

# Strategies for Multimodal Image Data Transformation to a Common Format for Cloud Integration and Visualization

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Due to their inherent complexity, biological systems require extensive imaging to achieve statistically significant results. Manual operation of microscopy equipment can be laborious and hinder the acquisition of large datasets, impacting reproducibility. To overcome these challenges, the integration of bioimage analysis with computer-controlled microscopes has led to the development of “smart microscopy”. This approach merges computer-controlled imaging systems, image analysis, and machine learning to execute automated imaging workflows that result in large and complex data sets. At the Centre for Cellular Imaging of Gothenburg University, we are developing and delivering smart microscopy solutions to our scientific community through open-access services for academia and industry alike. However, with increasing automation comes a significant challenge: the sheer volume of resulting imaging datasets. These datasets can span several terabytes, can be generated in a matter of hours, often consist of “multiscale” and “multimodal” datasets, and in some cases, are stored in proprietary file formats. Understandably, this poses formidable challenges for tasks such as visualization, image analysis, data management and sharing with the community.

To address these challenges, we're employing a multifaceted approach that incorporates cutting-edge techniques and tools. This includes utilizing next-generation file formats like ome-zarr,[1] leveraging advanced visualization software such as napari,[2] and integrating collaborative image analysis platforms like webknossos.[3] This comprehensive strategy not only accelerates insight extraction from microscopy datasets but also ensures efficient resource utilization in the era of data-driven life sciences. In this contribution, we focus on our efforts to generate open-access software tools that standardize the transformation of complex and proprietary file formats across a wide range of microscope solutions, including high content screening, light-sheet microscopy, and electron microscopy (both scanning and transmission). Of particular interest is our focus on datasets for correlative array tomography, including those obtained from the ZEISS MultiSEM,[4] and strategies for multimodal imaging with other technologies such as nanoSIMS[5]. Utilizing the emerging community standard ome-zarr provides us with access to a chunked, cloud-compatible format that enables rapid visualization and facilitates the analysis of large image datasets.

**Keywords:**

image analysis, data management, correlative

**Reference:**

- [1] Moore, Josh et al. "OME-Zarr: a cloud-optimized bioimaging file format with international community support." *Histochemistry and cell biology* vol. 160,3 (2023): 223-251. doi:10.1007/s00418-023-02209-1
- [2] Ahlers, J., et al. Napari: A Multi-dimensional Image Viewer for Python. v0.4.18, Zenodo, 5 July 2023, doi:10.5281/zenodo.8115575.
- [3] Boergens, Kevin M et al. "webKnossos: efficient online 3D data annotation for connectomics." *Nature methods* vol. 14,7 (2017): 691-694. doi:10.1038/nmeth.4331
- [4] <https://www.zeiss.com/microscopy/en/products/sem-fib-sem/sem/multisem.html>
- [5] Kay, Emma et al. "NanoSIMS Imaging Reveals the Impact of Ligand-ASO Conjugate Stability on ASO Subcellular Distribution." *Pharmaceutics* vol. 14,2 463. 21 Feb. 2022, doi:10.3390/pharmaceutics14020463