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Development of an AI model for Cerebral Microbleeds Detection on MR Imaging

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Cerebral microbleeds (CMBs) are tiny, chronic brain hemorrhages associated with various cerebrovascular diseases. However, their manual detection is challenging due to their small size and resemblance to other structures such as calcifications or vessels.

We propose a 3D deep learning framework that simultaneously detects CMBs and determines their anatomical locations (lobar, deep, and infratentorial). The model is built upon a 3D U-Net integrated with a Region Proposal Network enhanced by a Feature Fusion Module for small-lesion detection and Hard Sample Prototype Learning for false-positive reduction through a novel concentration loss. Anatomical segmentation further improves localization accuracy and suppresses false detections. Using susceptibility-weighted imaging and phase images as inputs, the proposed method achieves high sensitivity while significantly reducing the number of false positives per subject compared to the baseline.

Keywords: *Cerebral Microbleeds, AI*