

Accessible sharing of large correlative image datasets

Christian Tischler, Data Science Centre, EMBL

OME-Zarr Symposium, November 2025

Choices for image formats and storage locations...

Image format:

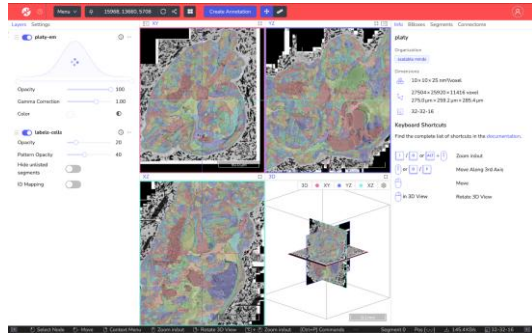
- OME-Zarr
 - Easy partial access (streaming)
 - Support for multi-resolution
 - Community format

Storage locations:

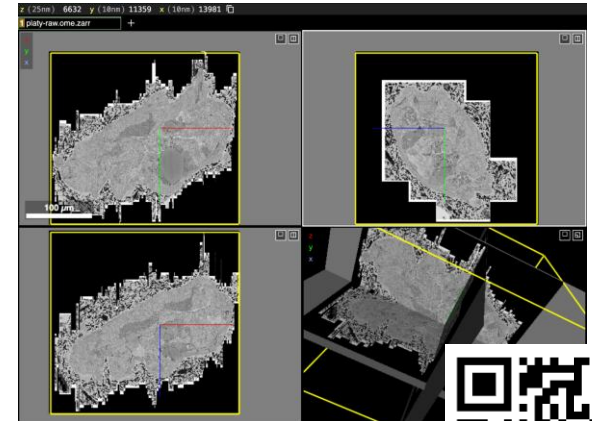
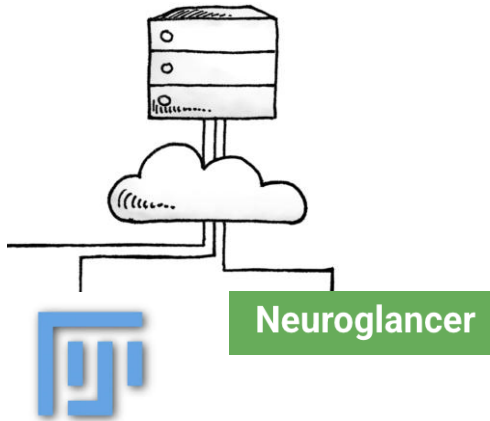
- File system
 - `/group/user/data/image.ome.zarr`
 - Typically only accessible within own group...
 - Data Management Application, EMBL
 - Fileglancer, Janelia, Konrad Rokicki
- S3 object store
 - <https://my-s3-endpoint/my-bucket/image.ome.zarr>
 - Publicly accessible



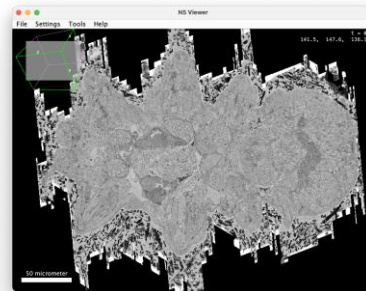
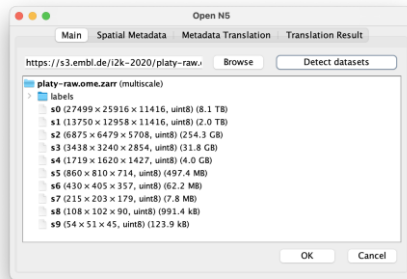
<https://s3.embl.de/i2k-2020/platy-raw.ome.zarr>



