AAL3 User Guide

The automated anatomical parcellation AAL3 of the spatially normalized single-subject high- resolution T1 volume provided by the Montreal Neurological Institute (MNI). This includes the original parcellation provided in AAL (Tzourio-Mazoyer et al., 2002), the new parcellation of the orbitofrontal cortex provided in AAL2 (Rolls, Joliot, and Tzourio-Mazoyer (2015)) , but also new areas, as described in this User Guide and by Rolls, Huang, Lin, Feng and Joliot (2020).

Anatomical Automatic Labeling (AAL3) is a package for the anatomical labeling of functional brain mapping experiments. It is an in-house package made by the Neurofunctional Imaging Group (GIN, UMR5296, Bordeaux, France), which is available to the scientific community as copyright freeware under the terms of the GNU General Public License.

Download

AAL 3v2, released on the 5 April 2024:

with the addition of the operating licence, "GNU General Public Licence", in the readme. Note that has there is no modification of the atlas, it is thus named AAL3v1 (.nii, …) like in the previous version. *Released on the 5th of April, 2024*

update involving small changes of the thalamic parcellation in line with the update of Freesurfer 7. Released on the 10th of June, 2020 (AAL 3v1)

New version of anterior cingulate, thalamus and brain nuclei (nucleus accumbens, substantia nigra, ventral tegmental area, red nucleus, locus coeruleus, and raphe nuclei). Released on the 30th of August, 2019 (AAL 3)

SPM12 version of AAL3 software: AAL3v2_for_SPM12.zip

User guide

Following a first version AAL of the automated anatomical labeling atlas (Tzourio-Mazoyer et al 2002), a second version (AAL2) (Rolls, Joliot, and Tzourio-Mazoyer, 2015) was developed that provided an alternative parcellation of the orbitofrontal cortex following the description provided by Chiavaras, Petrides, and colleagues. We now provide a third version, AAL3, which adds a number of brain areas not previously defined, but of interest in many neuroimaging investigations. The new areas in the third version are subdivision of the anterior cingulate cortex into subgenual, pregenual and supracallosal parts; division of the thalamus into its nuclei; the nucleus accumbens, substantia nigra, ventral tegmental area, red nucleus, locus coeruleus, and raphe nuclei. The new atlas is available as a toolbox for SPM, and can be used with MRIcron.

As in the previous release of AAL, AAL3 is provided with isotropic voxel size 2x2x2 mm. In addition, AAL3_1mm is also provided with a 1x1x1 mm voxel sampling size. Note that only the AAL3 added regions benefit from this finer spatial definition.

Please note that the original numbers in AAL2 for the anterior cingulate cortex (35, 36) and thalamus (81, 82) are left empty in AAL3, as those voxels were substituted by the new subdivisions (Thalamic nuclei: 121-151; ACC: 151-156). Thus, the total number of parcellations in AAL3 is 166, with maximum label number 170. This ensures that most of the numbers used in AAL2 remain the same in AAL3, while AAL3 mainly adds new areas starting at number 121.

Please also note that caution is advised in the use of some of the smaller regions defined in the AAL3, for reasons set out by Rolls, Huang, Lin, Feng, and Joliot (2020). Further, if AAL3 was resampled to for example 3x3x3 mm, some of the smaller areas might no longer be defined.

Content of the archive

1)   All the files with the ".m" extension are part of the code AAL3.m

2)   The nifti/gz files AAL3v1.nii / ROI_MNI_V7.nii / AAL3v1.nii.gz have the same volume data, but the headers and compressions are different to accommodate the needs of different types of software, which are AAL3 / spm (Results-Atlas)/ MRIcron respectively.

3)   The same applies to the 3 files: AAL3v1_1mm.nii / ROI_MNI_V7_1mm.nii / AAL3v1_1mm.nii.gz

Atlas	Filename	description
2x2x2 mm3	ROI_MNI_V7.nii	Required for AAL3.m
	ROI_MNI_V7_vol.mat	Required for AAL3.m
	ROI_MNI_V7_List.mat	Required for AAL3.m
	ROI_MNI_V7_Border.mat	Required for AAL3.m
	ROI_MNI_V7_vol.txt	ROI description (text format)
	ROI_MNI_V7.xml	ROI name (xml format)
	AAL3v1.nii.gz	Required for mricron
	AAL3v1.nii.txt	Required for mricron
	AAL3v1.nii	Required for spm (Results-Atlas)
	AAL3v1.xml	Required for spm (Results-Atlas)
1x1x1 mm3	ROI_MNI_V7_1mm.nii	Required for AAL3.m
	ROI_MNI_V7_1mm_vol.mat	Required for AAL3.m
	ROI_MNI_V7_1mm_List.mat	Required for AAL3.m
	ROI_MNI_V7_1mm_Border.mat	Required for AAL3.m

	ROI_MNI_V7_1mm_vol.txt	ROI description (text format)
	ROI_MNI_V7_1mm.xml	ROI name (xml format)
	AAL3v1_1mm.nii.gz	Required for mricron
	AAL3v1_1mm.nii.txt	Required for mricron
	AAL3v1_1mm.nii	Required for spm (Results-Atlas)
	AAL3v1_1mm.xml	Required for spm (Results-Atlas)

