization of 3D Medical Imaging Data, UCPH
- 3rd Bridging Nordic Microscopy Infrastructure Symposium, Geilo, Norway
- BIO Conference 2024, University of Copenhagen, Department of BIology
- Microscopy data analysis: Machine Learning and the BioImage Archive, EMBL, [Virtual Event]
- Danish BioImaging Scientific Symposium and Stakeholder Meeting, Copenhagen University, Denmark
- I2K: From Images to Knowledge Conference, Human Technopole, Milan, Italy
- Virtual I2K: Online Tutorials on Image Analysis, Virtual Event
- GloBIAS Bioimage Analysts Workshop, Conference Centre Wallenberg, Gothenburg, Sweden
- Euro-BioImaging Cross-Node Job Shadowing (11-15/11/2024, Bioimage Informatics Facility, Sweden)
- Crick BioImage Analysis Symposium, The Francis Crick Institute, London [Virtual Attendance]
- QIM Workshop:Advancing Medical Imaging- Integrating AI&Data Sharing for the Human Organ Atlas Hub, DTU

### Courses and Workshops

(co-)organised by the IACF)

- Quantitative 3D BioImaging PhD Course (co-organised 2 of 5 days), Roskilde University
- Python for BioImage Analysis, University of Copenhagen (UCPH)
- QuPath Workshop, Aarhus University
- Image Analysis PhD School, co-organized with the Core Facility for Integrated Microscopy (CFIM)
- Image To Data with Cellpose Segmentation, Danish BioImaging Scientific Symposium 2024, UCPH
- AI in Microscopy, European Microscopy Congress (EMC) Pre-Conference Workshop, Copenhagen
- Introduction in Image analysis for Life science (co-organised 1 of 5 days), University of Gothenburg
- Quantitative Imaging in Chromosome Biology PhD Course (co-organised 1 of 5 days), BRIC, UCPH
- Molecules To Human Bootcamp (co-organised 3 of 10 days), UCPH
- CellProfiler Demonstration at the BRIC Microscopy Interest Group, UCPH

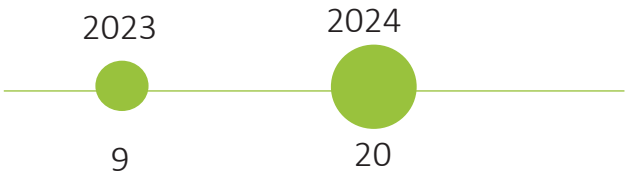
# DBI-INFRA IMAGE ANALYSIS CORE FACILITY

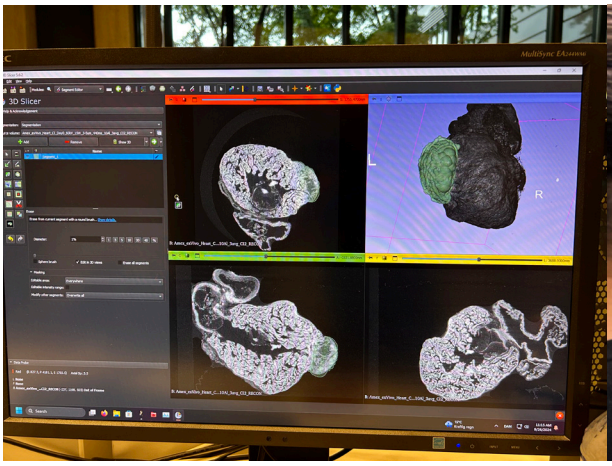
## ACTIVITIES AND SERVICE PROMOTION

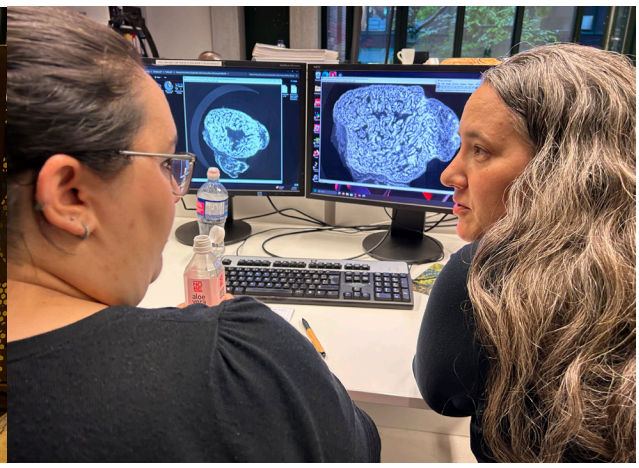
In 2024, the IACF worked on reaching out to DBI-INFRA nodes across Denmark and forging interdisciplinary connections. The team brought its well-rated workshops and courses to three node locations in Denmark (Roskilde University, Aarhus University, and the University of Copenhagen), as part of its outreach and education mission. The team has also initiated in-person consultations events at other nodes, to lower the barrier of entry for researchers seeking to address their BIA needs.

One of the main strategic goals for the creation of the DBI-INFRA IACF is to bridge the professional gap between bioimaging life scientists, and computer scientists developing new image analysis tools and software. The IACF team regularly joins in QIM (DIKU and DTU) workshops and monthly working group meetings where state-of-the-art developments are discussed. The facility staff also engages with researchers at the DIKU IMAGE section, participating in their symposiums to stay tuned on current research in both biomedical and natural image processing.

Image Analysis Core Facility
Number of Activities



## PILOT AND ONGOING IMAGE ANALYSIS PROJECTS

### Comparison of phosphor-alpha-synuclein+ (pSyn+) protein aggregates in Olig2+ oligodendrocytes v.s. non-oligodendrocytes

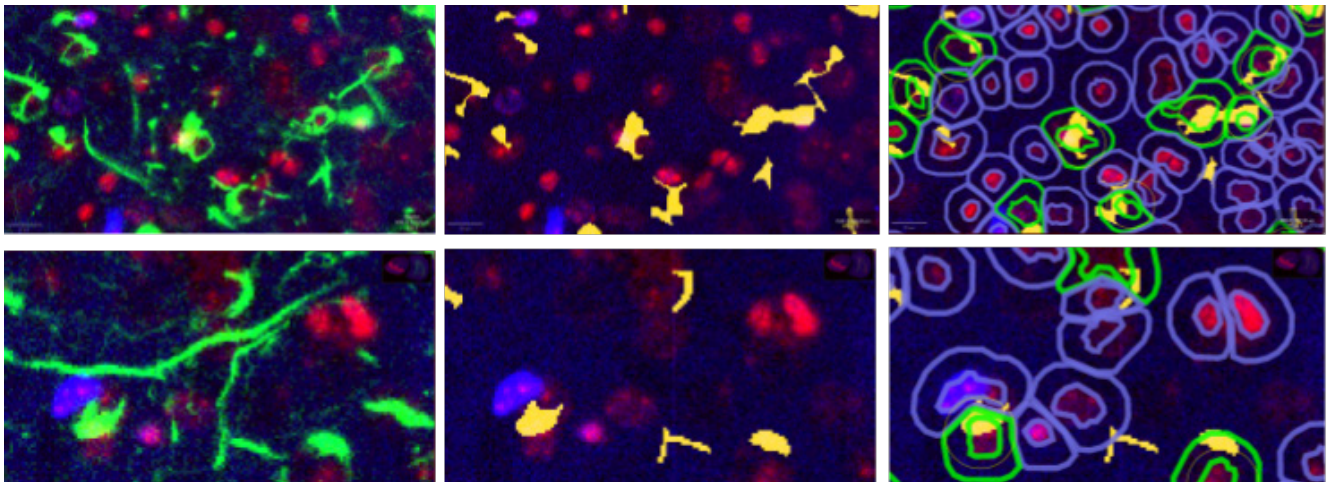
*This project studies the effects human pre-formed fibrils on Parkinson-like disease*

Collaboration: A. Strange Laursen
Centre for Neuroscience & Stereology, Bispebjerg Hospital, Region H

Context and Goal: To analyze if the injection of human pre-formed fibrils (alpha-synuclein) in transgenic mice overexpressing human alpha-synuclein in oligodendrocytes leads to an increased fraction of phosphor-alpha-synuclein+ (pSyn+) protein aggregates in Olig2+ oligodendrocytes compared to non-oligodendrocytes.

