

SOP: Using 3D Reference Objects

Integrating 3D Reference Objects into EUI and RUI Tools

Authors: Andreas Bueckle, Kristen Browne, Bruce Herr, Katy Börner

Approved by: Kristen Browne (3/19/21), Bruce Herr (3/22/21), Katy Börner (5/14/21)

HIVE MC-IU Team, Indiana University

PI: Katy Börner

NIH Award No: 1OT2OD026671

Updated: April 9, 2021

Introduction

The procedures outlined in this document describe how approved 3D reference organ objects are integrated into the [CCF Portal 3D Reference Object Library](#) on the [CCF Portal](#), the [Registration User Interface](#) (RUI), and the [Exploration User Interface](#) (EUI).

Roles and Responsibilities

Below, please find definitions for each role in the procedures outlined here. [Table 1](#) identifies the people occupying these roles currently.

The **Principal Investigator (PI)** is responsible for for delivering anatomically correct 3D models for use in the HuBMAP Atlas construction effort. The PI approves budgets associated with the 3D reference object modeling and usage process, sets high-level goals and associated deadlines, attends meetings, and reviews notes and recordings from relevant meetings between the Facilitator and other key personnel as outlined in this SOP.

The **3D Modeler** builds 3D models, negotiates and implements suggested changes with SMEs, and uploads the models for use in HuBMAP services and user interfaces.

The **Facilitator** is the 3D Modeler's main contact in the MC-IU team. The 3D Modeler and the Facilitator meet weekly.

The **CNS Systems Architect** uses the 3D objects in the Registration User Interface (RUI) and Exploration User Interface (EUI). The CNS Systems Architect offers their technical expertise in the areas of 3D model storage options and the integration of the 3D models into the HuBMAP ecosystem (e.g., how structures should be labeled to work well with existing ontology schemas).

Table 1. Roles, names, and email addresses of key personnel.

Role	Name	Email
PI	Katy Börner	katy@indiana.edu
3D Modeler	Kristen Browne	kristen.browne@nih.gov
Facilitator	Andreas Bueckle	abueckle@iu.edu
Systems Architect	Bruce W. Herr II	bherr@iu.edu

Workflow

Step 1: Updating the United File as Needed

1. The **3D Modeler** updates the United file with every newly approved organ or organ change, following the steps in the SOP on 3D Reference Object Approval.
2. The **3D Modeler** notifies the **CNS System Architect** and the **Facilitator** of the change.
3. The **CNS System Architect** adds the new United file to the CCF Ontology.

Step 2: Pushing to GitHub

4. The **3D Modeler** pushes the models to the CCF 3D Reference Object Library repository on Github: <https://github.com/hubmapconsortium/ccf-3d-reference-object-library>
5. The **3D Modeler** notifies the CNS System Architect and the Facilitator via email of the new organ.
6. The **Facilitator** keeps a local clone of the repository to track changes for their own records.

Step 3: Adding Organs to the CCF Portal

7. The **CCF Portal** contains a [sub-page](#) with a link to the repository. Reference organs are shown in a preview window with the number of anatomical structures and direct links to the corresponding object on GitHub.
8. The **CNS System Architect** adds all final organs to the CCF Portal.

Step 4: Exporting 3D Models

9. Once a 3D model has been approved as per the [corresponding SOP](#), the **3D Modeler** exports it in FBX and GLB formats.

HuBMAP

10. The **3D Modeler** creates two versions per format:
 - a. A low-polygon version, which serves as the working version and is always updated first and used to share should there be update requests going forward.
 - b. A high-polygon version once all changes are final. This is in order to save time as the export process in multiple resolutions is manual and time-consuming.

References

- The [CCF 3D Reference Object Library repository](#) on GitHub is where the 3D Modeler uploads their models.
- [GitHub Desktop](#) can be used by the Facilitator and/or the 3D Modeler to commit and review changes to the models.
- The [CCF Portal](#) is the central hub for many MC-IU contributions, such as the ASCT+B Tables, the CCF 3D Object Library, and the CCF Ontology.
- [3D Reference Object Approval](#) Standard Operating Procedures

Glossary

3D model: A 3D model is a digital object, consisting of vertices and edges, who, when taken together, can form a potentially endless variety of primitive (e.g., cubes, spheres, cones) and complex shapes (such as organs). 3D models come in many formats with various capabilities and limitations (OBJ, FBX, GLB, see below). We use GLB and FBX as output formats.

ASCT+B Tables: see [HuBMAP Glossary](#).

Common Coordinate Framework (CCF): see [HuBMAP Glossary](#).

Exploration User Interface (EUI): see [HuBMAP Glossary](#).

FBX file format: 3D file format specification, see <https://code.blender.org/2013/08/fbx-binary-file-format-specification/>

GitHub: an online service for version control and code-sharing

GLB file format: 3D file format specification, see <https://docs.fileformat.com/3d/glb/>

OBJ file format: 3D file format specification, see <https://www.cs.cmu.edu/~mbz/personal/graphics/obj.html>

Registration User Interface (RUI): see [HuBMAP Glossary](#).

HuBMAP

Standard Operating Procedures (SOPs): SOPs are issued to specifically instruct team members in areas of responsibility, procedural steps, appropriate specifications and required records. SOPs outline procedures, which must be followed to support the reproducibility of scientific research. Procedures can take the form of a narrative, a flow chart, a process map, computer screen printouts or combination of all or any other suitable form, however must be written in appropriate, effective grammatical style. (e.g. plain English).

United File: The United File is a GLB 3D object that contains all the modeled organs. It is hosted on GitHub and used in the EUI (see above) to display registered tissue blocks. The United file is thus a compound file with all 3D organ objects combined.