Report on a pilot study: Implementation of OMERO for microscopy data management

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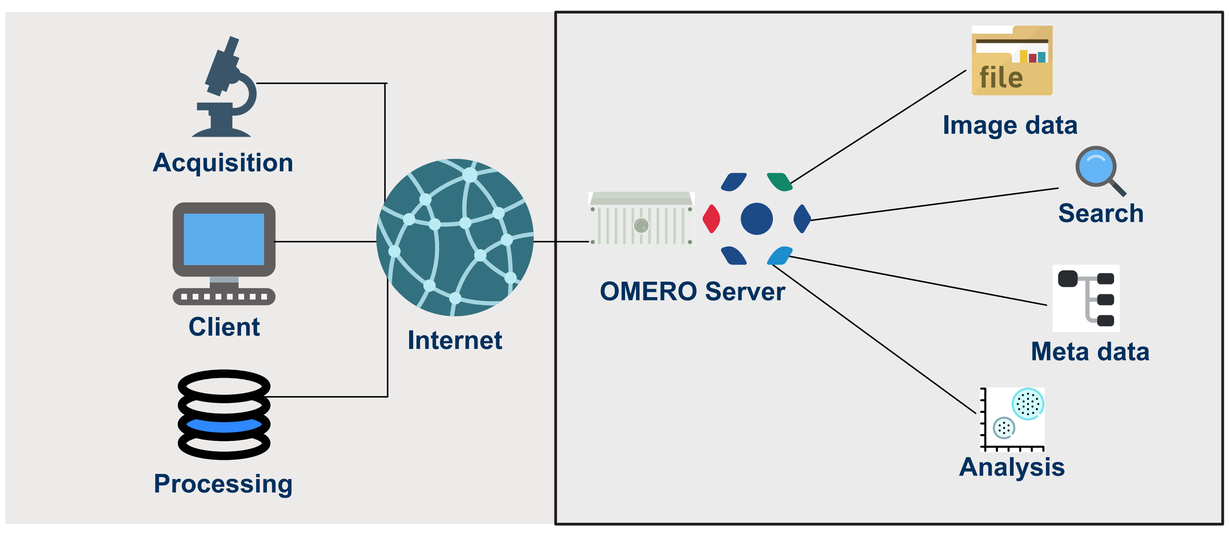
Abstract

The FAIR concept (Findability, Accessibility, Interoperability, Reproducibility) of data management is of relevance for all current areas of research. For imaging data obtained from both light and electron microscopy, data management is associated with a number of challenges related to the size, complexity, dimensionality, visualization and quantitative analysis of the acquired data. We have started to use the Python-based and open-source image data management software OMERO. This software package has been introduced by the Open Microscopy Environment developers of the University of Dundee. OMERO is an encouraging option to manage microscopy data. It is installed on a virtual machine and connected to a central data server to manage the storage of images in a multi-user environment. In addition to long-term data storage, it provides possibilities for saving important metadata in an efficient manner, thus avoiding multiple copies of data. It can also handle open source-based processing tools for image analysis, thereby allowing effective image analysis workflows. The Core Facility Cellular Imaging (CFCI) at the Faculty of Medicine Carl Gustav Carus (TU Dresden) is currently running a pilot project for testing the use and handling of the OMERO software. This is done together with interested users of the imaging facility and a research group. Currently, we are pushing forward this pilot study on a small scale without any data steward. Our experiences argue so far for giving data management issues into the hands of dedicated personnel not fully involved in research projects. As funding agencies will ask for higher and higher standards for implementing FAIR-data principles in the future, this will be a relevant topic for the whole research community. We want to introduce a convenient solution, which could be applicable for many users within the DRESDEN-concept research alliance and demonstrate how to establish and manage OMERO in a facility context.