Method: Development of a multi-component pipeline in Qupath with macro programming in ImageJ. Briefly, the steps include

1. Thresholding the pSyn channel with certain filters.
2. Analyze thresholded pSyn particles and filter out objects with certain aspect ratios to keep only the ones that are either roundish or wrapping structures.
3. Cell detections
4. Cell classifications for PSysn+ and PSyn- based on the kept threshold pSyns from step 2



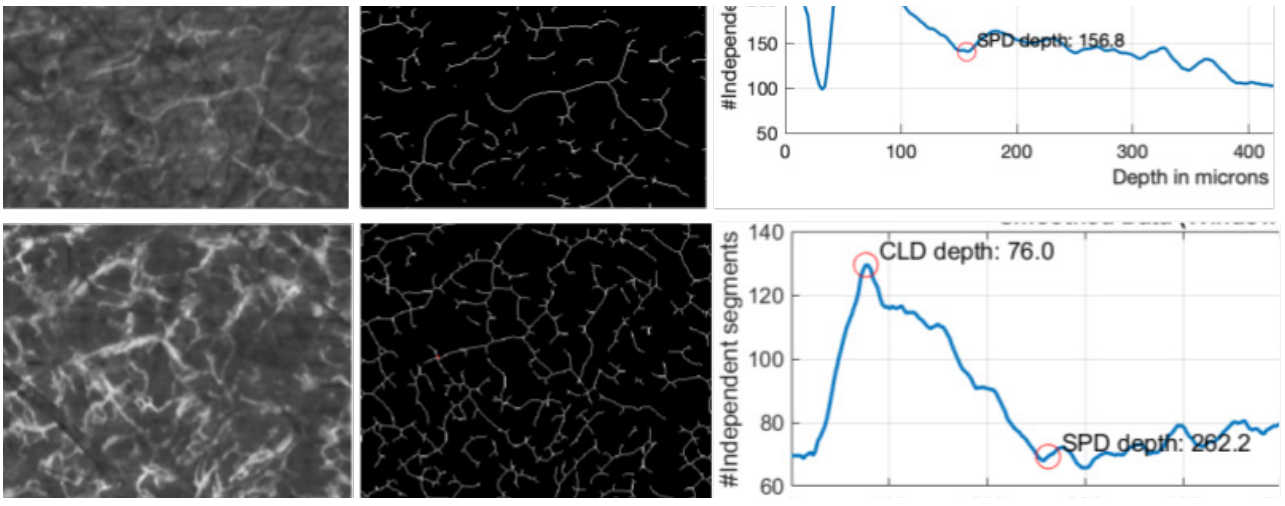
# Automated analysis of blood vessel morphology using angiographic optical coherence tomography

**This study investigates the correlation between quantitative imaging measures, such as vascular density, depth, and blood perfusion, and clinical findings.**

Collaboration: N. Moustgaard Knudsen and M. Pedersen, Comparative Medicine Lab, Aarhus University Hospital

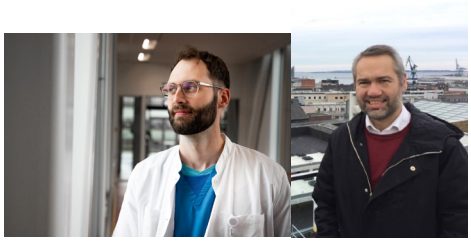
Context: Non-invasive imaging techniques like Laser Speckle Contrast Imaging (LSCI) and Optical Coherence Tomography Angiography (OCTA) offer valuable insights into skin vascularization, blood perfusion and micro-morphology in patients with atopic dermatitis and psoriasis. This study investigates the correlation between quantitative imaging measures, such as vascular density, depth, and blood perfusion, and clinical findings.

Goal and Method: Development of a multi-component pipeline in MATLAB. The pipeline consists of three scripts designed to automate the following processing steps:
Preprocessing: Autocropping z-stacks to eliminate noisy image signals, removing motion artifacts using a wavelet-FFT filter, and detecting the air-skin border to align the entire stack at this border.
Depth Detection: Identifying the Capillary Loop Depth (CLD) and Superficial Plexus Depth (SPD) from the z-aligned image stacks.
Morphological Analysis: Calculating morphological metrics at the depth of the SPD, including mean vessel diameter, branch length, vessel density, and fractal dimension.



## Osteoarthritis (OA) knee cartilage stem cell therapy

This project consists of developing a tool to accurately 3D segment the cartilage and neighboring bones from MRI images.

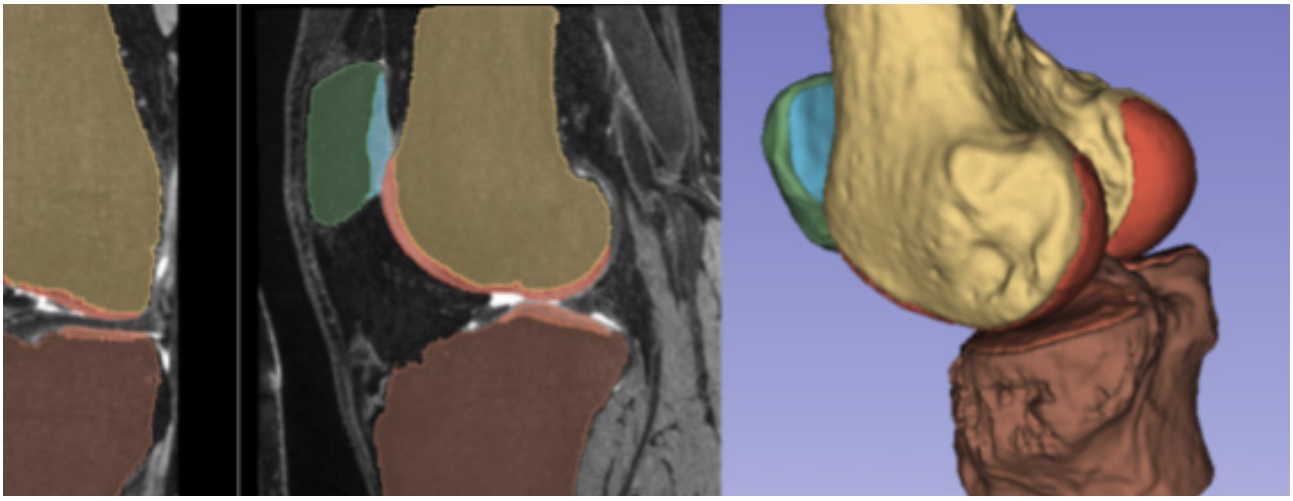


Collaboration: R. Aabling and M. Pedersen,
Dept. of Clinical Medicine, Aarhus University

Context and Goal: Severely impaired cartilage from OA patients can be partially healed by stem cell therapy. The effect of this treatment under different conditions can be studied from MRI imaging. This project consists of developing a tool to accurately 3D segment the cartilage and neighboring bones from MRI images. It is also a follow-up project from the last year (2023).

Method: Development of an accurate deep learning-based segmentation pipeline in Python. Briefly, the steps include

1. Pretrain a modified multi-Planar UNet using an open dataset consisting of similar images
2. Modify the model to include cartilage classes also while transferring the pretrained weight
3. An ongoing interactive learning pipeline while the model's predictions are manually corrected and fed back to the model to increase the model's robustness.



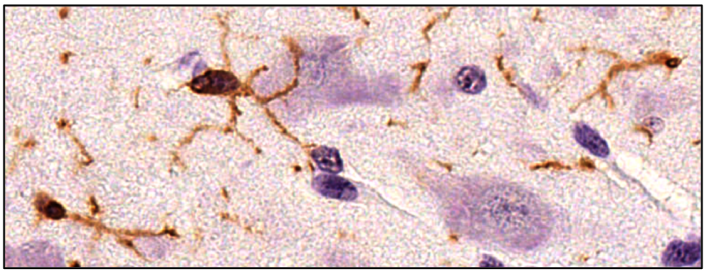
# Quantification of microglia morphology from whole piglet brain Brightfield images

**This project studies the effects of gut inflammation on the brain.**

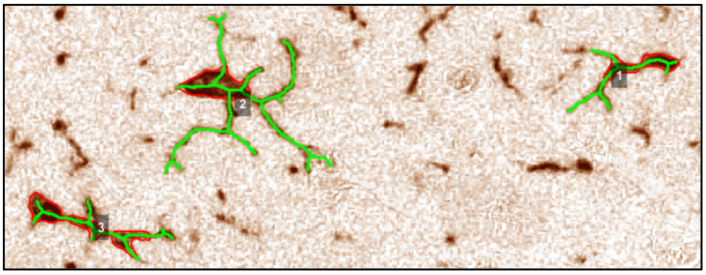
Collaboration: S. Pankratova,
Comparative Pediatrics
Faculty of Health and Medical Sciences, Copenhagen University

Context: Inflammation in the gut can influence brain health, with notable effects on the morphology of microglia cells. Microglia cells in healthy tissue typically exhibit fine, branching processes, while inflamed tissue shows thicker, darker cell bodies with fewer branches. This project quantifies microglia morphology in pig hippocampus tissue stained with H-DAB, using brightfield microscopy to study the effects of gut inflammation on the brain. Goal and Method: Development of an automated pipeline combining QuPath and ImageJ to analyze microglia morphology in histological images. The pipeline comprises:

1. Cell Body Detection: Identification of DAB-positive microglia soma within annotated regions using QuPath
2. Preprocessing, Segmentation and Skeletonization: Cropped regions around detected cells are exported to ImageJ for pre-filtering, thresholding and skeletonization of the segmented cells
3. Skeleton Analysis & Data Output: Morphological metrics, including the number of branches, junctions, endpoints, and average process length, are quantified from the skeletonized microglia. Results are saved as Excel files for statistical analysis, and the skeletons are returned to QuPath as overlays for visual verification.



Detect cells (QuPath)
Send to ImageJ
Prefilter & Threshold
Skeletonize & Analyze
Save to excel file



| ID | # Branches | # Junctions | # End-points | Average Branch Length |
|---|---|---|---|---|
| 1 | 7 | 3 | 5 | 31.877 |
| 2 | 19 | 9 | 11 | 35.408 |
| 3 | 11 | 5 | 7 | 23.997 |

# DBI-INFRA ACTIVITIES

2024 has been a very busy and exciting year for the Danish BioImaging community, marked by key scientific events, international collaborations, and impactful networking opportunities. Actively engaging with national and international bioimaging initiatives, the DBI-INFRA has reinforced its commitment to strengthening bioimaging sciences at the institutional, national and global level. Education and knowledge exchange are key missions of the DBI-INFRA. We work to make sure that all life scientists have access to the cutting-edge imaging technologies and expertise they need to optimally excel in their fields. To achieve this, the DBI-INFRA needs to recruit the best bioimaging professionals and support their continuous development and career path. In the following pages, we highlight some of the activities, workshops, and meetings where we engaged with our stakeholders. From expert discussions and hands-on training sessions to inspiring keynote speeches and vibrant networking opportunities. 2024 has undoubtedly been a year of progress and innovation for Danish BioImaging!

