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DEEP LEARNING-BASED SEGMENTATION OF THE CAROTID ARTERY WALL IN MR ANGIOGRAPHY

Dieuwertje Alblas

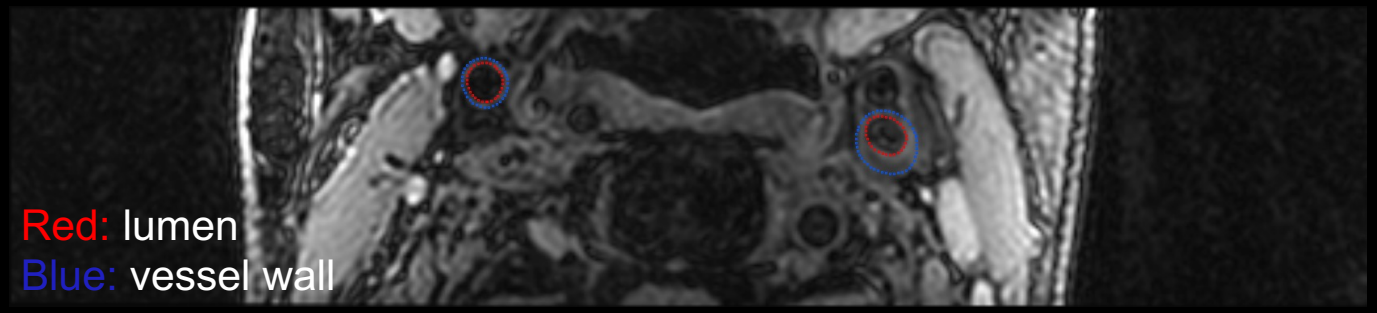
d.alblas@utwente.nl

DEPARTMENT OF APPLIED MATHEMATICS ● TECHNICAL MEDICAL CENTRE

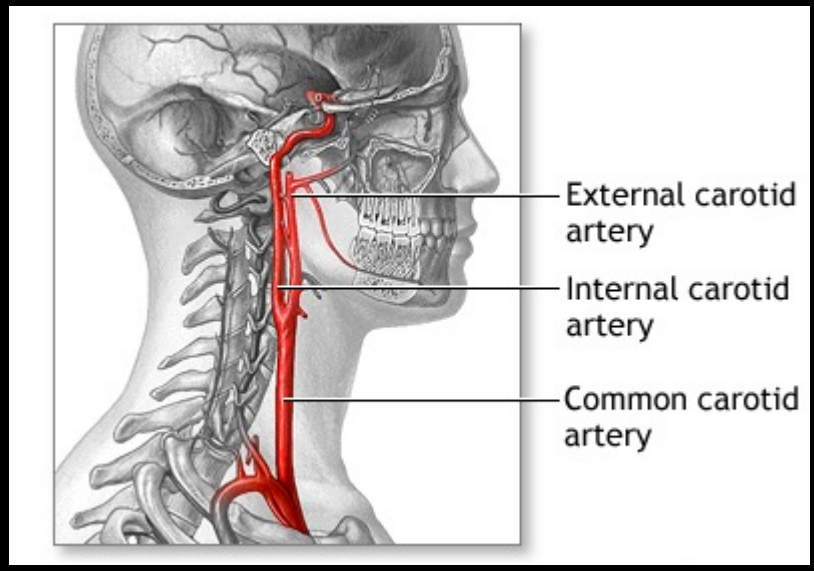
CAROTID ARTERY SEGMENTATION

Objective:

Automatic segmentation of the vessel wall of the internal and external carotid artery on black-blood MRI image data.



Annotated sample from dataset[1]



Anatomy of carotid arteries[2]

Main challenges:

- Imbalanced annotations
- Small dataset
- Diversity of patients
- Multiple arteries present
- Small-structure annotations

[1] https://vessel-wall-segmentation.grand-challenge.org
[2] https://medlineplus.gov/ency/presentations/

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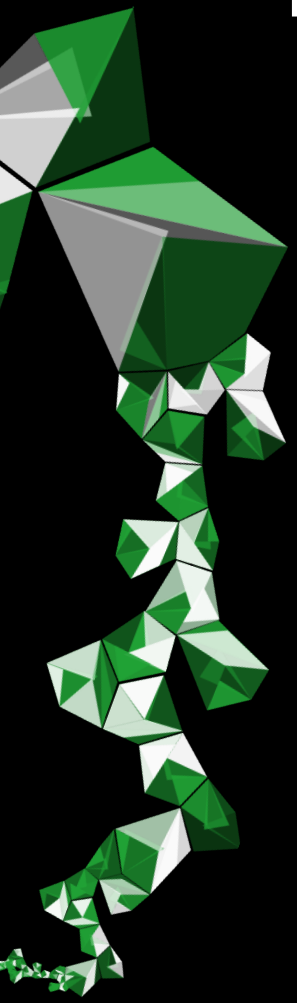
PROPOSED METHOD

