FULLY-AUTOMATED MS LESION QUANTIFICATION COMBINING UNSUPERVISED SEGMENTATION AND MACHINE LEARNING

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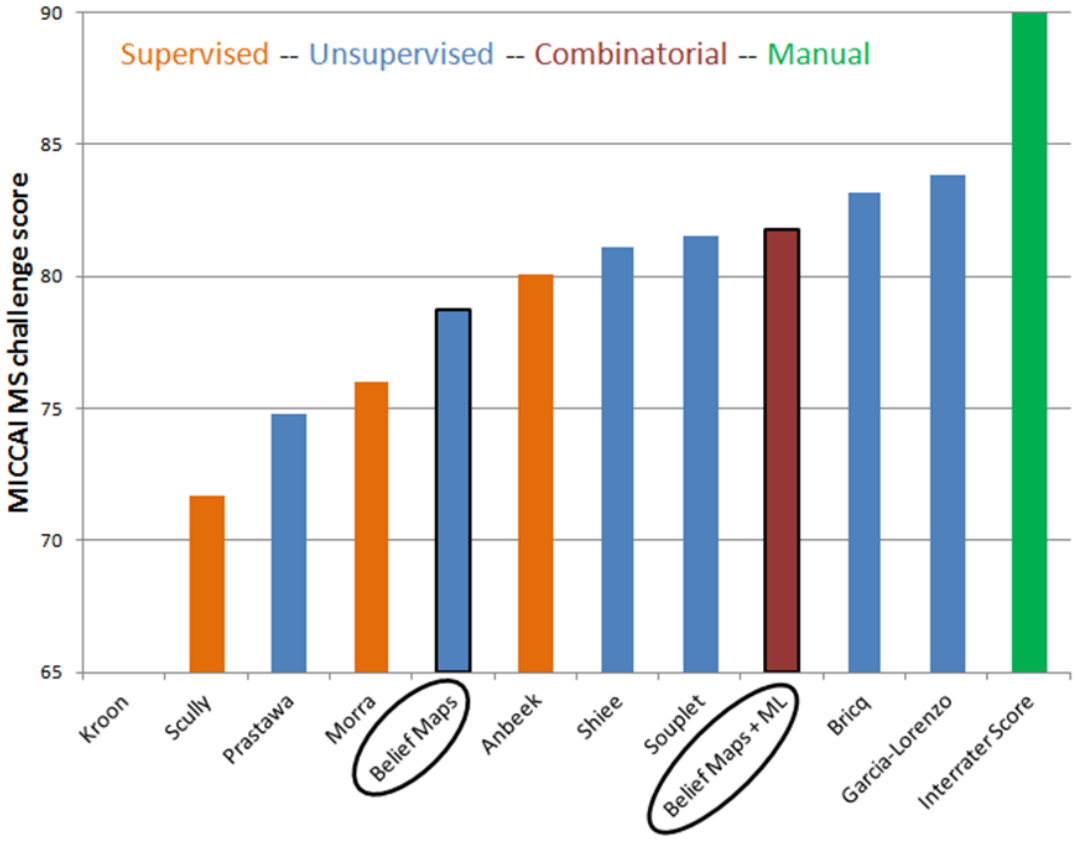
Background: Lesions hyperintense on T2 / FLAIR MRI are widely used biomarkers for multiple sclerosis (MS). They reflect inflammation, demyelination and axonal damage and are frequently used as endpoint in clinical trials. Even though there multiple automated methods have been proposed, measurement of lesion volume and number is typically done manually or semi-automatically due to limited robustness of automated methods.
Methods: Automated segmentation methods for MS lesions have been categorized into supervised and unsupervised methods where the former typically suffer from a small number of training subjects and the latter from the huge variability in abnormality that is not appropriately captured in the used models [1]. We propose a method that uses an unsupervised Belief Maps method [2] to generate a first segmentation estimate that is then improved by applying a machine-learning (ML) wrapper that was originally proposed to automatically learn the difference between two sets of segmentation protocols [3]. This ML layer learns from training data how to "correct" for the short-comings of the unsupervised method to agree better with manual reference segmentations.
Results: Figure 1 shows published results on 20 subjects from the MICCAI challenge in MS segmentation (http://www.ia.unc.edu/MSseg/) together with the unsupervised Belief Maps method and the presented method (Belief Maps + ML).



Conclusions: The results show how unsupervised methods generally outperform supervised methods. Adding a machine learning layer to the unsupervised Belief Maps method significantly improves results.

[1] Garcia-Lorenzo et al. Med Image Anal.,2013
[2] Schmidt et al. NeuroImage, 2011
[3] Wang et al. NeuroImage, 2011