Sonia Diaz Houbak
**DBI-INFRA Coordinator**

## 7th Danish BioImaging Scientific Symposium

More than 150 participants attended the 7th Danish Bioimaging Scientific Symposium. The program was designed to take us across scales. From imaging of human organs with Hierarchical Phase Contrast Tomography, to the visualization of ultrastructural alterations with volumen electron microscopy. The last day included a dedicated session to advanced image analysis tools, and currently available infrastructures in Denamrk. The symposium was filled with a very tight program of talks (8 invited speakers and 10 short talks), workshops (eight in total), poster session (38 posters) and a booth area (six commercial sponsors). We also hosted parallel sessions including the Panel of Facilities lunch meeting and the Alexandra Instituttet Stakeholder meeting on the use of AI in image analysis. Furthermore, we were honored with the participation of Mads Rugaard Christensen, from the Ministry of Higher Education and Science, Prof. Hans Bräuner, vice Dean for Research at the Faculty of Health and Medical Sciences, University of Copenhagen, and Prof. John Eriksson, General Director of the ERIC Euro-BioImaging.

In the left image, Mads Rugaard (center) with John Eriksson (right) and Clara Prats (left).
In the right image, Vice-Dean for Research Hans Braüner giving the openning talk to welcome everybody.

# DBI-INFRA ACTIVITIES

A highlight of the symposium was the keynote speech by John Eriksson, who emphasized Euro-BioImaging's vital role in connecting and coordinating national research communities across Europe and beyond. He underscored the importance of fostering international collaborations, stating that this is one of the greatest benefits Euro-BioImaging offers its members' national scientific communities. In addition, he discussed Euro-BioImaging's support for researchers and innovators through user access funding provided by Horizon Europe projects.


Photo on the top left: John Eriksson´s presentation EuroBioImaging - The Gateway to European Imaging Excellence. Top right: Clara Prats thanking the industrial partners Zeiss, Triolab, Ramcon, Miltenyi, Biotec, Andor, Oxxius and Akoya BioSciences for their support to the DBI Symposim; Photos Below (left): Michael Lisby is presenting one of the short talks. Center: Anders Dahl asking a question after one of the presentations.
On the Right: Jon Sporring is presenting one of the key speakers. The symposium also included a highly successful poster session and exhibition area, which attracted a large and engaged crowd. The event provided an excellent platform for interaction among participants, including representatives from major Danish universities and hospitals, industry professionals, members of the Danish Cancer Institute, and guests from Sweden.

The DBI Scientific Symposium invited speakers were:

- **Claire Wals,** UCL (University College London), who spoke about Metrics for Building the Human Organ Atlas;
- **Florian Jug**, Human Technopole, who discussed From Methods to Tools to Image Analysis as a Service: Our Experiences with Content-Aware Image Restoration and Semantic Unmixing of Microscopy Data;
- **Ole Graumann**, Aarhus University, who presented Clinical AI Imaging from a Radiologist's Perspective: The Practical Approach;
- **Shankar Srinivas**, University of Oxford, who spoke about Quantitative Imaging of Behavioural and Mechanical Heterogeneities Underpinning Mouse Anterior Patterning;
- **Tim Dyrby**, Hvidovre Hospital, Danish Research Centre for Magnetic Resonance (DRCMR), who presented Holistic Imaging of Microsized Axons: From Morphology to Topological Organization in the Brain Network;
- **Fena Ochs**, BRIC, who discussed Resolving the Molecular Mechanisms Governing 3D Chromatin Organisation;
- **Jakub Sedzinski,** reNEW, who spoke about Deciphering the Cell Fate of Developing Mucociliary Epithelium by Single-Cell Phenomics.

With its engaging presentations, insightful discussions, and dynamic networking opportunities, the 7th Danish BioImaging Scientific Symposium proved to be a key event in strengthening the bioimaging community.

Read the abstracts

# DBI-INFRA ACTIVITIES

During the afternoon, participants had the opportunity to engage in a series of interactive workshops, each designed to provide hands-on experience and in-depth insights into cutting-edge imaging technologies. The workshops were fully booked, demonstrating the high level of interest and engagement from the Danish BioImaging community. The list of workshops included:

- **Image to Data with Cellpose Segmentation** - This workshop guided participants through the general bioimage analysis workflow that takes them from Image to Data, using the cell segmentation software Cellpose. Participants were introduced to the Cellpose algorithm to understand how it works. Then, through practical exercises, they learnt to use the graphical interface to adjust parameters, make annotations and retrain the model to suit their image data.
- **Python for 3D Bioimage analysis** - This workshop covered the basics of the qim3d library, from installing it to practical examples of data processing.
- **Light Sheet Microscopy at CFIM**- This hand-on workshop introduced participants to tissue claering methods and light sheet microscopy imaging of large samples with the Novo Nordisk Foundation funded BioDEEP Zeiss Light Sheet 7 and 3i Cleared Tissue Light Sheet.
- **Zeiss workshop**- In this workshop participants joined a live remote demo from Zeiss Germany for an overall understanding of the opportunities the newest cutting edge Zeiss microscopes bring.
- **High Content Screening Workshop**- This workshop focused on high content screening applications and discussed the services available at Center for Advanced Bioimaging, Department of Biology, University of Copenhagen. Topics that were also covered: machine learning-enabled automated image acquisition, examples of applications and types of samples, data management, and training of users.

# 17th European Microscopy Congress

**August 26-30th, 2024**

In August 2024, Copenhagen hosted the 17th European Microscopy Congress (EMC2024), bringing together researchers, industry leaders, and microscopy experts from around the world.
The congress and exhibition were a great success, with an attendance of 2,500 registrants from at least 51 countries, who had the opportunity to hear from researchers at various career levels from both academia and industry.

The 1,310 submitted abstracts for the three main symposia complemented the impressive number of registrants and paved the road for an extensive and dynamic conference programme spanning advances in Life Science, Physical Science, and Instrumentation & Methodology. Accordingly, EMC2024 featured six parallel tracks with 35 scientific sessions giving room for 422 oral presentations, 50 invited speakers, and 5 plenary and 775 poster presentations.

Approximately 250 registrants decided to arrive early and attend one of the seven preconference workshops offered on the Sunday before conference kick-off.

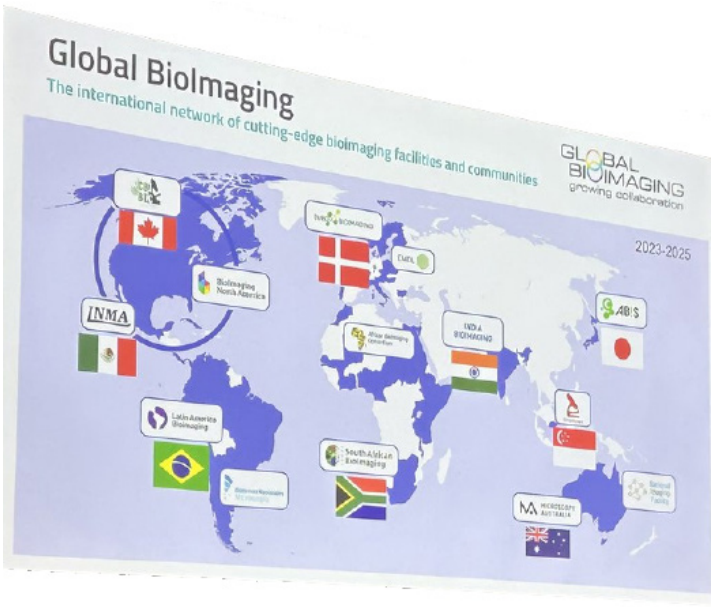
Moreover, during EMC2024, the Danish BioImaging Hub had the pleasure to welcome Johanna Bischof (Euro-BioImaging) and Yara Reis (Global BioImaging).

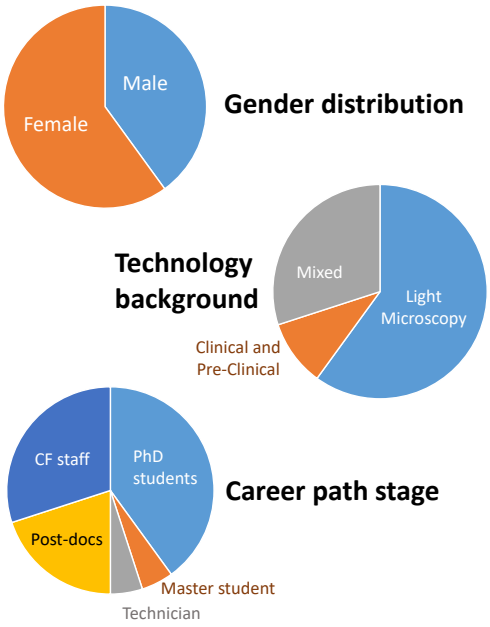
Top photos credits: European Microscopy Congress 2024 webpage. Botton photos, from left to right, Yara Reis (Global BioImaging), Clara Prats (Danish BioImaging), and Johanna Bischof (Euro-BioImaging) in front of the entrance of the Danish BioImaging Facility CFIM, participants of the EMC2024 preconference workshops during a coffee break, and Synny Dai, SPIM applications specialist at CFIM during the Light Sheet workshop.