WEBNOSSOS

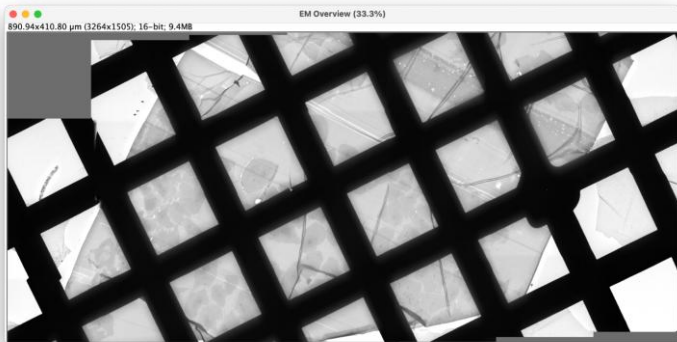


Plugins › BigDataViewer ›
HDF5/N5/Zarr/OME-NGFF Viewer

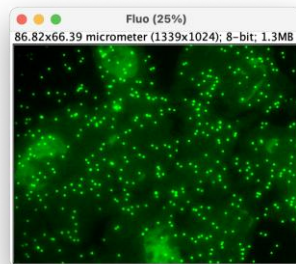


Moore et al., OME-Zarr,
Histochem Cell Biol. 2023

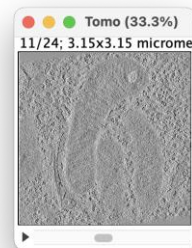
Correlative image data sharing...



900 x 400 micrometer²
2.1 micrometer voxel size
1 z-slice (2-D)

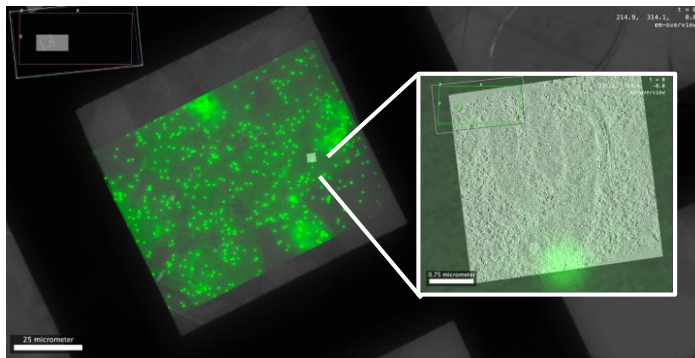


80 x 60 micrometer²
64 nanometer voxel size
1 z-slice (2-D)



3 x 3 micrometer²
1.5 nanometer voxel size
24 z-slices (3-D)

Challenges:
Different voxel sizes
Different dimensionality
Different datatypes
Different physical extent
Different physical locations



“Conventional solution”: Resample all data into one multi-channel image

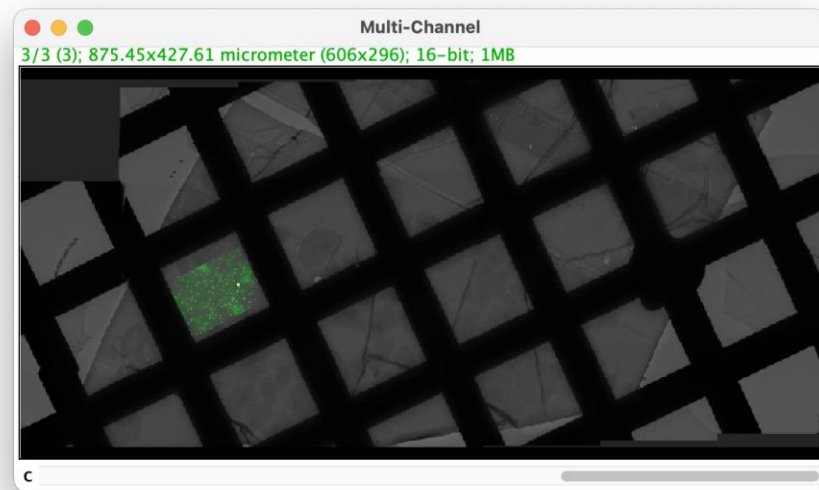
Pro:

Easy to share and work with

Con:

Data “duplication” (2 GB => 24 TB)

Registration improvements require resaving...



