Residual Volumetric Network for Ischemic Stroke Lesion Segmentation

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1 Introduction

We propose a 3D convolutional neural networks (3D CNNs) based method for lesion outcome prediction. The proposed 3D network takes advantage of fully convolutional architecture to perform efficient, end-to-end, volume-to-volume training. More importantly, we introduce the recent proposed residual learning technique into our network, which can alleviate vanishing gradients problem and improve the performance of our network.

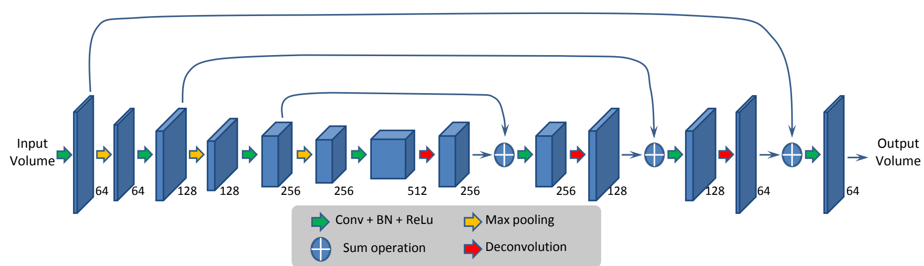

Fig. 1: Illustration of our proposed residual volumetric network. Numbers represent the number of feature volumes in each layer.

Fig. 1 demonstrates the architecture of our proposed residual volumetric network. It employs 3D fully convolutional architecture and is organized in a residual learning scheme. The layers of our network are all implemented with a 3D manner (under caffe library), thus the network can highly preserve and deeply exploit the 3D spatial information of the input volumetric data. We adopt small convolution kernels with size of $3 \times 3 \times 3$ in convolutional layers. Each convolutional layer is followed by a rectified linear unit (ReLU). Note that we also employ batch normalization layer (BN) before each ReLU layer. The BN layer can accelerate the training process of our network. At the end of the network, we add a $1\times1\times1$ convolutional layer as a classifier to generate the segmentation results and further get the segmentation probability volumes after passing the softmax layer. Note that our network might appear similar to U-Net, but there are differences: We use summation units instead of concatenation units when combining different paths, and thus we can reformulate our network as residual learning scheme; additionally, we adopt recently developed batch normalization technique to improve our performance.