# CZI Molecule to Human Boot Camp

**September 16-27th, 2024**

Danish BioImaging was chosen to organize and host the M2H boot camp in a competitive selection among different Euro-BioImaging Nodes for its unique integrated and project-focussed training program designed for the bootcamp.




# CZI Molecule to Human Boot Camp

**September 16-27th, 2024**

We received a total of 189 applications, from which 24 participants were selected from around the globe, with a diverse background, and at different stages of their career path. The program and boot camp content was developed as a collaborative work between Danish BioImaging clinical, preclinical and microscopists at the Aarhus University Hospital, Roskilde University and University of Copenhagen.

The CZI M2H boot camp started at the Aarhus University Hospital (16-19th September) with a combination of lectures and demonstrations on clinical and preclinical imaging methods and technologies, and moved to the University of Copenhagen (20-27th September) to dive into multimodal workflows across microscopy scales, and image analysis. The program was designed around two multi-modal imaging workflows, one to investigate type 1 diabetes in a transgenic mouse model with GFP-expressing pancreatic beta-cells, and the other to investigate heart regeneration in
Axolotls.

The CZI M2H boot camp was concived by a collaboration on a global scale coordinated by GlobalBioImaging, including: African BioImaging Consortium, Euro-BioImaging, Latin America Bioimaging, Africa Microscopy Initiative, Association for Biomolecular Research Facilities, Biomedical Science Research and Training Centre, and the Consortium for advancement of MRI education and research in Africa.

We would like to thank EuroBioImaging, Global BioImaging and the Chan Zuckerberg Initiative for the support and opportunity to organize and host this unique event! It was a true pleasure to witness the birth of this fantastic community.

# CZI Molecule to Human Boot Camp

## Aarhus University Hospital - September 16-19th, 2024

The first week of the CZI M2H Boot Camp focused on multimodal bioimaging frame setting, and the technical principles of clinical and preclinical imaging applications. Lectures were given by Anita Dittrich, Michael Pedersen, Lau Brix, Kasper Hansen, Aage Kristian Olsen Alstrup, Lars Thrane, Michael Robert Horsman, Henrik Lauridsen, Peter Agger, Janne Schwab, Karina Henrique Binda, Christoffer Laustsen , Morten Busk, Per Borghammer, Christian Damsgaard, Lene Niemann Nejsum and Nina Glöckner Burmeister.

# CZI Molecule to Human Boot Camp

## Roskilde University and University of Copenhagen, September 19 - 27th, 2024

The second week of the CZI M2H Boot Camp took place at the Faculty of Health and Medical Sciences, University of Copenhagen. The program included application focused talks on advanced microscopy workflows across scales, including state of the art image analysis pipelines. The lectures were given by Claras Prats, Pia Nyeng, Thomas Hartig Braunstein, Richard de Mets, Jana Harizanova, Sunny Dai, Jon Vergara, Anita Dittrich, Julia Mertesdorf, Tricia Loo and Peidi Xu.

# CZI Molecule to Human Boot Camp

## Roskilde University and University of Copenhagen, September 19 - 27th, 2024


From left to right: Gleb Grebnev, Manager of the training program at GlobalBioImaging presents ***the Global BioImaging network, the Imaging4All project and other user access and training opportunities.*** Teng-Leong Chew, Director of Advanced Imaging at Janelia, presents ***the Imaging Across Length Scales – From Single Molecules to Across the Globe*** on the closing day.

The M2H was a success and together, we have co-created two multimodal imaging workflows going from clinical and preclinical imaging in the Aarhus University facility to microscopy imaging and image analysis at the University of Copenhagen. Importantly, the community will meet regularly to bridge the clinical and preclinical imaging community with the microscopy community on a global scale, fostering interdisciplinary collaboration and to connect bioimaging scientists and experts at various stages of their careers, promoting mentoring and networking opportunities.

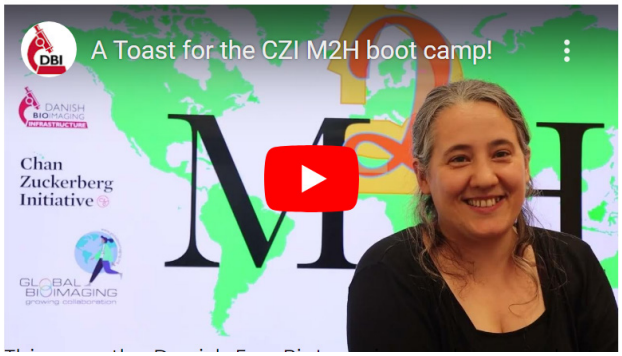
> “To witness the birth of the M2H community has been a true privilege. Let’s keep supporting and inspiring each other as we move forward towards the globalization of access to bioimaging technologies, and towards bridging the clinical and preclinical imaging communities with the microscopy and image analysis communities”.
>
> **Clara Prats**

# CZI Molecule to Human Boot Camp

## In Numbers

The boot camp was a success, receiving much praise and fantastic feedback from stakeholders. In a survey sent to the participants, more than 95% said they would recommend it.

- 96% highty recomend the M2H Boot camp
- 92% describe the boot camp as Excellent




Scan to watch the video of the 24 participants In the video, they openly share their impressions of the bootcamp, addressing:

- what did they expect?
- what did they get?
- what they would like to highlight of the M2H Boot Camp in Denmark?

# M2H Participants´s Testimonials


#M2H2024 video


#M2H2024 video

# CZI Molecule to Human Boot Camp

## Social Activities

The Molecular to Human program featured a variety of engaging activities designed to foster networking, team building, and cultural exchange among the participants. Highlights included the Global Cooking event, where participants shared culinary traditions from their home countries. The tight program also included cultural excursions, such as visits to the beautiful Moesgaard Museum dedicated to archaeology and ethnography in Aarhus. In Copenhagen the M2H participants visited the Kronborg Castle, Home of Hamlet and UNESCO world heritage.

# Educating the new generation of bioimaging

## The DBI-INFRA courses and workshops

The Danish BioImaging network has been running a yearly DBI cross-institutional PhD course since 2018. The course is unique as it allows Danish PhD students to visit several DBI-INFRA groups and facilities, learning about bioimaging technologies across scales, and the available Danish bioimaging infrastructures and expertise. The course is relevant for PhD students within medicine, physics, chemistry, biochemistry, molecular biology, nano-bioscience, pharmaceutical sciences, agricultural science or biology. The emphasis of the course is a tour aroundl bioimaging technologies available in Denmark, and it covers subjects such as advance live cell imaging, confocal microscopy, electron microscopy, super-resolution microscopy and image analysis.

In 2024, the DBI cross-institutional PhD course kicked off on Monday, September 2, at DaMBIC (Danish Molecular Biomedical Imaging Center). On Monday September 9 the group continued the tour at CFIM, University of Copenhagen for a full day dedicated to confocal microscopy. In the photo: PhD students attending the DBI cross institutional at CFIM.

The Bioimaging Facility at Aarhus University has hosted a Light Sheet Microscopy workshop in collaboration with the Bridging Nordic Microscopy Infrastructures. The DBI-INFRA Image Analysis Core Facility has organized two workshops, one focused on the histopathology image analysis software QuPath, and the other focused on introducing life scientists and core facility staff to python coding for bioimage analysis and deep learning workflows deployment.Furthermore, there was over-full house for the 6 days Image Analysis course organized by the Core Facility for Integrated Microscopy (CFIM) and the DBI-INFRA Image Analysis Core Facility in June 2024. The course received excellent feedback (4.8 out of 5 stars). During these intensive days, the 22 students dived deep into the world of digital images, learning:

- What a digital image is
- How and when to perform basic image processing tasks
- Combining tasks to perform advanced image processing and segmentation
- Automated pixel classification
- 2D and 3D measurements

# DBI-INFRA ACTIVITIES

## The DBI-INFRA courses and workshops

The BioImaging core facility in Aaarhus organised the Light sheet microscopy workshop (with BNMI financial support on the 19th- 22nd of August, 2024 . The workshop provided hands-on experience in small groups and guide new users through all the steps necessary when getting started with Light sheet microscopy. From theory, clearing, immunostaining, good imaging practice, data management to 4D quantitative analysis. Furthermore, The Light Sheet Microscopy Workshop also brought together young scientists and experts in the field of light sheet microscopy. The facility aimed to give the participants an overview on current best practice in light sheet microscopy along with tips & tricks for every step from methodological aspects all the way to data analysis and to facilitate increased awareness of both the prospects and the limitations of light sheet.microscopy.
Along with other activities, Nina Burmeister, manager of the core facility, attended Imaging Across Length Scales 2024, Janelia Research Campus, Howard Hughes Medical institute, Ashburn Virginia in July 2024.