“Modern solution”: Produce multi-resolution OME-Zarr images and transformation text files

Neuroglancer URL



```
"projectionOrientation": [↔],
"projectionScale": 72147.78080095498,
"layers": [
  {
    "type": "image",
    "source": {
      "url": "https://uk1s3.embassy.ebi.ac.uk/bia-zarr-test/mobie/clem-full/remote-data/em-overview.ome.zarr",
      "transform": {
        "matrix": [
          [
            -0.971,
            -0.102,
            483042.99999999994
          ],
          [
            0.119,
            -0.985,
            487002.99999999994
          ]
        ]
      }
    }
  }
]
```

Neuroglancer JSON

Pro:

Data size stays the same

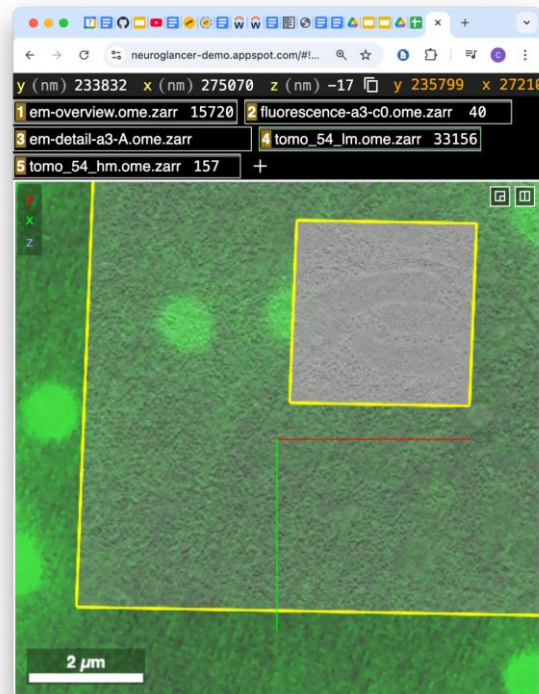
One URL to share the data

Improvements in registration just require update of JSON text file

Con (currently...):

Only few software can open it

Difficult to compute on this data



JSON text files for correlative image data sharing

Software supporting JSON based correlative image data visualisation:

Neuroglancer (WWW)

MoBIE (Fiji)

BigDataViewer (Fiji)...

SpatialData (Python)

...unfortunately all have a different “JSON Schema”

Ongoing community work:

Create community standard “OME-Zarr Collection & Transformation JSON” that will be read by all applications.



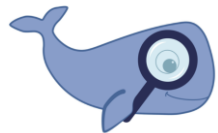
Norman
Rzepka



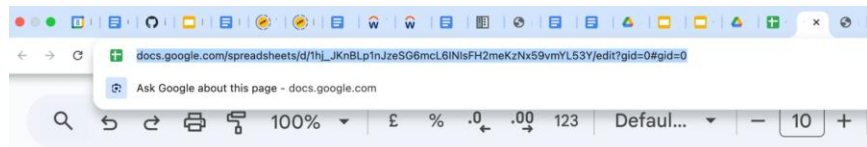
John
Bogovic

Could there be additional ways to specify image data collections that are more easily creatable by humans than JSON?

```
{
  "dimensions": {↔},
  "position": [↔],
  "crossSectionScale": 88.29435200705845,
  "projectionOrientation": [↔],
  "projectionScale": 32768,
  "layers": [
    {
      "type": "image",
      "source": [
        "https://s3.embl.de/i2k-2020/platy-raw.ome.zarr/zarr2:",
        "s3+https://"
      ],
      "tab": "source",
      "name": "platy-raw.ome.zarr"
    }
  ],
  "selectedLayer": {↔},
  "layout": "4panel-alt"
}
```

