

Supplementary Material

Sensitive Measures of Cognition in Mild Cognitive Impairment

ASHS-T1 is an open source multi-atlas label fusion algorithm (publicly available at <https://sites.google.com/view/ashs-dox/cloud-ashs/cloud-ashs-for-t1-mri>) that propagates anatomical labels from a set of manually-labeled MRI scans called “atlases” to new unlabeled “target” T1-weighted MRI scans to automatically segment the subregions of the medial temporal lobe (MTL), including anterior/posterior hippocampus, entorhinal cortex, Brodmann areas 35 and 36, and parahippocampal cortex. Hippocampal subfields segmentations are not provided because they cannot be reliably segmented in T1-weighted MRI. Manual labels are generated guided by the T2-weighted MRI of the same set of subjects in the atlas dataset from the University of Pennsylvania (UPenn) to assure accurate segmentation of the dura mater, which locates inferior to the MTL cortex, that is commonly segmented as gray matter by popular segmentation algorithms because it has similar intensity as the cortex in T1-weighted MRI. The algorithm includes the following steps: (1) The T1-weighted MRI scan is first up-sampled to $0.4 \times 0.4 \times 0.8$ mm³ resolution using a non-local-mean super-resolution algorithm [1]. (1) ASHS-T1 uses symmetric greedy diffeomorphic registration in the ANTs software [2] to warp each atlas to the target MRI; (2) the joint label fusion algorithm to combine the anatomical labels from the warped atlases into a single consensus segmentation in a way that assigns spatially varying weights to each atlas based on patch-level similarity to the target image while accounting for possible redundancy among the atlases [3]; (3) the corrective learning algorithm to correct for systematic segmentation biases using classifiers learned from leave-one-out segmentation of the atlas images [4]; (4) bootstrapping, i.e., using the results of multi-atlas segmentation to initialize deformable registration to improve atlas-

target matching. The accuracy of ASHS-T1 relative to manual segmentation was evaluated in [5] using cross-validation. The ASHS-T1 atlas set is publicly available at <https://www.nitrc.org/frs/downloadlink.php/10885>. The automatic segmentations, generated in the space of the upsampled T1-weighted MRI space (0.4x0.4x0.8 mm³), are used to generate volume and thickness measurements.

REFERENCES

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