MARINA:

An easy to use tool for the creation of MAsks for Region of INterest Analyes

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Background

The analysis of fMRI data is usually performed by voxelwise tests of the effects under question. The large number of tests (often > 50,000) requires a rigid control of type I error, which is obtained by procedures using Bonferroni corrections, the random field theory, or the false discovery rate. However, even the least conservative procedure leads to a substantial loss in statistical power compared to a single test.

Statistical power can be greatly enhanced when the number of voxels to be tested is reduced by restricting the analysis to a region of interest (ROI) instead of testing the entire brain. This is appropriate for explorative analyses with specific search regions as well as for confirmatory testing of hypotheses concerning selected brain regions.

Analyses of ROIs require the definition of a ROI in the same space that is used for the imaging data. As many analyses are done with brains that were normalized to the standard brain of the Montreal Neurological Institute (MNI), MARINA was developed as a tool for creating and manipulating masks in the MNI space.

Shortcomings of the Talairach brain

Most researchers use the Talairach brain atlas [1] for labeling coordinates of activated brain regions. This well known atlas provides maps of several brain structures as well as Brodman areas. On the first look, it seems to be appropriate to use this brain for the creation of masks.

The application of the Talairach brain for this purpose has several drawbacks:

- There are considerable gaps between the slices of the Talairach brain.
- The Talairach brain is substantially smaller and has a different shape compared to the MNI brain. Even nonlinear trans-formations of coordinates [2] can lead to mislocations [3].
- The locations of Brodman areas are subject to interindividual variations that cannot be corrected by procedures for anatomical normalization.

Better use the MNI brain!

Normalization to the MNI brain is an often used procedure in the preprocessing of fMRI data. Therefore masks for ROI analyses should use the same space.

As the template for normalization is an average image based on 152 brains provided by the MNI, it is impossible to identify anatomical details which can be used for the creation of masks. This problem was solved through a high-resolution T1 image of a single subject that was normalized to the MNI space.

An invaluable help for the identification of anatomical structures in the single subject MNI brain is the anatomical parcellation of this brain by Tzourio-Mazoyer and coworkers [3]. This work as well as the parcellation of the cerebellum provided by Schmahmann et al. [4] serve as templates for masks in MARINA.