MoBIE (Fiji plugin) Collection Tables



	A	B	C	D
1	uri	affine	color	notes
2	https://uk1s3.embassy.ebi.ac.uk/bia-zarr-test/mobie/clem-full/remote-data/em-overview.ome.zarr	(-0.102, -0.971, 0, 483.043, -0.985, 0.119, 0, 487.003, 0, 29.308, 0)		
3	https://uk1s3.embassy.ebi.ac.uk/bia-zarr-test/mobie/clem-full/remote-data/tomo_54_hm.ome.zarr	(-0.04, 1.004, 0, 234.172, 1.02, 0.018, 0, 271.224, 0, 1, -0.075)		mitochondria
4	https://uk1s3.embassy.ebi.ac.uk/bia-zarr-test/mobie/clem-full/remote-data/fluorescence-a3-c0.ome.zarr	(-0.371, 0.946, 0, 215.345, 0.969, 0.353, 0, 244.318, 0, 15.423, 0)	green	
5	https://uk1s3.embassy.ebi.ac.uk/bia-zarr-test/mobie/clem-full/remote-data/em-deta-il-a3-A.ome.zarr	(-0.24, 0.972, 0, 193.857, 0.969, 0.353, 0, 244.318, 0, 15.423, 0)		
6	https://uk1s3.embassy.ebi.ac.uk/bia-zarr-test/mobie/clem-full/remote-data/tomo_54_lm.ome.zarr	(-0.102, -0.971, 0, 483.043, -0.985, 0.119, 0, 487.003, 0, 29.308, 0)		

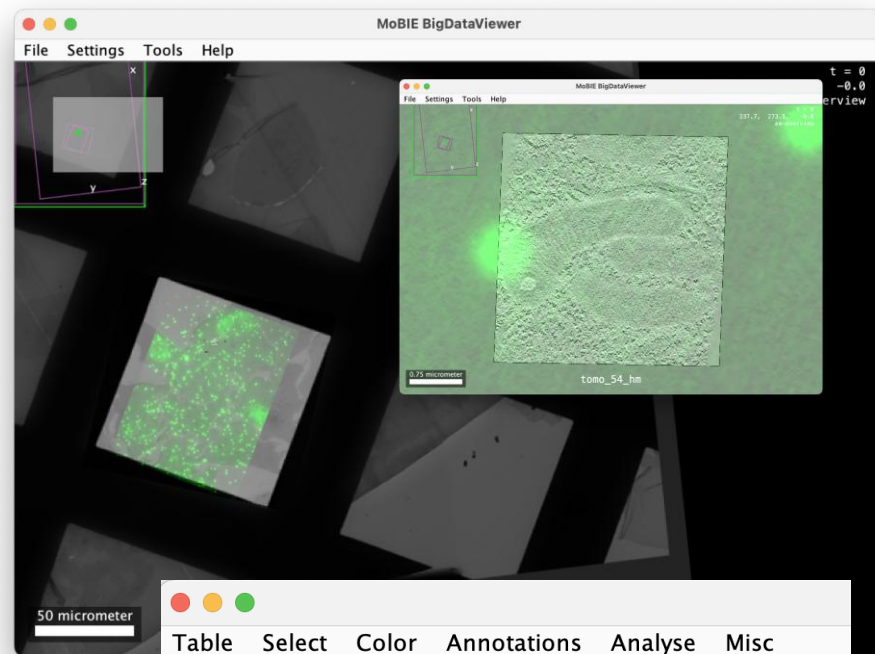
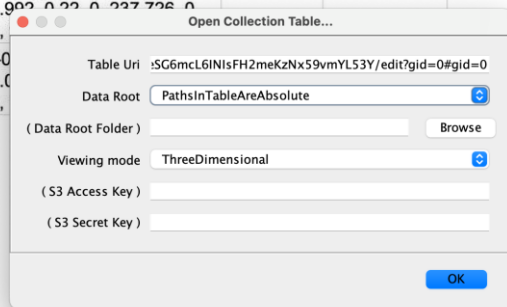
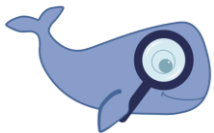


