

DRAFT 3D Reconstruction (v0.1)

This document and specification is actively evolving. Please reach out to the DCWG or IEC prior to investing time preparing data to meet these current specifications.

[HuBMAP EPICs Overview](#)

3D reconstruction are pseudo 3D volumes generated from serial sections. All images used to create the 3D reconstruction must be uploaded prior to uploading this EPIC. True 3D images such as from the lightsheet assay should be uploaded as primary data and not using this EPIC datatype. A 3D Reconstruction might not be a comprehensive 3D volume, for example, if one of the serial sections is missing. Hence these are considered “pseudo” 3D volumes and sometimes referred to as “2.5D”. There is also no expectation with regard to the type of images used in a 3D reconstruction. For example the reconstruction could include Visium, histology and CODEX images.

While most reconstructions will consist of 2D serial sections, the specification allows for 3D layers within the reconstruction.

Requirements

Metadata

- Required and optional dataset-level metadata are defined [here](#). There are currently no specific metadata requirements, beyond the [Common Derived Dataset Fields](#).
 - The “parent dataset id” should include all HuBMAP IDs for the primary datasets pertaining to the serial sections used in creation of the 3D reconstruction. For example, if the 3D reconstruction included 10 serially sectioned histology images, then this would be the HuBMAP IDs for each of the 10 histology datasets.
 - When uploading the parent (primary) datasets, it is important to include the [sample-section metadata](#). As the section-level metadata includes both the thickness of each section and the index of the sectioning within the tissue block.
 - Any discrepancies across sections (e.g., different antibodies) will need to be managed by the data provider and documented in the protocol.

Files

- OME-TIFF
 - The deliverable is a 3D OME-TIFF file
 - How do we handle heterogeneous stacks?
 - [Common imaging fields](#)
- [ome-tiff.channels.csv](#)

- This optional file details which channels to display as default and channel thresholds.
- Transformations
 - There are currently no standards around the structure or content of the transformation files, beyond the file location:
 - TOP/derived/3d_reconstruction/transformations/
 - The structure and usage of transformation files should be detailed in the protocol.
 - These files could, for example, contain vector field-type (nonlinear) transformations

[Metadata about the dataset](#)

[Directory structure specification](#)

Examples

Notes from meeting 12-4-24

- Somewhere, the 2D data that was ingested needs to have an indicator that it is _part of_ a 3D dataset
 - We have this for free, when 2D sections are uploaded when submitter uploads section sample metadata
 - Parent dataset ID is attached to a list of the 2D datasets
- Alignment of the 2D slices is the minimal information needed to define the 3D volume
 - Alignment may require a vector field-type of (nonlinear) transformation
- What do end-users want to do with 3D objects
 - Construct meshes or otherwise derive new segmentations?
 - Visualize the 3D volume directly?
- Making a 3D volume “usable” is challenging
 - Channel windowing, transparency thresholds, etc.
 - Depends on where the volume came from
 - Lightsheet can be easier
 - CODEX or IMS are more challenging - looks messier, user sees “wall of color”, especially if the set of channels selected is random
 - Don’t want user to have the initial reaction that the data is garbage, when really it is just due to the set of channels that have been pre-selected
 - Ideally, data submitters can provide a list of interesting channels and predefined channel windowing ranges

- There is an existing channel metadata file that data submitters upload (ome-tiff.channels.csv)
- What about reconstructions with “gaps”
 - Can gaps be inferred from the metadata in the portal?
 - Every section in a block should be registered, but visually things can be incoherent in certain cases
 - Certain masks may only make sense to define for part of a block
 - Is z-axis gap equal to x/y between-voxel size? Not necessarily, it should be up to data submitter.
- SpatialData format question
 - This can be an `_output_` of HIVE processing pipelines (as opposed to an input)
 - Only note is to ensure that there is enough metadata to make this possible (coordinate systems, physical size units, correspondence between image and derived spatially-resolved data such as segmentations, etc)
- What is the thing we are talking about?
 - Just an image; no objects
 - How will identified objects be specified/submitted? (3D) [Segmentation Masks](#) (other schema, also includes meshes)
- What would be useful for a demo day presentation?
 - Does the draft 3D reconstruction work for future data submitters? Demo day would be useful to receive feedback on this question
- Do we care about file size?
 - 3D OME-TIFF can be stored using an image pyramid which can alleviate issues with large images
 - HIVE will generate the pyramids, so uploaded image does not need to be pyramidal