Effect of Intensity Standardization on Deep Learning for WML Segmentation in Multicentre FLAIR MRI

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Abstract

Deep learning methods for WML segmentation in MRI may suffer from generalization issues when applied to data from another scanner or center. This is critical for translation and wide scale adoption, since models cannot be readily applied to data from new institutions. In this work, we evaluate the performance of several intensity standardization methods for MRI as a preprocessing step for lesion segmentation in FLAIR MRI. SC-UNet was trained on the standardized images, as well as the original data and segmentation performance was evaluated over several dimensions. The training data consists of a single study, of 60 volumes, and the test data is 128 unseen volumes from multiple clinical studies and centres. Results show the proposed intensity standardized methods IAMLAB and Ensemble provide higher lesion segmentation performance compared to other normalization methods and the original data. The performance increase compared to the original data was shown through t-tests to be statistically significant. Testing and training only on MICCAI shows that IAMLAB & Ensemble have the highest DSC (0.78 & 0.80) versus 0.75 in the original data. In unseen clinical datasets, DSC was highest for IAMLAB compared to the original data for all lesion categories (LL>25mL: 0.77 vs. 0.71; 10mL≤ LL<25mL: 0.66 vs. 0.61; LL<10mL: 0.53 vs. 0.52). All this taken together indicates that IAMLAB and Ensemble normalization methods are mitigating generalization issues and are optimal for WML segmentation in unseen FLAIR MRI datasets.

Keywords: Standardization, white matter lesions, segmentation, FLAIR MRI

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