Multi-view Convolutional Network Ensembles for detection and segmentation of intracranial aneurysms

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INTRODUCTION

Detection and Segmentation of intracranial aneurysms from Time of Flight MRAs is challenging in clinical practice, especially for small aneurysms. Early detection of intracranial aneurysms is important in clinical routine to facilitate treatment decisions.

Contributions:

We present a 2D **multi-view** deep learning-based approach to automatically detect and segment intracranial aneurysms from Time of Flight MRAs and structural images.

METHODS

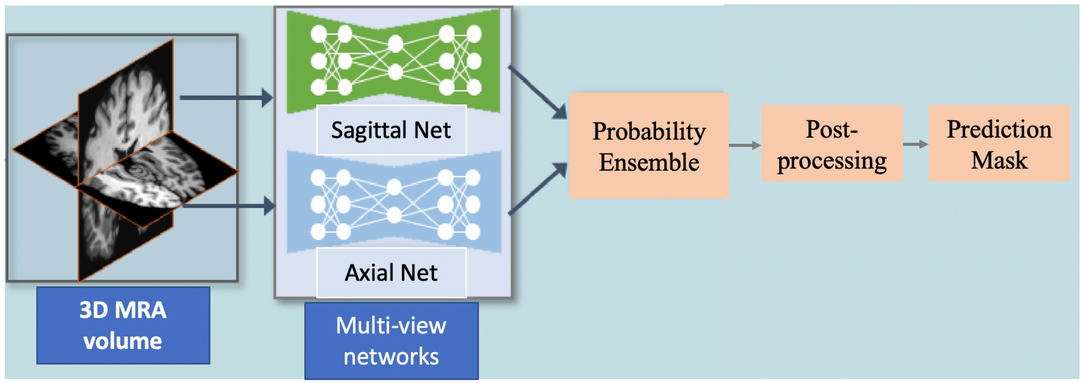


Fig. 2. Schematic view of our approach. It consists of three modules:
a) **Segmentation networks** involving two U-nets for individual views (sagittal and axial)
b) **Probability ensemble** of two views;
c) Post-processing with connected component analysis

METHODS CONTINUED

- **Pre-processing:** a) z-score normalization; b) cropping and padding of each view to a uniform size
- **Segmentation networks: vanilla U-Net [1]**

  Input modalities: **TOF-MRA** and the **aligned** structural MR image.
  Input size: **448*128** for each view
  Data augmentation: rotation, scaling and shearing
  Training: 10 epochs with a batch size of 16
- **Post-processing**

  3D connected component analysis. The regions that are larger than 500 voxels and smaller than 4 voxels are treated as false positives.

RESULTS

- **Results on the validation set including 5 subjects:**

  Sensitivity: 94%
  Dice scores: 21%
  Volume similarity: 32%
  Hausdorff distance: 45mm

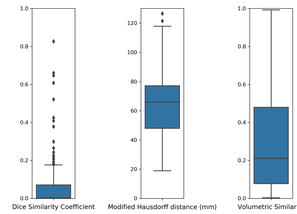
- **Results on the test set**

Task 1 Rank: 0.7	Task 1 Place: 11 th
Task 2 Rank: 0.7	Task 2 Place: 9 th

(lower rank is better)

Task 1	False Positives	Sensitivity
Average	22.62	0.43
Rank	1	0.4

Task 2	Dice Coefficient	Modified Hausdorff Distance (mm)	Volumetric Similarity
Average	0.07	65.02	0.31
Rank	0.84	1	0.39



References

[1] Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. "U-net: Convolutional networks for biomedical image segmentation." International Conference on Medical image computing and computer-assisted intervention. Springer, Cham, 2015.

[2] Li, Hongwei, et al. "Complex Grey Matter Structure Segmentation in Brains via Deep Learning: Example of the Claustrum." arXiv preprint arXiv:2008.03465 (2020).