AOC - Method Description

We present a conceptually novel framework for brain tissue segmentation based on an Atlas of Classifiers (AoC). The AoC allows a statistical summary of the annotated datasets taking into account both the imaging data and the corresponding labels. It is therefore more informative than the classical probabilistic atlas and more economical than the popular multi-atlas approaches, which require large memory consumption and high computational complexity for each segmentation. Specifically, we consider an AoC as a spatial map of voxel-wise multinomial logistic regression (LR) functions learned from the labeled data. Upon convergence, the resulting fixed LR weights (a few for each voxel) represent the training dataset, which might be huge. Segmentation of a new image is therefore immediate and only requires the calculation of the LR outputs based on the respective voxel-wise features. Moreover, the AoC construction is independent of the test images, providing the flexibility to train it on the available labeled data and use it for the segmentation of images from different datasets and modalities.
The proposed method has been applied to publicly available datasets for the segmentation of brain MRI tissues and is shown to outreach commonly used methods. Promising results were obtained also for multimodal, cross-modality MRI segmentation.

We want to test the proposed AoC on sets of multimodal MRI scans: T1, T1-IR and T2-FLAIR. The AoC was trained (LOO) on bi-modal scans and tested on unimodal, including cross-modality scans. By testing the method on the training images of the MRBrains13 data set, we find the results very promising given the extremely small training and the fact that both T1-IR and T2-FLAIR imaging (unlike T2) drastically changes the intensity distribution of the tissues, affecting the compatibility between the train and the test feature space.

Due to the fact that we are not a skull stripping algorithm, we use the FSL toolkit to strip the skull.
The runtime of the test stage of the algorithm is 6 seconds per image.