Description of GUI of the 3D model building tool

To facilitate reconstruction process a simple graphical user interface was prepared. Below, the 3dBAR reconstruction GUI with an exemplary CAF dataset loaded (<u>Johnson et. al., 2010</u>.)

Selecting structures

The left panel contains *ontology tree* loaded from CAF index file. One can browse through structures, select them for reconstruction or load already reconstructed, cached models. The right panel contains two tabs. *Structure selection tab* displays detailed information about the currently selected structure for reconstruction. This includes abbreviated and full name of the structure, span of slides on which it is defined as well as color assigned to this structure. Here one can also set the resolution, the depth of decomposition of the structure into substructures according to ontology tree, and mirroring of brain hemisphere may be enabled if needed.

' 3d Brain Atlas Reconstructor ver. 0.1 – + 😵							
<u>A</u> tlas <u>E</u> dit	<u>H</u> elp						
Abbreviation	Full name of the structure	Model customization	Structure select	ion			
✓ Brain cb	Whole brain Cerebellum	Structure details:					
▼ FB	Forebrain	Abbreviated name:	Str				
▷ Th Amy	Thalamus (remainder) Amygdala	Full name:	Striatum				
Hc	Hippocampus	Slides:	(366, 589)				
Acb GP	Nucleus accumbens Globus pallidus	Assigned colour:	(41, 83, 20	4)			
Fnx	Fornix	Reconstruction properties:					
Hyp Str	Hypothalamus	Coronal resolution (mm/voxel):					
Pin Cx	Striatum Pineal gland Cerebral cortex	Anterior - posterior res. (mm/voxel): 0.0215					
SN	Lateral septal nuclei	Generate substructures up to level: 0					
P HB P fibres	Hindbrain fibres	Mirror along y axis					
P ∨s olf	Ventricular system Olfactory areas	Perform reconstruction	n				
⊳ мв	Midbrain						

Figure 1: The *structure selection tab*. The *Striatum* selected for reconstruction (gray highlight); *Amygdala* and *Hippocampus* loaded as context models (red font). The reconstruction of Hypothalamus is cached and available for loading (bold font).

Viewing and customizing the reconstructions

Reconstructed models can be viewed in the *Model customization tab* (Fig. 2) which also provides access to parameters of VTK pipeline. The preview is displayed in the form of triangular mesh although the actual model is still stored in volumetric form. The model can be rotated by pressing and holding left mouse button, zoomed in or out by pressing and holding the right button. Pressing the middle button allows one to pan the model over the scene. One can switch between wireframe and surface representations of the model by pressing w or s keys.

Atlas Edit Help Abbreviation Full name of the structure Model customization Structure selection ✓ Brain Whole brain Structure selection ✓ FB Forebrain Forebrain ✓ FB Forebrain Forebrain ✓ Th Thalamus (remainder) Amy Amygdala Hc Hc Hippocampus Acb Acb Nucleus accumbens GP GP Globus pallidus Fnx Fnx Fornix Hyp Hyp Hypothalamus Total cortex SN Lateral septal nuclei HB ▶ HB Hindbrain Hindbrain								
 Brain Whole brain cb Cerebellum FB Forebrain Th Thalamus (remainder) Amy Amygdala Hc Hippocampus Acb Nucleus accumbens GP Globus pallidus Fnx Fornix Hyp Hypothalamus Str Striatum Pin Pineal gland Cx Cerebral cortex SN Lateral septal nuclei 	<u>A</u> tlas <u>E</u> dit							
cb Cerebellum ✓ FB Forebrain ▷ Th Thalamus (remainder) Amy Amygdala Hc Hippocampus Acb Nucleus accumbens GP Globus pallidus Fnx Fornix Hyp Hypothalamus Str Striatum Pin Pineal gland Cx Cerebral cortex SN Lateral septal nuclei	Abbreviation	Full name of the structure	Model customization	Structure selection				
 ▷ fibres fibres ▷ VS Ventricular system ○ Olf Olfactory areas ▷ MB Midbrain ✓ Axes permutation □ Gaussian volume smoothing ✓ Isosu New order of axes Standard deviation Contour □ along x,y and z axes 0 □ 1.0 	cb ✓ FB ▷ Th Amy Hc Acb GP Fnx Hyp Str Pin Cx SN ▷ HB ▷ fibres ▷ VS Olf	Cerebellum Forebrain Thalamus (remainder) Amygdala Hippocampus Nucleus accumbens Globus pallidus Fornix Hypothalamus Striatum Pineal gland Cerebral cortex Lateral septal nuclei Hindbrain fibres Ventricular system Olfactory areas	New order of axes	Standard deviation along x,y and z axes 1.0 1.0	Contour va			

Figure 2: The model customization tab. Reconstructions of Striatum, Amygdala and Hippocampus are presented.

After changing VTK pipeline parameters, mesh may be recalculated by pressing *Refresh* button and cached by pressing *Save model*. Models are cached in form of polygonal meshes (<u>vtkPolyData</u>). *Clear scene* button removes all models from preview window. When a model is cached, the corresponding element of the ontology tree is displayed with bold font. Cached models can be loaded in the preview window as *context models* alongside the model being presently reconstructed, however they cannot be modified. When a cached model is loaded into

context, the corresponding element in ontology tree is displayed in red.

Generating multiple reconstructions

Multiple reconstructions can be performed one by one as described above. However, this is convenient only when few models are required. To reconstruct multiple structures one can choose a parent structure containing desired substructures and reconstruct them down to a desired level of detail. All substructures are generated using the same set of reconstruction parameters provided in Structure selection tab and the same VTK pipeline. Models are generated one by one and automatically cached. When all the substructures are reconstructed they are loaded into preview window as context models.

Exporting the models

By default models are cached in the directory where CAF dataset is located. One may choose another export directory by selecting *Set cache directory* from *Edit* menu. When cache directory is changed, all currently loaded structures are removed from preview and ontology tree updates information about availability of cached models from the new directory.

3d Brain Atlas Reconstructor GUI offers three ways of exporting three dimensional models. Single reconstructions may be cached as polygonal data (<u>vtkPolyData</u>) or exported as volumetric datasets in the native VTK (<u>vtkImageData</u>) or (Neuroimaging Informatics Technology Initiative, <u>NIFTI</u>) formats. Complex scenes containing numerous context models may be exported into (Virtual Reality Modelling Language, <u>VRML</u>) or <u>X3D</u> format.