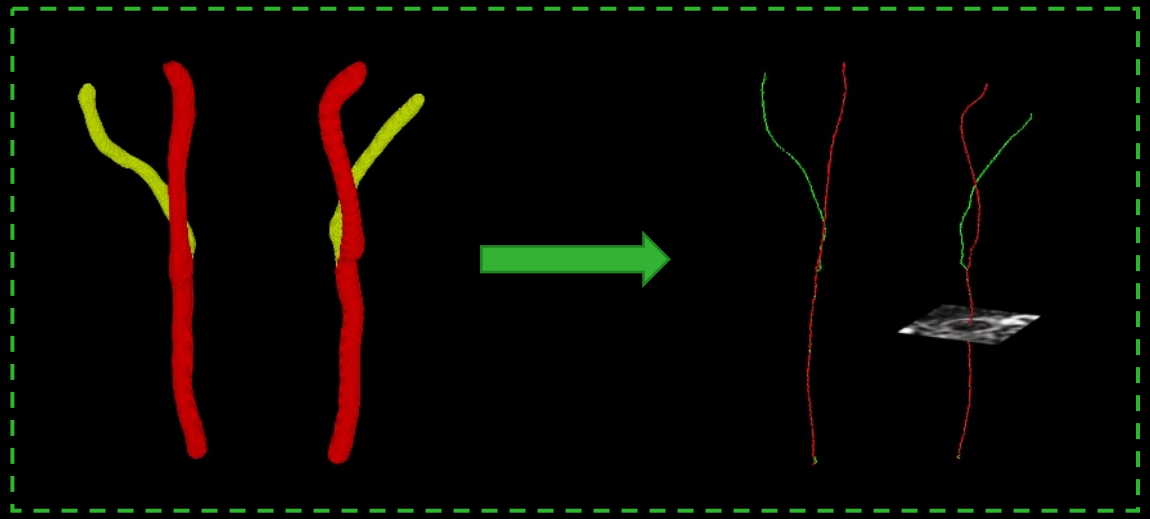


Two steps:

1. Global localization
2. Local estimation

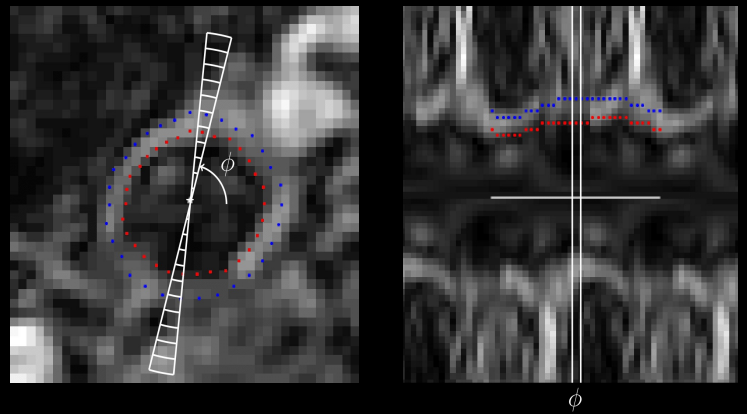
1. Global: centerline extraction

- Obtain rough 3D segmentation using 3D CNN's
- Skeletonize 3D segmentations



2. Local: contour estimation

- Build 2D image in polar coordinates by ray casting from centerline point[1]
- For each ray, estimate distance from lumen to centerline, and lumen and outer wall using CNN
- Sub-voxel accuracy



[1] Wolterink et al., 2019, *Graph Convolutional Networks for Coronary Artery Segmentation in Cardiac CT Angiography*