Table	Select	Color	Annotations	Analyse	Misc
uri		affine		color	notes
https://uk1s3.emb...	(-0.371, 0.946, 0, ...	green			
https://uk1s3.emb...	(-0.04, 1.004, 0, 2...	green			mitochondria
https://uk1s3.emb...	(-0.04, 1.004, 0, 2...				
https://uk1s3.emb...	(-0.24, 0.972, 0, 1...				
https://uk1s3.emb...	(-0.102, -0.971, 0...				



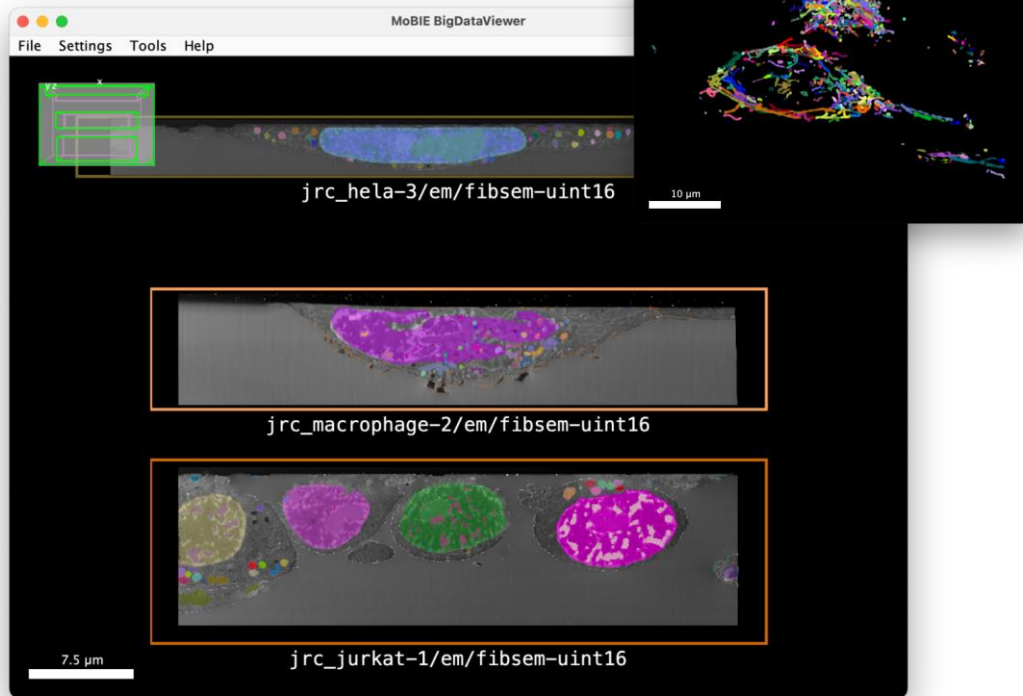
Label masks and grid layout

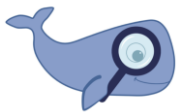
Janelia Open-organelle MoBIE collection

File Edit View Insert Format Data Tools Extensions Help

100% 123 Calibri

	A	B	C
1	uri	type	grid_position
2	s3://janelia-cosem-datasets/jrc_hela-3/jrc_hela-3.n5/em/fibsem-uint16	intensities	(0,0)
3	s3://janelia-cosem-datasets/jrc_hela-3/jrc_hela-3.n5/labels/nucleus_seg	labels	(0,0)
4	s3://janelia-cosem-datasets/jrc_hela-3/jrc_hela-3.n5/labels/pm_seg	labels	(0,0)
5	s3://janelia-cosem-datasets/jrc_hela-3/jrc_hela-3.n5/labels/chrom_seg	labels	(0,0)
6	s3://janelia-cosem-datasets/jrc_hela-3/jrc_hela-3.n5/labels/mito_seg	labels	(0,0)
7	s3://janelia-cosem-datasets/jrc_macrophage-2/jrc_macrophage-2.n5/em/fibsem-uint16	intensities	(0,1)
8	s3://janelia-cosem-datasets/jrc_macrophage-2/jrc_macrophage-2.n5/labels/nucleus_seg	labels	(0,1)





