

SPM Anatomy Toolbox

Version 3.0

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For general questions and comments regarding cytoarchitectonic mapping please contact Prof. Katrin Amunts (k.amunts@fz-juelich.de)

References for the SPM Anatomy toolbox:

Eickhoff S, Stephan KE, Mohlberg H, Grefkes C, Fink GR, Amunts K, Zilles K. A new SPM toolbox for combining probabilistic cytoarchitectonic maps and functional imaging data. *NeuroImage* 25(4), 1325-1335, 2005

Eickhoff, S.B.; Heim, S.; Zilles, K.; Amunts, K. Testing anatomically specified hypotheses in functional imaging using cytoarchitectonic maps. *NeuroImage* 32(2), 570-582, 2006

Eickhoff SB, Paus T, Caspers S, Grosbras MH, Evans A, Zilles K, Amunts K. Assignment of functional activations to probabilistic cytoarchitectonic areas revisited. *NeuroImage* 36(3), 511-521, 2007

References for probabilistic cytoarchitectonic mapping

Zilles K, Amunts K. Centenary of Brodmann's map – conception and fate. *Nature Reviews Neuroscience* 11(2): 139-145, 2010 Amunts K, Schleicher A, Zilles K. Cytoarchitecture of the cerebral cortex – more than localization. *Neuroimage* 37: 1061-1065, 2007

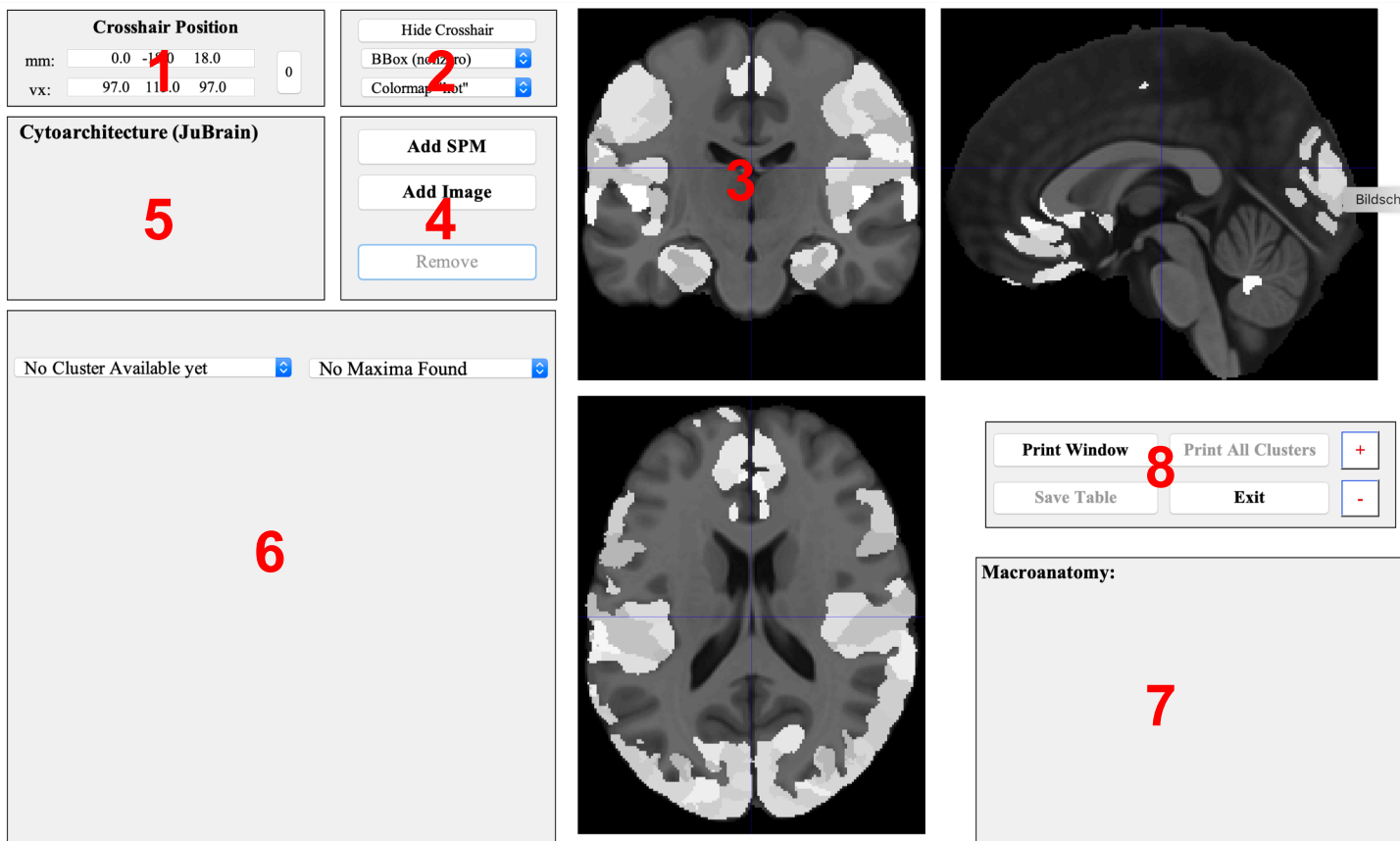
Zilles K, Schleicher A, Palomero-Gallagher N, Amunts K. Quantitative analysis of cyto- and receptor architecture of the human brain. In: *Brain Mapping: The Methods*, J. Mazziotta and A. Toga (eds.), p. 573-602, 2002