*The flyer on the left showcases the summer school at CAB, while the one below highlights the Light Sheet Microscopy workshop in Aarhus.*


CAB summer School in Advanced live cell imaging with 13 students comprised theory and show-cases on selected topics, such as Fluorescence Lifetime, Super Resolution and High Throughput Microscopy as well as high speed live and spectral imaging. Internationally outstanding experts gave key notes on these topics. Part of the summer course was the annual meeting of the Danish Bioimaging network with opportunity to present posters or talks.


## The DBI-INFRA courses and workshops

DDEA/RUC PhD Course on the DDEA website:

The RUC node ran the international PhD course Quantitative 3D Bioimaging DDEA/RUC for 5 days in January 2024. The course was developed and held in collaboration with the DBI-INFRA image analysis core facility. This 5-day intensive residential course included lectures on how to design and run quantitative imaging pipelines and publish the results, inspirational research talks, and demo workshops in laser scanning & spinning disc confocal microscopy and image analysis. Additionally, RUC hosted several Danish high school students for SRP/SOP-project related demonstrations, and contributed to one RUC master course on experimental cell biology.

The Translational Imaging Center Technical University of Denmark supported 12 student projects on the MRI scanner. Provided practical exercises for the "Introduction to Medical Imaging" bachelor course (58 students) in 2024.

Additionally, In collaboration with the GTS Alexandra Institute, the DBI-INFRA has co-organized the fourth stakeholder meeting. The meeting was part of Danish BioImaging Network's Annual Scientific Symposium held in Panum June 2024. The focus of the stakeholder meeting AI in biodata: Industry Insights was on collecting and understanding industry insights and challenges when working with AI in biodata.

CAB ran the PhD course Advanced Methods in Light Microscopy with 15 participants and contributed to the TWIN2PIPSA workshop for PhD students and postdocs funded by the European Union' Horizon Europe research and innovation programme, which took place 18-20 September 2024, Lisbon, Portugal.

The DBI-INFRA TCF organize courses and workshops tailored to the needs of the local research community, but open and disseminated through the DBI network. In order to boost knowledge exchange, a DBI course repository has been created, which gathers a list of the bioimaging relevant courses hosted at different institutions.

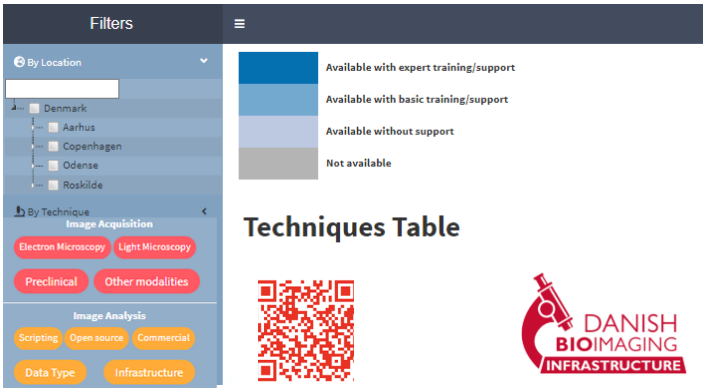
*Group photo of the international PhD course Quantitative 3D Bioimaging DDEA/RUC.*

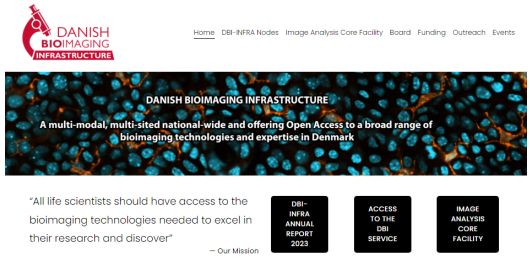
# DBI-INFRA OUTREACH

## The DBI-INFRA website

To keep updated about the DBI-INFRA, you can check the DBI-INFRA website to get an overview of the bioimaging technologies, and planned activities offered at the different DBI-INFRA facilities (www.dbi-infra.eu). In addition, you can also check available funding opportunities to cover travelling and transnational user access to the best facilities across Europe, such as ISIDORe, AgroServ, AI4Life, CanServ and the new EVOLVE project.
DBI recently implemented an innovative tool on its website: the techniques table. This tool includes a search function by location and technique, providing an updated table that lists core facilities along with their level of expertise categorized as low, intermediate, expert, or no equipment. This valuable resource is available on the DBI website under the "DBI INFRA Nodes" section.
Additionally, DBI portal has also a variety of interesting courses, workshops and events organised by the DBI-INFRA Image Analysis Core Facility under events.

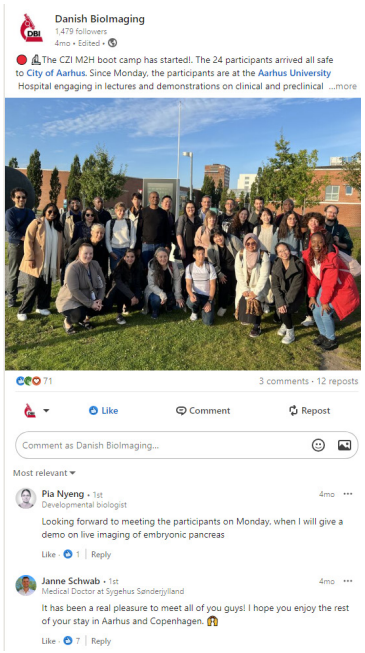
In 2024, DBI INFRA website received 22K visits, averaging approximately 2,000 visits per month. Our visitors came from all over the world, with the highest number of visits originating from Denmark, Germany, the Netherlands, Finland, France, and the United States.



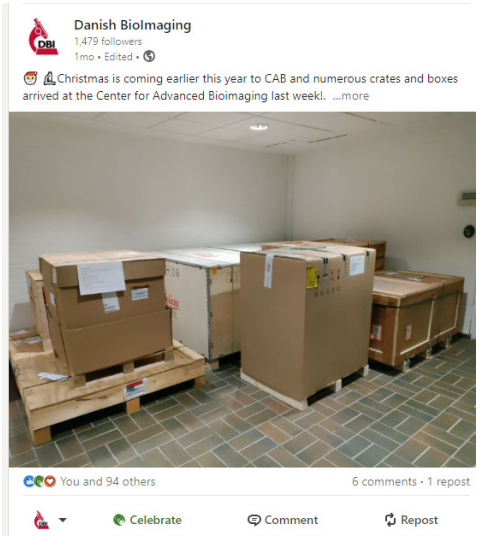



## Social Media

The impact of the DBI-INFRA is highly dependent on the use of the implemented bioimaging technologies, and the visibility of its activities. To disseminate our services and activities, DBI-INFRA maintains accounts on several social media platforms, including Twitter, LinkedIn, and YouTube. DBI sends out twice a year newsletters to more than 400 subscribers. Also through social media, DBI-INFRA is connecting with the global bioimaging communities and infrastructures. Re-sharing and liking each others services and activities to drive the dissemination of relevant post among the Danish bioimaging community. On LinkedIn, DBI-INFRA currently has more than 1,500 followers. In 2024, DBI-INFRA received 77,000 impressions and over 1,600 reactions, with a total of 38 posts and 8 videos published. Moreover on X (Twitter) has more than 500 followers. Since December 2024, DBI-INFRA has also expanded its presence to Bluesky and Instagram. The DBI-INFRA accounts are used to disseminate new services, activities, and applications. The impact of the social media posts is easy to measure as the number of times the news have been viewed and/or shared. To inspire life scientists and showcase the impact of open access bioimaging technologies, during 2024 we have continued the DBI serie serie called "meet the DBI-INFRA users". Our latest video, published in November, features an interview with Rikke Agerskov, a PhD researcher in the Department of Science and Environment at Roskilde University (RUC). The video has garnered over 50,000 views on the DBI YouTube channel, received 80 likes, and increased the channel's subscriber count from 2 to 120. Below are some of the most popular posts that attracted strong interest from our audience in 2024.
Among these, one of the most popular post highlighted the Chan Zuckerberg Initiative-funded Molecule to Human Boot Camp (M2H), with the Danish Euro-BioImaging node selected to organize and host this global event.