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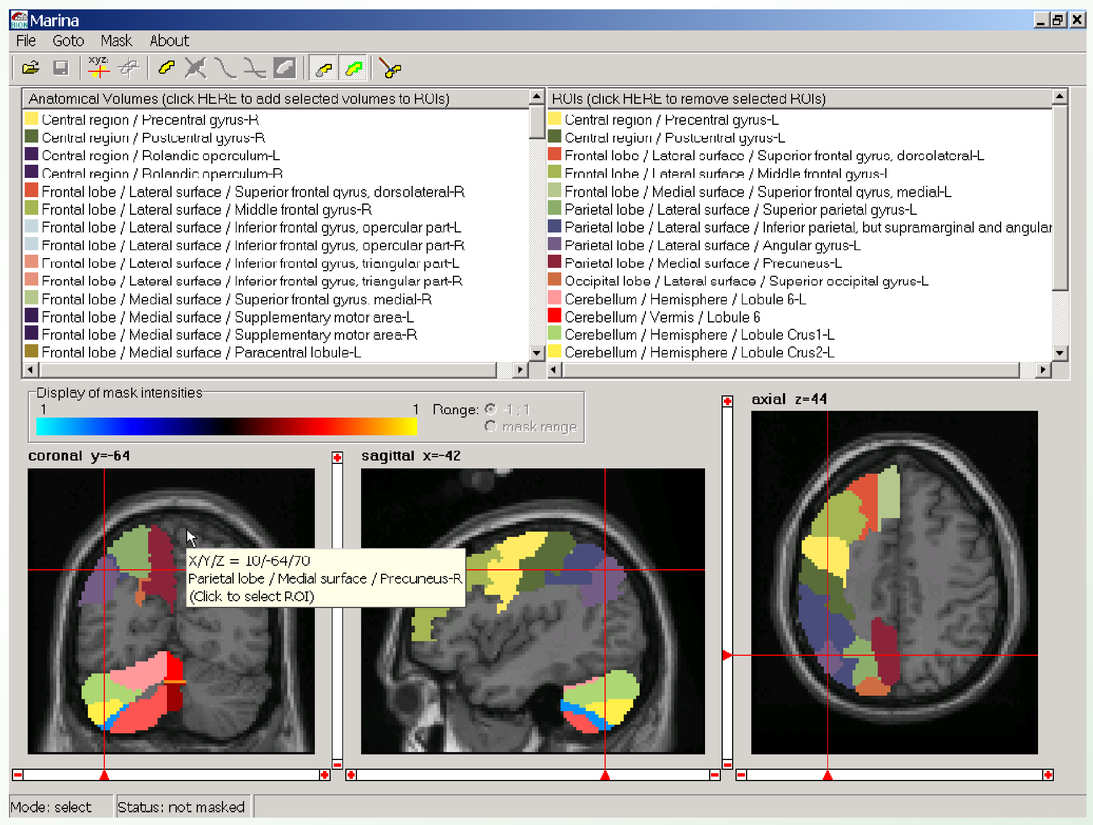
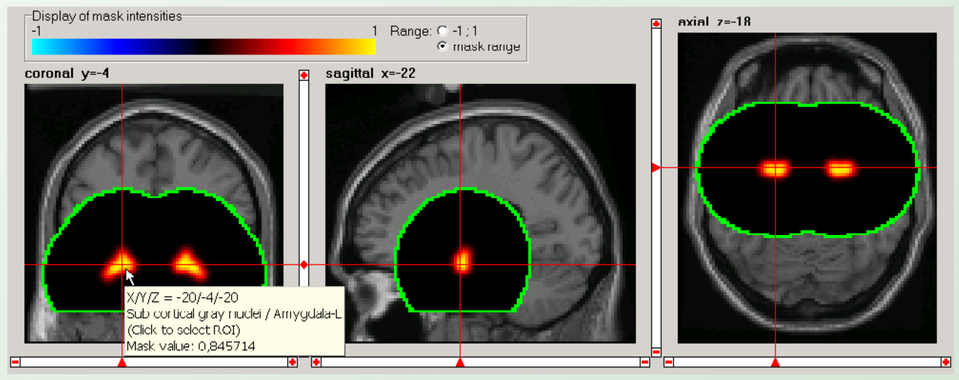
Features

- Creation of masks in SPM Analyze format
- Output mask resolution: 2 mm isotropic
- Visual control in coronal, sagittal, and axial views simultaneously
- Creation of masks aided by templates from [3] and [4]



- Display of labels of anatomical details under cursor in a pop up window
- Editor for modifications of masks
- Growing and shrinking of masks by smoothing using a Gaussian kernel with user defined FWHM and subsequent thresholding
- Reading SPM T-maps as well as masks from other sources (e.g. [5] http://hendrix.imm.dtu.dk/services/jerne/ninf/voi.html)



Availability

- Download at http://www.bion.de
- Free software under the terms of the GNU General Public License (source code available)
- Runs under Windows and WINE (Linux)

References

[1] Talairach, J. & Tournoux, P. (1988). *Co-planar stereotaxic atlas of the human brain*. Stuttgart, New York: Thieme.

[2] Brett, M. http://www.mrc-cbu.cam.ac.uk/Imaging/mnispace.html.

[3] Tzourio-Mazoyer, N., Landeau, B., Papathanassiou, D., Crivello, F., Etard, O., Delcroix, N., Mazoyer, B., & M. Joliot (2002). Automated anatomical labeling of activations in SPM using a macroscopic anatomical parcellation of the MNI MRI single-subject brain. *NeuroImage 15*, 273-289.

[4] Schmahmann, J. D., Doyon, J., McDonald, D., Holmes, C., Lavoie, K., Hurwitz, A. S., Kabani, N., Toga, A., Evans, A., & Petrides, M. (1999). Three-dimensional MRI atlas of the human cerebellum in proportional stereotaxic space. *Neuroimage, 10*, 233-260.

[5] Nielsen, F. A. & Hansen, L. K. (2002), Automatic anatomical labeling of Talairach coordinates and generation of volumes of interest via the BrainMap database. *Neuroimage*, Poster No.: 10497 at HBM 2002.