ADNI Alzheimer's Disease Neuroimaging Initiative

Automated hippocampal segmentation using similarity and truth estimation for propagated segmentations (STEPS)

M. Jorge Cardoso, Kelvin K. Leung, Casper Nielsen and Nick C. Fox
Dementia Research Centre, UCL Institute of Neurology

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Summary

We describe the processing methods in the hippocampal segmentation using similarity and truth estimation for propagated segmentations (STEPS) algorithm. All the images in a template library are registered to the target image. The segmentations are fused by STEPS, which combines a probabilistic formulation of the label fusion problem with the local selection of best atlases.

Methods

We now describe each step in STEPS in more details.

Template library preparation

We used a previously-described hippocampal template library of manually-segmented regions from 55 subjects (36 AD and 19 age-matched controls) scanned at a single site 1.5T GE scanner using a volumetric T1-weighted acquisition (Barnes et al., 2008). The left and right hippocampal regions were manually segmented in MNI 305 space by an expert segmentor (JB). In addition, we included the left-right flipped images and segmentations, in order to double the size of the template library.

Image registration and label propagation

All templates were registered to the target image around the hippocampus using a block-matching affine registration (Ourselin et al., 2000) and non-rigid registration based on free form deformation (Modat et al., 2010; Rueckert et al., 1999). For each registration, the control point spacing was set to 2.5 voxel along each axis. The weight of the bending energy and Jacobian-based penalty terms were set to 1% and 0.5% of the overall objective function respectively.

Label fusion

All the segmentations were fused by STEPS, which used a probabilistic formulation of the label fusion problem where the likelihood of the complete data was maximised given the set of row normalised confusion matrices (Cardoso et al., 2011). In order to select morphologically similar templates, only the locally most similar deformed templates according to the locally normalised cross correlation (LNCC) were used. STEPS also reduced the bias towards small structures by

assuming that if all the templates agreed on a label at a certain spatial position, then the voxel was not taken into account from the estimation of the confusion matrix. A Markov random field (MRF) was also added to introduce spatial smoothness and consistency. The fused segmentation was then thresholded using 60% of the mean brain intensity.

Manual checking and editing

The segmentation was checked and edited, if required, by an expert rater validated on manual segmentation.

Version Information

This is the first version.

Dataset Information

This methods document applies to the following dataset(s) available from the ADNI repository:

Dataset Name	Date Submitted
UCL – Hippocampus Summaries [ADNIGO/2]	1st May 2013

Reference List

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About the Authors

This document was prepared by M. Jorge Cardoso, Kelvin K. Leung, Casper Nielsen and Nick C. Fox at the Dementia Research Centre, UCL Institute of Neurology. For more information please contact Jorge at +44 75 4992 9026 or by email at manuel.cardoso@ucl.ac.uk, or Kelvin at +44 020 3448 4773 or by email at kkleung@ucl.ac.uk.