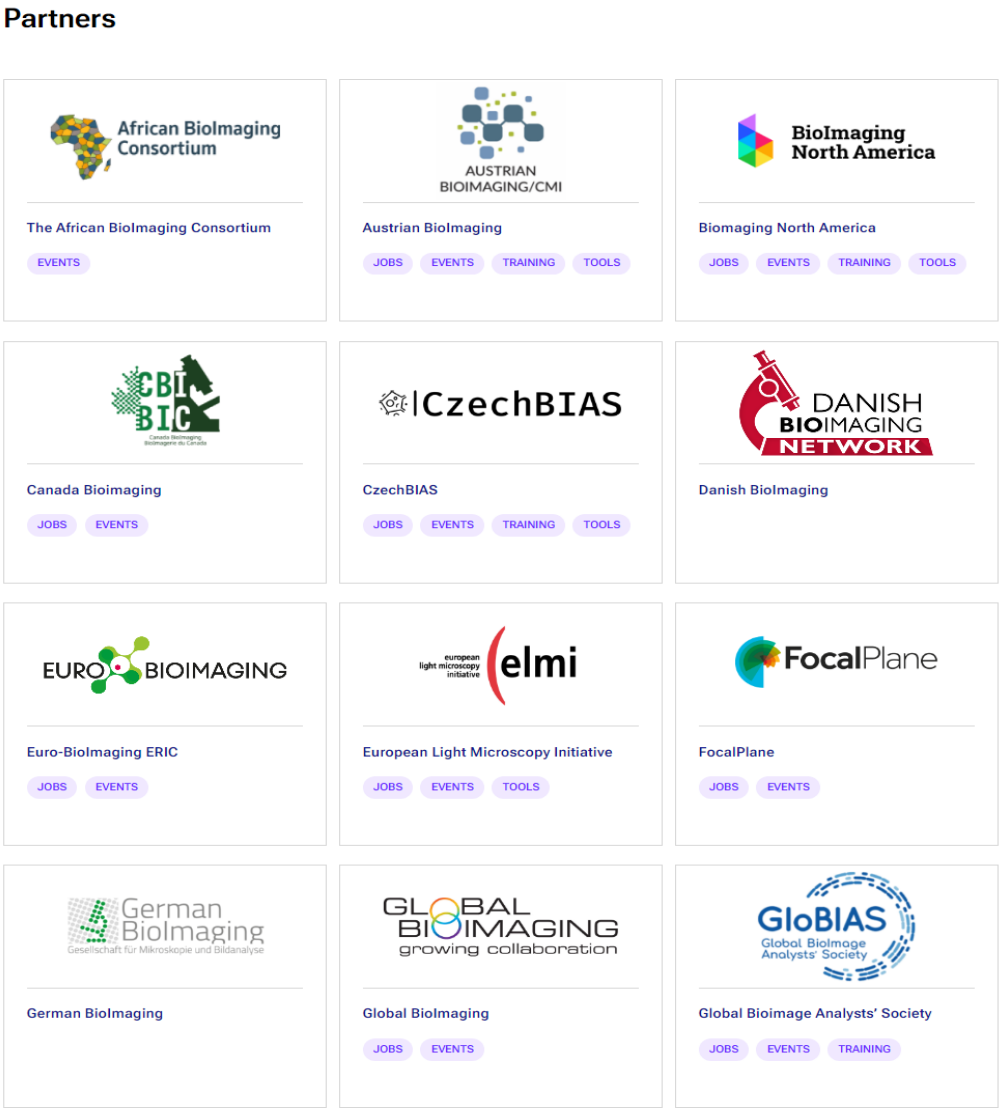






## DBI partnership with MicroscopyDB

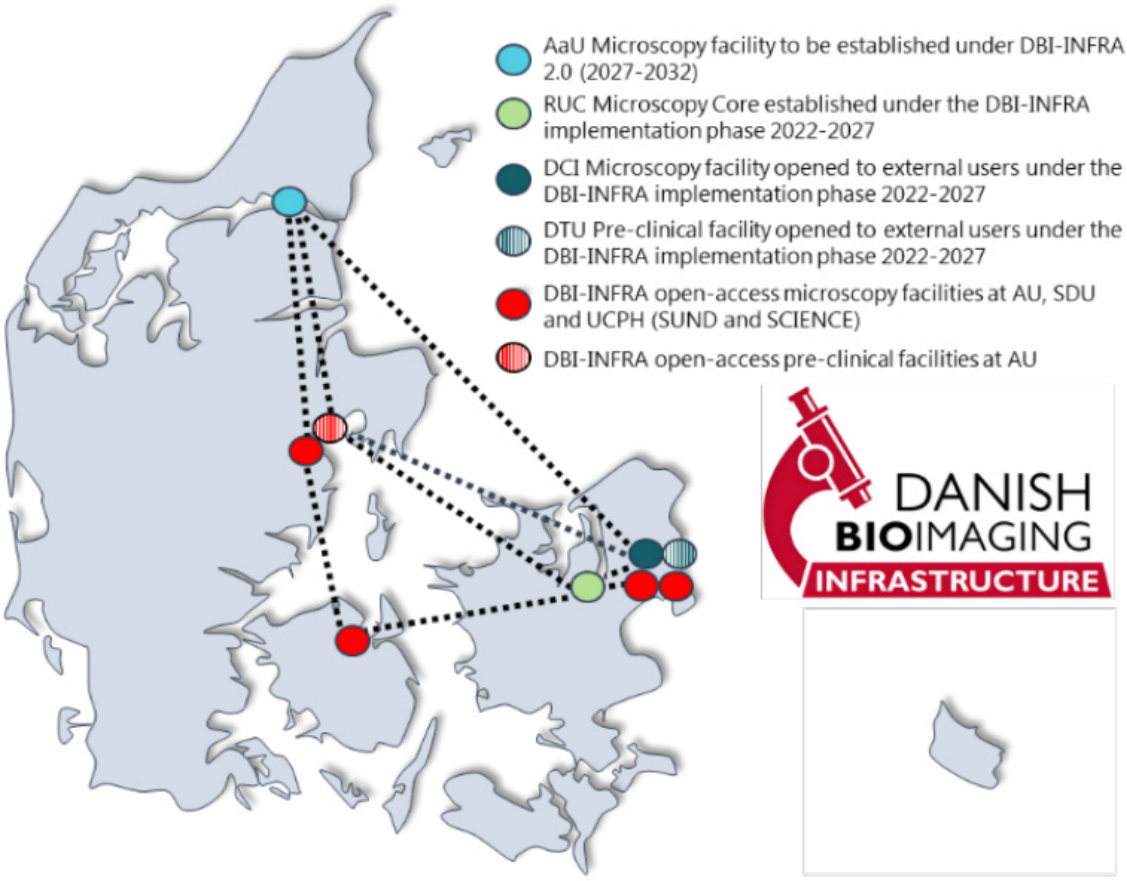
In 2024, DanishBioImaging partnered with MicroscopyDB, a repository of online microscopy resources. The Danish BioImaging website now features a new global jobs section powered by Microscopy-DB, while still maintaining the Danish job postings. In this new feature, visitors can find a non-exhaustive list of job opportunities within the imaging community.




Microscopy DB is a community-driven effort, led by the Founding Members with contributions from the Partners listed below. It emerged following international stakeholder discussions held during the 2022 European Light Microscopy Initiative (ELMI) meeting. Above is the list of all current MicroscopyDB partners that are contributing to this content with Danish BioImaging being one of them.

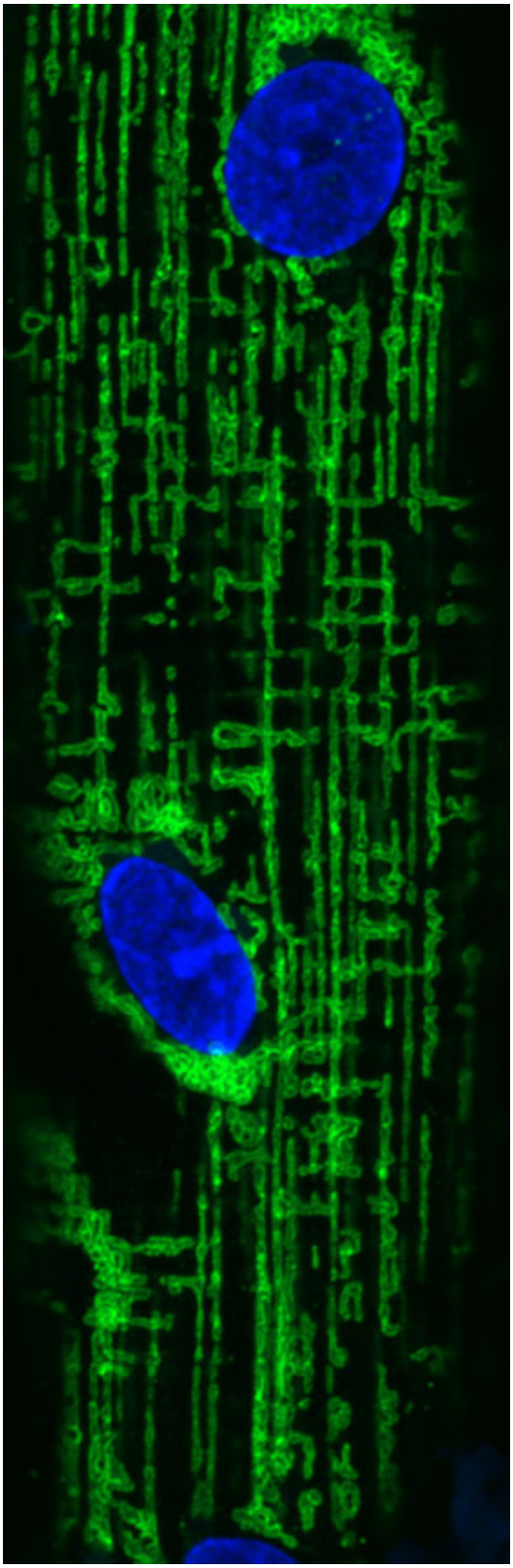
# DBI-INFRA STRATEGIC DEVELOPMENTS

The Danish BioImaging INFRAstructure (DBI-INFRA) was launched in April 2022 as a national distributed, and mixed bioimaging technology infrastructure to offer open-access to excellent bioimaging technology platforms that support bioimaging across scales – from clinical to molecular imaging – and across academic and research institutions.