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Atlas & Assignment Tool

ROI Tool

Atlas & Assignment Tool



- 1) **Coordinate panel**
Showing and changing the crosshair position
- 2) **Figure settings**
Modifying the display of the orthogonal sections
- 3) **Orthogonal sections**
Showing the MNI152 template in the background with the JuBrain Maximum Probability Map in lighter greyx
- 4). **Overlay controls**
Load or remove an SPM map or an image overlay
- 5) **JuBrain Voxel Assignment**
Cytoarchitectonic information for the crosshair location
- 6) **JuBrain Cluster assignment**
Cytoarchitectonic information per overlay-cluster + Navigation through the overlay (SPM map, image)
- 8) **Macroanatomical panel**
Assignment of the crosshair position and the current overlay cluster (if applicable) to the Harvard-Oxford macroanatomical atlas
- 7) **Control panel**
Various controls including the change of font size (+ / - buttons)

Coordinate panel

Cross-hair position in MNI152 (world) space

Cross-hair position in MPM voxel space

Changing the coordinates (confirmed by ↵)

moves the cross-hair and updates the voxel assignment

Crosshair Position				
mm:	0.0	-18.0	18.0	0
vx:	97.0	115.0	97.0	

Move cross-hair to origin

Figure settings

Hide Crosshair	
BBox (nonzero)	⬇
Colormap "hot"	⬇

Toggle cross-hairs on / off (not affecting behavior)

Zoom in/out focused on the cross-hair location

Change the colormap of an overlay
(not affecting the atlas & template display)

Control panel

Cycle through all clusters and save a screen-shot

Screen-shot

Save JuBrain

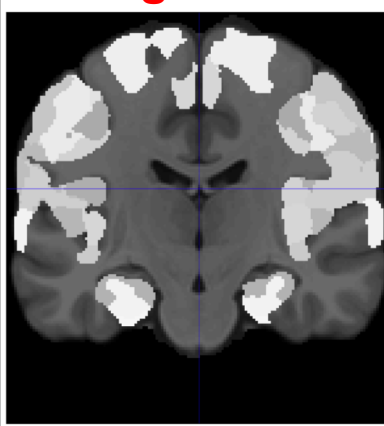
assignment for all clusters as tsv

Print Window	Print All Clusters	+
Save Table	Exit	-

Increase font size

Decrease font size

Orthogonal sections



In dark grey, the (non-linear) MNI152 template is shown, light grey represents the assignment to histological areas based on the JuBrain Maximum Probability Map. This map assigns each voxel to the most likely histological area at that position.

Overlays, e.g., findings from functional or structural imaging studies may be overlaid on this map and are shown using the color-scale defined in the figure settings panel.

Clicking on any of the three sections changes the cross-hair position to that location. In this process, the coordinate panel, the JuBrain voxel assignment and the macroanatomical information is updated.