Labels and spots annotation tables

uri	type	labels_table_uri
https://s3.embl.de/i2k-2020/platy-ra_w.ome.zarr	intensities	
https://s3.embl.de/i2k-2020/platy-ra_w.ome.zarr/labels/cells	labels	https://docs.google.com/spreadsheets/d/1xZ4Zfpg0RUwhPZVCUrX_whB0QGztLN_VVNLx89_rZs4/edit?gid=890359520#gid=890359520
https://docs.google.com/spreadsheets/d/1xZ4Zfpg0RUwhPZVCUrX_whB0QGztLN_VVNLx89_rZs4/edit?gid=1367078606#gid=1367078606	spots	

label_id	anchor_x	anchor_y	anchor_z	cell_type
45	193.58	167.33	0.68	None
46	198.42	178.09	6.29	epithelial
47	178.99	176.70	6.60	epithelial
48	178.83	180.67	7.45	epithelial
49	179.52	183.37	0.26	None
50	188.07	182.52	3.79	epithelial
51	193.43	176.37	4.66	None

spot_id	x	y	z	annotation
1	235.33	154.81	75.68	eye
2	111.61	153.65	108.03	muscles

“Label table” use case:
Segmented objects QC
Segmented objects measurement visualisation

“Spots” use cases:
Annotate biological landmarks
Spatial-transcriptomics


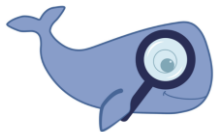

all: cells

Table	Select	Color	Annotations	Analyse	Misc	
label_id	anchor_x	anchor_y	anchor_z	cell_type	bb_min_x	bb_min_y
1092	206.6823...	122.1988...	26.65133...	None	196.68	117.76
1093	219.5788...	134.1085...	22.90546...	epithelial	207.6	128.8
1094	179.7710...	140.9873...	37.01252...	None	174.4200...	138.704
1095	177.9612...	139.6881...	28.30483...	None	174.08	137.14
1096	175.7957...	140.5504...	18.50597...	None	174.9200...	139.04
1097	179.9020...	145.1115...	23.51018...	None	174.24	140.16
1098	190.6461...	135.9894...	22.33678...	None	185.4	133.08
1099	188.1850...	141.8533...	21.44417...	None	185.26	135.6
1100	187.7486...	135.1876...	17.58766...	None	186.6	134.06
1101	188.2234...	136.6862...	17.80333...	None	186.94	135.18
1102	191.1063...	142.1615...	21.73320...	None	186.32	135.06
1103	200.1759...	140.2512...	24.50101...	None	192.42	138.04
1104	207.8793...	136.6378...	24.82344...	None	186.1	131.08

all: locations

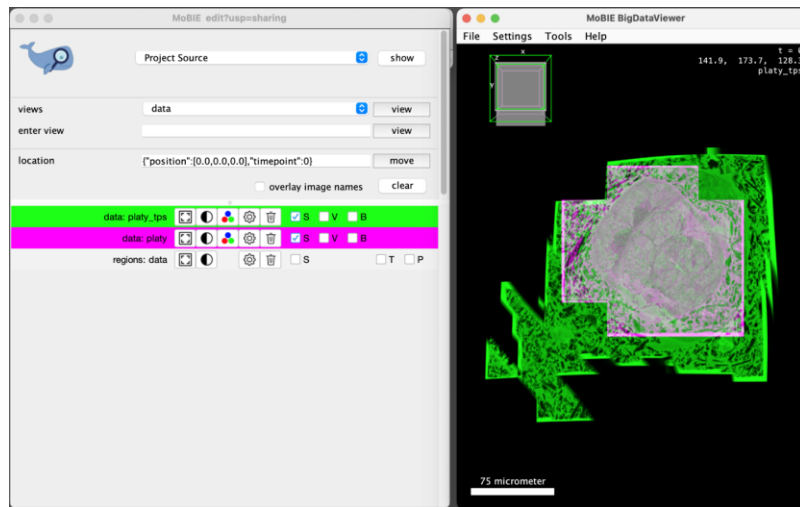
Table	Select	Color	Annotations	Analyse	Misc
spot_id	annota...	source			
1	eye	locations			
2	muscles	locations			