The DBI-INFRA national operation is structured into four organization bodies. The **DBI-INFRA Executive Board (EB)** is the decision-making body composed of representatives elected by the partner institutions. The EB meets every year with the **DBI-INFRA Institutional Board (IB)**, which is composed of one member of each partner institution's leadership team. The EB and the IB are working together to define which external stakeholders should be invited to be part of the **DBI-INFRA Advisory Board** (AB) based on the DBI-INFRA strategic goals for 2025-2030. The **DBI-INFRA Coordinator** is an essential pillar for the national operation, coordinating technology and service implementations, organizing workshops and education activities, and raising DBI-INFRA awareness at the national and international level. The **DBI-INFRA Panel of Facilities (PoF)** is open to any person working at a bioimaging core facility in Denmark. The PoF, with the support of the coordinator, is responsible for the execution of strategic activities across the facilities, and the dissemination of DBI-INFRA technologies and services through Social Media channels and Newsletters. The coordinator ensure efficient bidirectional communication between the EB and the PoF.

# DBI-INFRA STRATEGIC GOALS



## Strengthen the Danish Bioimaging Infrastructures

- coordinating the implementation and development of open-access cutting-edge imaging technologies across institutions
- minimizing infrastructure redundancy to maximize investment impact
- driving collaboration and knowledge exchange between DBI-INFRA facilities
- defining guidelines for service provision quality and performance monitoring
- creating career paths for bioimaging technology researchers/experts working at DBI-INFRA

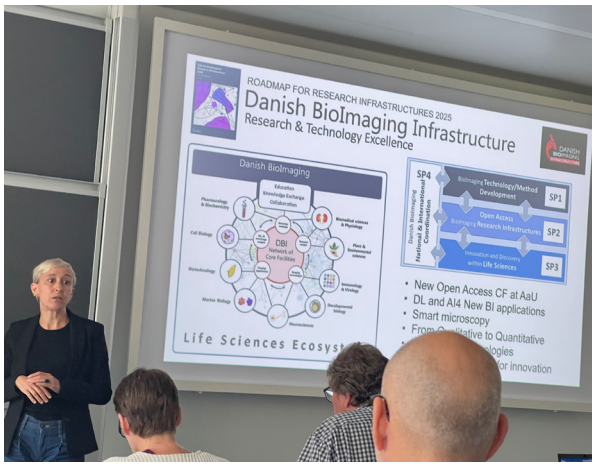
## Support the life science ecosystem

- coordinating interdisciplinary collaboration for technology development, beta testing, and implementation
- continuously updating the technology portfolio offered as open access services
- educating the next generation of bioimaging life scientists
- promoting the application of the FAIR principles for image-based data sharing at the national and international level
- driving the integration of bioimaging technology core facilities and their professionals into life science institutions

## Secure the long-term sustainability of BioImaging Infrastructures

- communicating society & economic impact and value to all relevant stakeholders
- lobbying toward a long-term financial plan to maximize the impact of invested resources
- driving infrastructure and expertise sharing across institutions
- defining protocols and strategies to minimize the environmental footprint
- coordinating fundraising activities to sustain and develop bioimaging infrastructures and services
- continuously adapting to the changing needs of the community, and emerging new opportunities

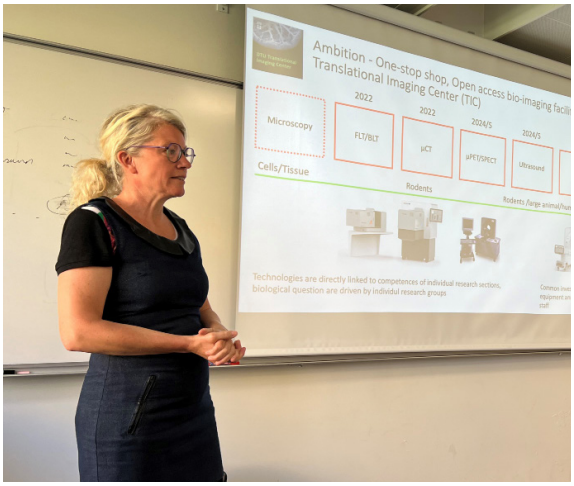
# DBI-INFRA STRATEGIC GOALS





The call for Danish Roadmap for Research Infrastructure 2025 was announced in 2024 and consortia from Danish research institutions were encouraged to prepare proposals for submission to this roadmap. Danish BioImaging Infrastructure was invited to attend the seminar that was held on May 31st 2024 at University of Southern Denmark (SDU) in Odense organised by the National Committee for Research Infrastructure (NUFI) and Danish Agency for Higher Education and Science. In the photos above: Clara Prats, Director DBI-INFRA, presenting the DBI Infrastructure proposal during this seminar.

Below some photos during the DBI-INFRA physical meeting in Aarhus in August to discuss the new submission to this roadmap. The meeting agenda included a 15 minutes presentation of each facility. The accompanying photo captures Mathilde Haugen presenting The Translational Imaging Center (TIC) at DTU followed by a discussion.




# DBI-INFRA PANEL OF FACILITIES

PoF Chair
Thomas Hartig Braunsten
Core Facility for Integrated Microscopy

PoF Co-chair
Nynne Meyn Christensen
Center for Advanced BioImaging

**Want to know more?**

**Visit the Panel of Facilities website!**

The Panel of Facilities (PoF) is the assembly of representatives and staff from Danish BioImaging Core Facilities in Denmark. Created after the 1st Danish BioImaging Facility Meeting in October 2021, the panel was formed in order to drive knowledge exchange between facilities in areas as diverse as technology, booking systems, performance monitoring, user training, career paths, and core facility values, visions and missions. In 2020, Denmark became a founding member of the ERIC Euro-BioImaging (EuBI), and in 2021 the DBI-INFRA was approved to become an EuBI node. Since then, the Chair and Co-Chair of the PoF have represented the Danish BioImaging Core Facilities at the EuBI Panel of Nodes. The Danish Panel of Facilities meets three times a year, with one annual in-person meeting.

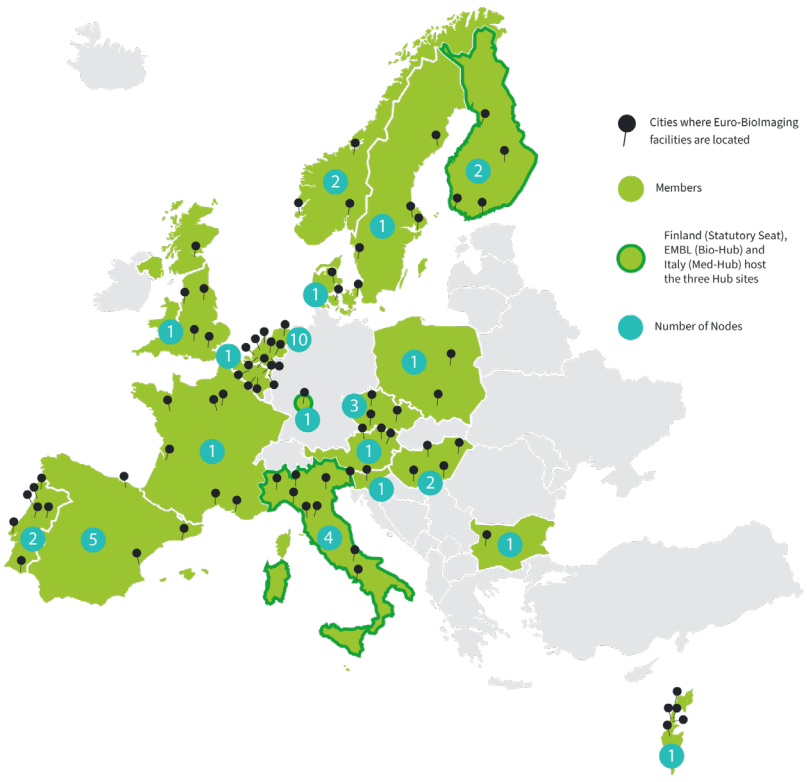
Among various activities, in 2024 the PoF has organized a webinar focused on microscopy performance quality control protocols and tools by ArgoLight, and an interactive pedagogy workshop on improving microscopy trainings by Sylvie Le Guyader, Senior Research Infrastructure Specialist at Karolinska Institutet. The workshop was tailored to core facility service provision professionals to help them implement new teaching and training methods and tools into bioimaging courses and user trainings.

**The photo shows the Panel of Facilities' in-person meeting during the DBI Symposium on June 25th, 2024.**

# DBI-INFRA COLLABORATIONS

## INTERNATIONAL COLLABORATIONS
## ERIC EUROBIOIMAGING

The DBI-INFRA is the Danish Euro-BioImaging node. Euro-BioImaging is an European Research Infrastructure Consortium (ERIC) that offers open access to imaging technologies, training and data services in biological and biomedical imaging. Euro-BioImaging links the DBI-INFRA facilities with the best bioimaging core facilities in Europe, giving DBI-INFRA users access to state-of-the-art bioimaging technologies available in Denmark, or in other European countries. In addition, being part of the european bioimaging technology landscape brings visibility to the Danish infrastructures, and facilitates professional development and technology knowledge exchange. Clara Prats and Michael Pedersen are members of the EuroBioImaging Executive Board and attend their anual meetings. In 2024, they attended the 8th Euro-BioImaging Board Meeting in May, and the 9th Euro-BioImaging Board Meeting in November.




DBI INFRA Coordinator participates actively in the **EuroBioimaging communication expert group meetings.**

The DBI INFRA Image Analysis Core Facility participates regularly in the **Euro-BioImaging Image Data Expert Group Meeting**, a forum for image data experts to discuss challenges faced in providing Image Data Analysis as a service, and to exchange experience within the bioimage analysis community. Through EuBI, the IACF also participated in a cross-node job shadowing opportunity to visit the BIIF in Sweden to learn from their experience of running an image analysis service facility.