How to install the software on a unix system

1)	Copy the archive to the chosen location (e.g. /usr/local/soft/spm12/toolbox) after removing the old AAL3 directory

unix> cp AAL3v2_for_SPM12.zip /usr/local/soft/spm12/toolbox

unix> cd /usr/local/soft/spm12/toolbox

2)	Gunzip and untar the archive will create an AAL3 directory

unix> unzip AAL3v2_for_SPM12.zip

3) Add this directory to your Matlab path and copy the 4 files in your SPM12/atlas directory:

unix> mkdir /usr/local/soft/spm12/atlas

unix> cp /usr/local/soft/spm12/toolbox/AAL3/AAL3v1.nii /usr/local/soft/spm12/atlas

unix> cp /usr/local/soft/spm12/toolbox/AAL3/AAL3v1.xml /usr/local/soft/spm12/atlas

unix> cp /usr/local/soft/spm12/toolbox/AAL3/AAL3v1_1mm.nii /usr/local/soft/spm12/atlas

unix> cp /usr/local/soft/spm12/toolbox/AAL3/AAL3v1_1mm.xml /usr/local/soft/spm12/atlas

4) To install AAL3 for mricron software:

unix> cp /usr/local/soft/spm12/toolbox/AAL3/AAL3 v1.nii.gz /usr/local/soft/mricron/templates

unix> cp /usr/local/soft/spm12/toolbox/AAL3/AAL3 v1.nii.txt /usr/local/soft/mricron/templates

unix> cp /usr/local/soft/spm12/toolbox/AAL3/AAL3v1_1mm.nii.gz /usr/local/soft/mricron/templates

unix> cp /usr/local/soft/spm12/toolbox/AAL3/AAL3v1_1mm.nii.txt /usr/local/soft/mricron/templates

(In Windows, copy the 4 files AAL3v1.nii.gz, AAL3v1.nii.txt and AAL3v1_1mm.nii.gz and AAL3v1_1mm.nii.txt into mricron/templates.)

How to install the software on a Mac or Windows system

The AAL3v2_for_SPM12.zip file is compatible with both Mac and Windows systems. The installation is depending of your local installation of SPM and Mricron software.

How to use the software

Both AAL3 (see 1) or spm (see 2) can be used

Launch Matlab unix> matlab

1) *Using AAL3*

1.1) how to launch AAL3

- First option: launch AAL3 from SPM12:

Launch spm from the command window

>> spm fmri

In the SPM12 Menu window: "Results"

Select the desired contrast, mask, probability and extent threshold

In the SPM12 Menu window: "toolbox / AAL3"

- Second option: Launch AAL from the Matlab command window:

>> AAL3

Select the desired contrast, mask, probability and extent threshold like in the regular spm Results.

1.2) Choose a labeling procedure. The 3 choices are explained and documented in the paper (Tzourio-Mazoyer et al., 2002): Local maxima labeling, Extended local maxima labeling and Cluster labeling. For "Extended local maxima labeling" input the local maxima radius of the sphere in millimeters (default 10 mm).

1.3) Select the anatomical parcellation database

In /usr/local/soft/spm12/toolbox/AAL3

The file: ROI_MNI_V7.nii (2mm voxel edge, same file than AAL3v1)

or

The file: ROI_MNI_V7_1mm.nii (1mm voxel edge, same file than AAL3v1_1mm)

1.4) Then you get the label on the coordinates in the Graphic window.

2) *Using spm Atlas labelling function : "* spm (Results-Atlas)"

2.1) Launch spm from the command window

>> spm fmri

2.2) Select the desired contrast, mask, probability and extent threshold in the regular "Results". In the SPM12 Results window: Atlas / Label using / AAL3v1

(You may in the SPM Graphics window need to right click on the sections, and select Display > Labels > AAL3v1).

2.3) Then you get the label with a right click on the coordinates in the Graphic window.

Original references

Automated Anatomical Labeling of Activations in SPM Using a Macroscopic Anatomical Parcellation of the MNI MRI Single-Subject Brain. N. Tzourio-Mazoyer, B. Landeau, D. Papathanassiou, F. Crivello, O. Étard, N. Delcroix, B. Mazoyer, and M. Joliot. *NeuroImage* 2002. 15: 273-289. http://dx.doi.org/10.1006/nimg.2001.0978

Implementation of a new parcellation of the orbitofrontal cortex in the automated anatomical labeling atlas. Rolls ET, Joliot M & Tzourio-Mazoyer N (2015) *NeuroImage* 122: 1-5. http://dx.doi.org/10.1016/j.neuroimage.2015.07.075

References

Rolls, E.T., Huang, C.C., Lin, C.-P., Feng, J., Joliot, M., 2020. Automated anatomical labelling atlas 3, Neuroimage 206:116189. https://doi.org/10.1016/j.neuroimage.2019.116189