Overlay controls



Bring up the SPM contrast manager, allowing you to define, evaluate and threshold contrasts

Add an overlay image from a nifti-file.
Premultiply: Multiply all image values by a scalar
Hight threshold: Evaluated after pre-multiplication
Extent threshold: In voxels (native image space)

Remove the current overlay (only one overlay can be shown at any time)

Overlays need to be in MNI152 space and are resampled to the template resolution (1 mm isotropic)

JuBrain Voxel Assignment

Cytoarchitecture (JuBrain)
Area OP4 [PV]
48.5% Area OP4 [PV]
18.5% Area 1
12.6% Area 3b
3.2% Area PFop (IPL)

“Hard” assignment based on the Maximum Probability Map (MPM)

Full description: probabilities for all histological area found at this position

Information in this panel pertain (only) to the voxel at the cross-hair position

Crosshair Position
mm: 65.4 -7.6 17.8
vx: 162.0 125.0 97.0

Cytoarchitecture (JuBrain)
Area OP4 [PV]
48.5% Area OP4 [PV]
18.5% Area 1
12.6% Area 3b
3.2% Area PFop (IPL)

Hide Crosshair
BBox (nonzero)
Colormap "hot"

Add SPM
Add Image
Remove

No Cluster Available

Area OP4 [PV]
S. Eickhoff, A. Schleicher, K. Zilles, K. Amunts. The human parietal operculum. I. Cytoarchitectonic mapping of subdivisions. Cereb. Cortex 16 (2): 254-267, 2006.
S. Eickhoff, K. Amunts, H. Mohlberg, K. Zilles. The human parietal operculum. II. Stereotaxic maps and correlation with functional imaging results. Cereb. Cortex 16 (2): 268-279, 2006.
Area 1
S. Geyer, A. Schleicher, K. Zilles. Areas 3a, 3b, and 1 of human primary somatosensory cortex: I. Microstructural organisation and interindividual variability. NeuroImage 10: 63-83, 1999.
S. Geyer, T. Schormann, H. Mohlberg, K. Zilles. Areas 3a, 3b, and 1 of human primary somatosensory cortex: II. Spatial normalization to standard anatomical space. NeuroImage 11 (6): 684-696, 2000.
Area 3b
S. Geyer, A. Schleicher, K. Zilles. Areas 3a, 3b, and 1 of human primary somatosensory cortex: I. Microstructural organisation and interindividual variability. NeuroImage 10: 63-83, 1999.
S. Geyer, T. Schormann, H. Mohlberg, K. Zilles. Areas 3a, 3b, and 1 of human primary somatosensory cortex: II. Spatial normalization to standard anatomical space. NeuroImage 11 (6): 684-696, 2000.
Area PFop (IPL)
S. Caspers, S. Geyer, A. Schleicher, H. Mohlberg, K. Amunts, K. Zilles. The human inferior parietal cortex: Cytoarchitectonic parcellation and interindividual variability. NeuroImage 33 (2): 430-448, 2006.
S. Caspers, S. B. Eickhoff, S. Geyer, F. Scheperjans, H. Mohlberg, K. Zilles, K. Amunts. The human inferior parietal lobule in stereotaxic space. Brain Structure and Function 212 (6): 481-495, 2008.

Print Window Print All Clusters

Pointing the cursor on the name of a cytoarchitectonic area and keeping it there for ~1 second reveals the references describing the cytoarchitectonic mapping of this histological area.

JuBrain Cluster assignment

This will update the *JuBrain Voxel Assignment panel* for information on maxima location



Use this menu to jump to the different clusters.
Coordinates indicate the location of the cluster maximum

Use this menu to jump to the different peaks (local maxima) within a cluster.
Values in parenthesis indicate the overlay value (e.g., T / Z statistic).

