CMB detection and segmentation using nnU-Net

We participated in the Task 2 (CMB detection and segmentation) of the Valdo challenge. In this submission, we proposed to address this challenge with one of the state-of-the-art framework: nnUnet[1].

Method

nnU-Net offers an automated U-Net based network configuration system specifically in biomedical image segmentation. It focuses on generalizing the method to various applications with optimized hyper-parameters. The framework categorizes all network configuration parameters into three categories: fixed, rule-based, and data-based parameters. First, a set of fixed hyperparameters are set empirically, such as loss function, learning rate. Besides, it consists of a set of rule-based parameters, such as patch size, batch size, that depends on the image modality, gpu memory limit. These are all dataset agnostic parameters that are decided without running expensive training tasks. Following the fixed and rule-based parameters, nnU-Net trains different network architectures, including 2D, 3D and 3D cascaded networks and then decides the optimal post-processing and ensemble selection strategies. The whole framework serves as a toolbox which requires no manual configurations.

Implementation details

In this work, we used all three input modalities (T1, T2 and T2*) provided for task 2. No additional dataset was utilized for developing the model. We adopted the nnU-Net without any domain specific adaptions. Dice and cross-entropy are the loss functions. Poly learning rate scheduler is utilized with an initial learning rate of 0.01. Please refer to [1] for more detailed settings of the fixed and rule-based network parameters. Five-fold cross validation was employed with all subjects randomly grouped into five even subsets. The model with the highest dice score on the validation subset is then selected as the final model.

Results

Both 2D U-net and 3D U-net were tested. However, the 3D U-net did not seem to work; it produces nearly zero in dice score. This is likely due to the fact that the CMBs are very much scattered along the z-dimension. With the 2D U-Net configuration of nnU-Net, we achieved a dice score of 0.7 in a five-fold cross validation.

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References:

[1]. Isensee, Fabian, et al. "nnU-Net: a self-configuring method for deep learning-based biomedical image segmentation." *Nature methods* 18.2 (2021): 203-211.