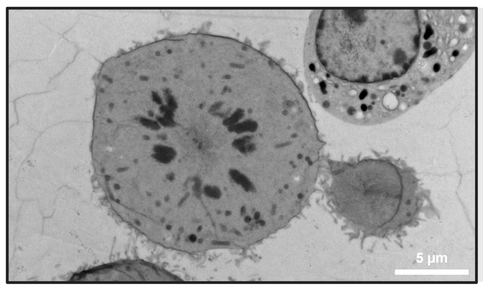
OMERO



FAIR principles

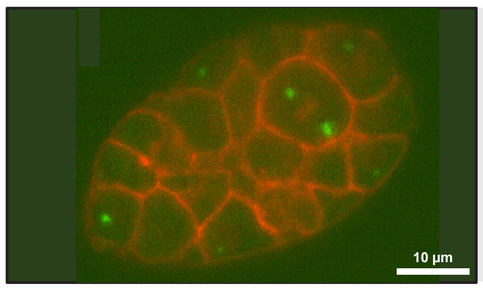
OMERO			
Findability	**A**ccessibility	**I**nteroperability	**R**eproducibility
Unique image ID	OMERO.web interface (browser-based)	Python-based	Raw image data are stored unchanged
Tagging	Public access	Interface to Fiji and Napari	File attachments (figures, results, tables, macros, scripts)
Advanced search (key-value pairs & meta data)	OpenLink (collaboration)	Integration in other software (KNIME,QuPath, CellProfiler)	Integration with electronic lab notebooks

Pilot projects



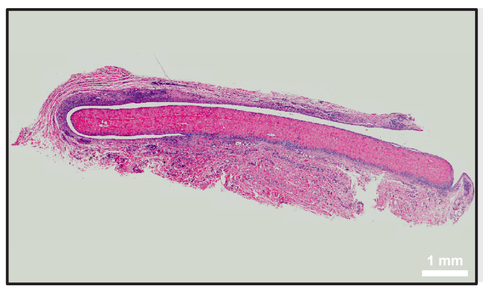
Electron microscopy

- Various file formats
- Large data volume
- Complex analysis
- Low sample number



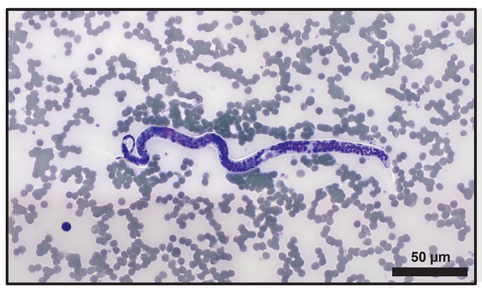
Lattice light-sheet microscopy

- Few experiments
- Each experiment very complex
- Large data volume per experiment (~ 10 TB in total for all experiments)



Histology

- Complex experiments
- High experiment
- Large data volume
- Integrated analysis
- 100 animals
- 4 stainings
- ~20 TB



Medical education

- Annotations for teaching
- Parallel access for students
- Diversity of samples and stainings
- Virology

OMERO implementation

Swedlow et al. developed OME-TIFF (2000)

DFG funds German BioImaging Network (2012)

RDM4mic
OMERO Research Data Management for Microscopy (2019)

Funding for I3D:bio by DFG (2022 - 2024)

TiM Conference
First hand-on meeting with data stewards and OMERO support (2023)

Funding for NFDI4BIOIMAGE by DFG (2023 - 2028)

Current Challenges

- IT resources, infrastructure (space, backup, long-term storage)
- IT support (installation, maintenance)
- Data steward

Implementation strategy of OMERO at the CFCI (2020 - now)

2020 March	TiM conference: first introduction to OMERO
2020 October	Letter of support for the I3D:bio grant application
2022 February	First local meeting with IT to start a pilot project (10 TB server space)
2022 March	Support by RDM4mic for setting up the OMERO server
2022 May	Cooperation agreement with I3D:bio for support during pilot project
2022 May	IT infrastructure (storage & virtual machine & staff) ready to start
2022 July	OMERO setup finished, test environment at IT department
2022 September	OMERO login (only for members of the Faculty of Medicine)
2022 October	Preliminary teaching materials provided by I3D:bio team
2022 November	Start uploading of data (light-sheet microscopy, live-cell imaging, slide scanner)
2023 March	TiM conference - First hands-on training with I3D:bio team (tagging, data structure)
2023 April	OMERO open for all TU members, web access from all over the world
2023 April	Start to implement analysis workflow in OMERO environment
2023 August	Second hands-on meeting with I3D:bio team (scripting, key value templates)
2023 August	Meeting with local IT for future expansion (IT resources, personnel resources)
2023 September	Pilot implementation for medical education (parallel data access for >300 students)

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Mitglied im Netzwerk von DRESDEN concept SCIENCE AND INNOVATION CAMPUS

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