# Automatic Brain Tissue Segmentation in MR Images Using Random Forests and Conditional Random Fields

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*Brief description* The segmentation framework is based on a Conditional Random Field with a Random Forest encoding the likelihood function. Hence, the Random Forest learns the appearance of the tissues, while the prior of the Conditional Random Field ensures regularization. The features include intensities, gradients, probability maps, and locations. Additionally, skull stripping is critical for achieving an accurate segmentation; thus, after extracting the brain we refine its boundary during segmentation. To this end, we identified portions of the skull that were not removed during pre-processing in the training set to use for training the Random Forest with an extra label of skull. At segmentation time, errors of the skull stripping in the pre-processing would be corrected. This procedure consistently improved results in all the test subjects, achieving superior results when compared against well established algorithms, namely the Brain Extraction Tool (BET).

We use the three thick slice sequences (T1-weighted, T1-weighted inversion recovery, and T2-weighted FLAIR), and we segment the images into cerebrospinal fluid, gray matter, white matter, basal ganglia, white matter lesions, and skull. The framework was implemented in non-optimized Python code, and the segmentation of one subject takes no more than 25 minutes in a desktop equipped with an Intel i7-3930k 3.2 GHz processor, 48 GB of RAM, and Ubuntu 14.04 OS.

More details and validation are provided in: `http://www.sciencedirect.com/science/article/pii/S0165027016301455`

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