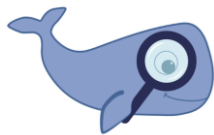




BigWarp ThinPlateSpline transformation support

	A	B	C
1	uri	color	thin_plate_spline
2	https://s3.embl.de/i2k-2020/platy-raw.ome.zarr	magenta	<pre>{"type": "Thin Plate Spline", "landmarks": {"type": "BigWarpLandmarks", "numDimensions": 3, "movingPoints": [[112.98000000000002, 105.93294117647059, 142.40000000000003], [202.55647058823533, 185.98000000000005, 142.4000000000003], [141.56823529411767, 135.47411764705885, 45.140455717198996], [225.42705882352945, 206.94470588235296, 45.140455717198996], [147.2858823529412, 166.92117647058828, 5.4912482766544155], [107.26235294117649, 87.82705882352941, 269.1371777702781], [145.38000000000002, 120.22705882352942, 269.1371777702781], [117.74470588235297, 109.74470588235295, 233.44546221564804], [155.8623529411765, 51.61529411764705, 233.44546221564804]], "fixedPoints": [[112.98000000000002, 107.83882352941177, 142.40000000000003], [217.80352941176474, 207.897647058</pre>
3	https://s3.embl.de/i2k-2020/platy-raw.ome.zarr	green	





MoBIE supports many data formats

Data types: Images and tables

Storage locations: S3 object store URLs, absolute and relative local file paths

For tables, in addition: Google Sheet URLs, GitHub URLs

Image formats: OME-Zarr¹, Bio-Formats², ilastik-HDF5

Table formats: Google Sheet, CSV, TSV, Excel

Label table column names: MoBIE, CellProfiler, ImageJ/MorphoLibJ, ImageJ/ParticleAnalyzer, skimage regionprops, ilastik segmentation and tracking

1) <https://github.com/saalfeldlab/n5-ij>

2) <https://github.com/BIOP/bigdataviewer-image-loaders>



John
Bogovic



Nicolas
Chiaruttini

I know.....

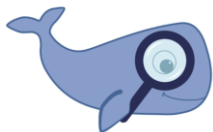
...I invented another file format...I am sorry...

Excuses:

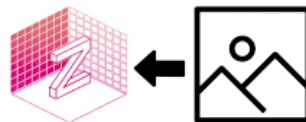
...it is easy to use and accessible for non-computational people

...I am promise to develop on a tool that converts MoBIE collection tables to the upcoming OME-Zarr (and/or Neuroglancer) collection JSON

Acknowledgments (very incomplete)



- Constantin Pape
- Kimberly Meechan



OME-ZARR

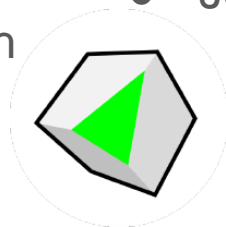
Tutorial



Videos



- Stephan Saalfeld
- Stephan Preibisch
- Tobias Pietzsch



- Josh Moore
- Norman Rzepka
- John Bogovic



**NFDI 4
BIOIMAGE**

Partially funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) under the National Research Data Infrastructure – NFDI 46/1 – 501864659



**CHAN
ZUCKERBERG
INITIATIVE**