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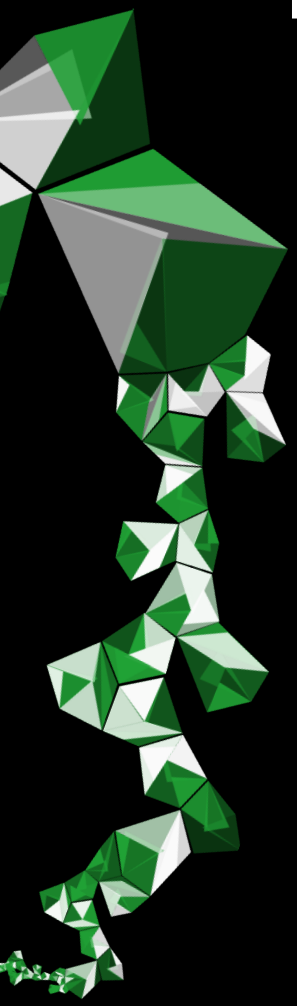
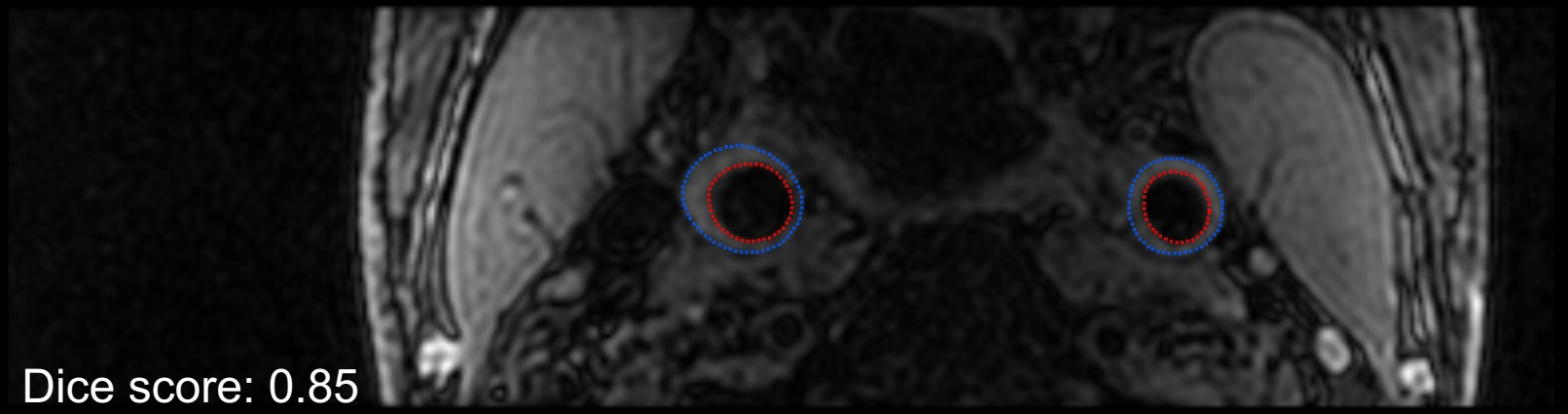
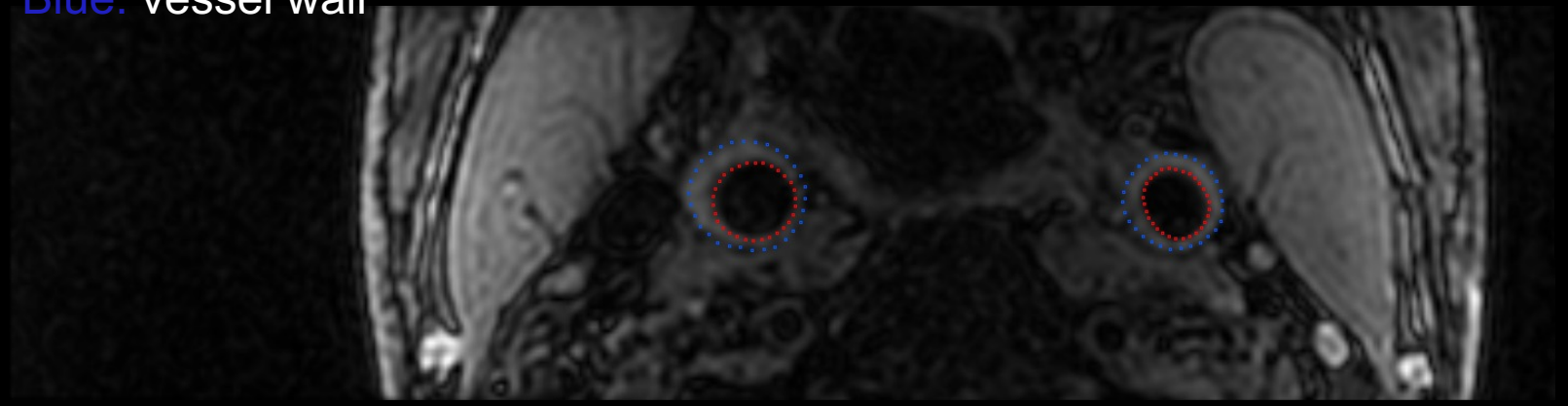
EXAMPLE RESULT



Dice score: 0.85
Red: lumen
Blue: vessel wall



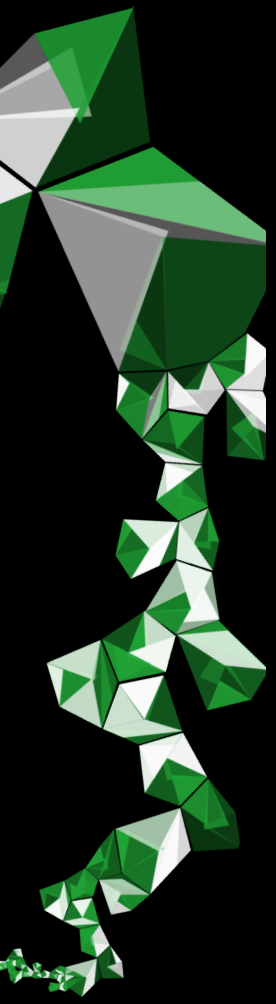
Ground truth



Prediction

3D prediction

CONCLUSION AND OUTLOOK



- Automatic method for contour prediction of lumen and outer wall in MR angiographies of carotid arteries
- Extend method to:
  - Other image modalities: CT, ultrasound
  - Different pathologies: aneurysms, stenosis

Thank you for your attention!

Dieuwertje Alblas
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