ADAM challenge - Brief description of method

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The implemented method was based on the work of Nakao, T. in [1] and even though the result outputs segmentation, I'm only submitting for task 1 - Aneurysm Detection - of the ADAM challenge.

Data Preprocessing

The original TOF MRA images are resampled to a fixed shape of 256*256*128 and normalized. An automatic region growing method, as described in [2], is then applied to extract the high intensity vessels. Due to frequent false positive vessels in the skull, brain extraction is performed with HD-BET [3] on the original structural images. After this, the brain mask is registered to the TOF MRA space with ANTs (http://stnava.github.io/ANTs/) and a final filtered mask of the vessels is obtained.

Then for each voxel in the vessels mask, a 3D patch of size 16*16*16 is generated around the voxel and maximum intensity projection (MIP) images in 9 different directions are generated and concatenated to form a 1 channel 2D input image of size 16*144.

Methods

Online data augmentation is performed applying Flips and Rotations (10º) on the 3D patch. A simple CNN is employed with two convolutional layers, each followed by Batch Normalization layer, Relu activation function and max pooling layer, and two fully connected layers at the end, as shown in FIg.1.

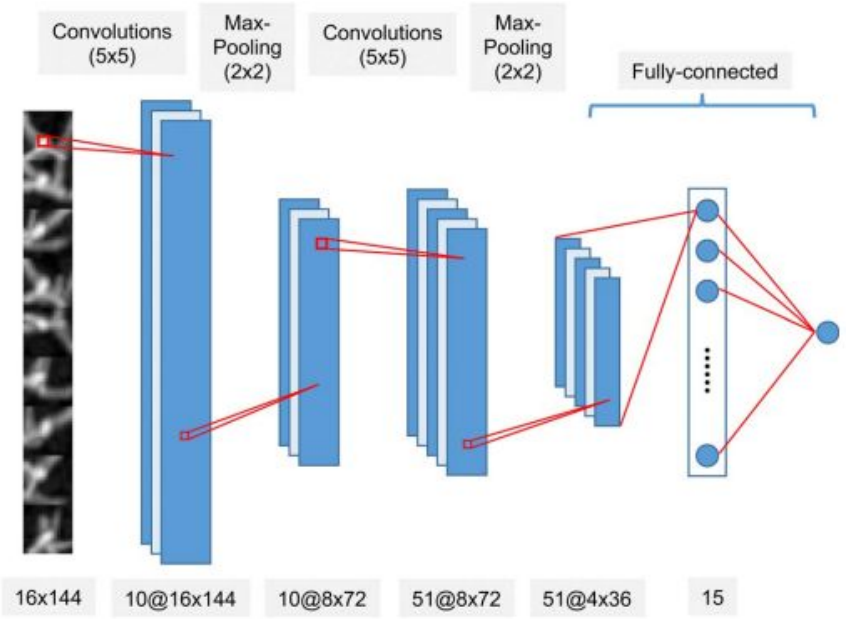

Fig.1 - Architecture of the employed network. Taken from [1].

During training the Adam optimizer was used with an initial learning rate of 1e-5 and ReduceLROnPlateau schedule. Negative images are downsampled to deal with the highly imbalanced dataset.

Postprocessing

In the end, probabilities are binarized at a threshold of 0.9. Connected components of the binarized image are extracted as positive predictions and components that have less than three voxels are discarded. Finally, the center of mass is computed for every connected component.

References

1. NAKAO, Takahiro, et al. Deep neural network-based computer-assisted detection of cerebral aneurysms in MR angiography. Journal of Magnetic Resonance Imaging, 2018, 47.4: 948-953.

2. HANAOKA, Shouhei, et al. HoTPiG: A novel geometrical feature for vessel morphometry and its application to cerebral aneurysm detection. In: *International Conference on Medical Image Computing and Computer-Assisted Intervention*. Springer, Cham, 2015. S. 103-110.

3. ISENSEE, Fabian, et al. Automated brain extraction of multisequence MRI using artificial neural networks. *Human brain mapping*, 2019, 40. Jg., Nr. 17, S. 4952-4964.