Danish Euro-Bioimaging Node

https://www.eurobioimaging-access.eu/nodes/danish-bioimaging

## INTERNATIONAL COLLABORATIONS

### EVOLVE Cross-Node Job Shadowing at the BioImage Informatics Facility


In November 2024, Julia Mertesdorf from the IACF, visited the BioImage Informatics Facility (BIIF) at Uppsala University through the Euro-BioImaging EVOLVE Cross-Node Job Shadowing program. This EU-funded initiative enables Euro-BioImaging Node staff to visit other Nodes, fostering knowledge exchange and the sharing of best practices in facility management, operations, and technical advancements. The visit was co-organized with a staff member from the MicroPICell facility in Nantes, creating additional opportunities for collaboration and shared learning.

The six-day visit offered valuable insights into facility management, software tools, and collaboration with image analysis experts at BIIF. Key topics included writing effective user agreements, project management strategies, and methods to improve user outreach. Discussions with the BIIF team highlighted practical approaches to making bioimage analysis tools more accessible, addressing common challenges, and optimizing workflows. The visit also included hands-on training in advanced image analysis software tools, such as TissUUmaps for spatial transcriptomics visualization, Napari for advanced data visualization and analysis, and MagicGUI for creating user-friendly Napari plugins.

The shadowing experience provided a great opportunity to learn, exchange ideas, and connect with the broader bioimage analysis community. It inspired actionable ideas and offered practical tools and methodologies to enhance operations at the IACF. Furthermore, the visit established a solid foundation for future collaboration, supporting ongoing knowledge exchange and advancing bioimage analysis practices across Euro-BioImaging Nodes.

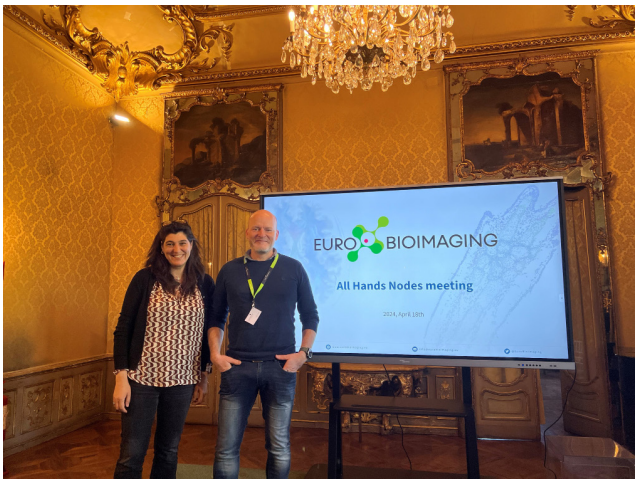
## INTERNATIONAL COLLABORATIONS

### Danish Bioimaging is connected to a large network of European bioimaging

Through Euro-BioImaging, the Danish bioimaging facilities are connected to a big network of European bioimaging facilities, boosting collaborations, and knowledge exchange.

Under these lines, a picture taken during the meeting "Euro-BioImaging All Hands Nodes" in Torino in 2024. The All-Hand's Nodes meeting happens once a year, and the goal is to bring together scientists from the Euro-BioImaging Nodes to meet each other, encourage interdisciplinary collaborations, and to discuss the most relevant topics for Euro-BioImaging operation and developments in imaging.

The 2024 edition of the All Hand's Nodes meeting was organized by the Euro-BioImaging Med-Hub. Around ninety Euro-BioImaging Node & Hub staff, and industry partners gathered in Palazzo Ceriana Mayneri in downtown Torino for 3 days of exciting scientific talks, networking and exchanges. The event started on Tuesday, April 16, with a satellite event in collaboration with the EUCAIM project, followed by a joint Euro-BioImaging Industry Board & Nodes Workshop on Wednesday, April 17. Over the course of the week, sessions covered topics like Imaging across scales and modalities, Screening and working with disease models, Updates from the Nodes, and Updates on Euro-BioImaging operations, including the EVOLVE project. On Friday, breakout sessions covered topics such as Node Training & Job shadowing, FAIR Image Data Stewardship and Communications & Outreach.




*Sonia Diaz, DBI-INFRA Coordinator with Thomas Hartig Braunstein, chaiman of the Danish Panel of Facilities, during the Hands Nodes meeting in Torino in 2024.Not in the photo, Michael Pedersen*


*John Eriksson Euro BioImaging Director General during his presentation higligting what are the benefits of being part of EuroBioImaging for nodes and for researchers*

# DBI-INFRA COLLABORATIONS

## INTERNATIONAL COLLABORATIONS
## BRIDGING NORDIC MICROSCOPY INFRASTRUCTURES


In April 9-12, 2024 Danish Bioimaging attended the third Bridging Nordic Microscopy Infrastructure (BNMI) network meeting in the beautiful Norwegian mountains, in Geilo. Morten Schallburg Nielsen, Anna lorentzen, Nynne Meyn Christensen, Nina Burmeister, Eva Arnspang Christensen, Yenisleidy de las Mercedes Zulueta Díaz, Thomas Hartig Braunstein, Keqing Sunny Dai, Sebastian Kjeldgaard-Nintemann, Sonia Diaz, Cristiano di Benedetto, Jialing Hu, Jonathan Brewer, Julia Mertesdorf and Tricia Loo Yi Jun gathered with colleagues from the other Nordic countries and actively participating in the program and outdoor activities.

The overall objective of Bridging Nordic Microscopy Infrastructure (BNMI) is to strengthen the international competitiveness and facilitate the development of world-leading Nordic advanced microscopy environments, by organizing scientific and technical Symposia, workshops and knowledge-exchange seminars, shadowing programs for facility staff and short-term scientific mobility grants for researchers and increase the training and innovation activities among the participant Nordic countries. The participating countries in this infrastructure are Denmark, Iceland, Finland, Norway and Sweden.

# DBI-INFRA COLLABORATIONS

## DBI-INFRA is partner of GloBIAS

The Global BioImage Analysts' Society (GloBIAS) aims to be a worldwide association that brings together all those interested in bioimage analysis. The society enable learning and knowledge exchange between members by a number of different tools, such as online events, in-person workshops and online repositories. The project is hosted by German Bioimaging and the group responsible to implement the project has a large experience in bioimaging and bioimage analysis. In 2024 Tricia Loo attended the attended the first in-person GloBIAS Bioimage Analysts Workshop in Gothenburg, Sweden on Nov 5 to 8, 2024. (Group photo under).Furthermore, Clara Prats, DBI INFRA Director, is part of the group that is responsible to implement the project.

**Open Science**

DBI-INFRA collaborates with the Danish e-Infrastructure Collaboration (DeiC), Globias and Euro-BioImaging to consolidate existing bioimaging and computing infrastructures, foster new image and workflow management standards, and organize networking and dissemination activities around bioimage analysis and image data management.

## Global BioImaging's Exchange of Experience 2024 Conference, Osazaki, Japan

Clara Prats, DBI INFRA Director, attended the Global BioImaging´s Exchange of Experience conference held in Okazaki, Japan in October 29-31. She presented the Image Analysis and Data Managementat the Danish BioImaging Infrastructure. Scan the Qr code to view her presentation on the Global Bioimaging website and Youtube.

# DBI-INFRA COLLABORATIONS

## Alexandra Institutet - key insights 2024

During the past three years, the Alexandra Institute has facilitated a series of stakeholder meetings in collaboration with Danish BioImaging Network and QIM. The fourth stakeholder meeting was part of Danish BioImaging Network's Annual Scientific Symposium held in Panum June 2024

The focus of the fourth stakeholder meeting AI in biodata: Industry Insights was on collecting and understanding industry insights and challenges when working with AI in biodata. A common issue in this field is that AI models require large amounts of data. The keynote speaker Kirstine Roepstorff presented how Novo Nordisk address this issue by collaborating with 45 partners and competitors to build a structure to share image data. The message was that sharing data is crucial for the development of AI models. By giving collaborators access to data, Novo Nordisk can develop strong AI within their own production. Central to this project is however also the ability to trust the data from other partners as well as ensuring that sharing images will not disclose industry secrets.
This series of stakeholder meetings on biodata analysis has shown several interesting insights about the key challenges when working in a cross-disciplinary field.

Stakeholder meeting in at Copenhagen University on June 2024

"We are creating a common language in a new field that is constantly changing".

**Jon Sporring**
Professor, Department of Computer Science, UCPH

THIS ANNUAL REPORT IS A
PUBLICATION OF
DANISH BIOIMAGING INFRASTRUCTURE

Many thanks to all our colleagues at EuroBioImaging Communication and Danish BioImaging Core facilities who contributed with texts and images to this report.

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THANKS TO THE DANISH ROADMAP FOR RESEARCH INFRASTRUCTURES 2020 FOR FINANCING OUR ROADMAP INFRASTRUCTURE

## ACKNOWLEDGMENTS

Ministry of Higher Education and Science

UNIVERSITY OF COPENHAGEN

AARHUS UNIVERSITET

DTU

Roskilde Universitet

SDU

Danish Cancer Society | RESEARCH CENTER

AALBORG UNIVERSITET



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