Comparison between the current cluster and the JuBrain MPM
Overlap is provided relative to cluster and area (in brackets) volume (Eickhoff et al., 2005)

Average probability for each JuBrain area at the location of the cluster relative to its full probability map
Higher values indicate a location more towards the center of the area (cf. Eickhoff et al., 2007)

Image: timing [u=0.0, k=0]

(618 vox): -38 / -12 / +60 (7.61): -38 / -12 / +60

Assignment based on Maximum Probability Map

11.8% in Area 3b [5.8 activated]

7.2% in Area 1 [3.4 activated]

4.0% in Area 4p [3.3 activated]

3.9% in Area 4a [1.7 activated]

3.5% in Area 2 [1.6 activated]

Probability exceedance (under cluster vs. entire map)

1.51 [1.35; 1.73] for Area 4p

1.49 [1.40; 1.55] for Area 3b

1.24 [1.16; 1.33] for Area 1

0.90 [0.82; 0.97] for Area 2

0.75 [0.72; 0.79] for Area 4a

Top probabilities at peak voxels (union)

0.99 for Area 1

0.92 for Area 3b

0.77 for Area 2

0.46 for Area 4a

Union of the probability values for each area at the location of the local maxima
High values indicate that at least one peak was most likely located in the respective area give histological variability

The **Macroanatomical panel** follows the same layout
It is concurrently updated when a new cluster / maximum is selected

ROI Tool

Click on area name selects both sides

Currently selected regions

Lobe for which
available areas
are shown →

Changing lobes
retains all area
selections

The screenshot shows the ROI Tool interface. On the left, a list of lobes is shown: amygdala, basal forebrain, cerebellar nuclei, frontal lobe (highlighted in red), insula, limbic lobe, occipital lobe, parietal lobe, and temporal lobe. To the right of the lobes is a list of brain areas, each with 'L' and 'R' checkboxes and a text input field. The areas are: Area 44, Area 45, Area 4a, Area 4p, Area 6d1, Area 6d2, Area 6d3, Area 6mc / SMA, Area 6mr / preSMA, Area Fo1, Area Fo2, Area Fo3, Area Fp1, Area Fp2, Area OP8, and Area OP9. Below the list of areas are four buttons: 'Clear page' (blue), 'Select page' (green), 'Clear all' (blue), and 'Select all' (green). To the right of the list of areas are two buttons: 'Create joint ROI (all selected)' and 'Create individual ROIs'. On the far right, there is a 'Selected regions' box, which is currently empty. Below this box are two buttons: 'Extract data per ROI' and 'Exit'. At the bottom right, there are two buttons: '+' and '-'.

Lobe	L	R	Area
amygdala	<input type="checkbox"/>	<input type="checkbox"/>	Area 44
basal forebrain	<input type="checkbox"/>	<input type="checkbox"/>	Area 45
cerebellar nuclei	<input type="checkbox"/>	<input type="checkbox"/>	Area 4a
frontal lobe	<input type="checkbox"/>	<input type="checkbox"/>	Area 4p
insula	<input type="checkbox"/>	<input type="checkbox"/>	Area 6d1
limbic lobe	<input type="checkbox"/>	<input type="checkbox"/>	Area 6d2
occipital lobe	<input type="checkbox"/>	<input type="checkbox"/>	Area 6d3
parietal lobe	<input type="checkbox"/>	<input type="checkbox"/>	Area 6mc / SMA
temporal lobe	<input type="checkbox"/>	<input type="checkbox"/>	Area 6mr / preSMA
	<input type="checkbox"/>	<input type="checkbox"/>	Area Fo1
	<input type="checkbox"/>	<input type="checkbox"/>	Area Fo2
	<input type="checkbox"/>	<input type="checkbox"/>	Area Fo3
	<input type="checkbox"/>	<input type="checkbox"/>	Area Fp1
	<input type="checkbox"/>	<input type="checkbox"/>	Area Fp2
	<input type="checkbox"/>	<input type="checkbox"/>	Area OP8
	<input type="checkbox"/>	<input type="checkbox"/>	Area OP9

Clear page Select page

Clear all Select all

Create joint ROI (all selected)

Create individual ROIs

Selected regions

Extract data per ROI

Exit

+ -

One binary ROI image
in 1mm MNI152 space
containing the MPM
representations of all
selected areas is saved

Extracts the mean value at the MPM
representations of all selected areas
for a set of user-provided images
Provided images must be in MNI space
Resolution can be arbitrary

One binary ROI image per selected area
containing its MPM representation in
1mm MNI152 space is saved

In- / decrease
font size