Vasculature and perfusion analysis in DSA using deep learning

Research Line: Medical Image Analysis
Project type: Master End Project
Approx. duration: 9 to 12 months
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Background Stroke is one of the worldwide leading causes of death and permanent disability. Recently, endovascular therapy (EVT) has been proven effective in recanalizing the occluded vessels and brain territory, leading to improved outcome for patients suffering from acute ischemic stroke. Digital Subtraction Angiography (DSA) is the imaging modality for visual procedural guidance and reperfusion assessment in EVT. Such DSA image sequences (2D+Time) provide information on vasculature, perfusion profile and brain anatomy, which are valuable for treatment quality assessment, therapeutic decision making, as well as outcome prediction. However, such information is mainly captured visually and interpreted subjectively by interventional neuroradiologists so far, which can be error-prone and time consuming. Therefore, this project aims to assist clinicians to maximize patient benefits in an automated manner leveraging the power of artificial intelligence.

Project Vasculature and tissue perfusion analysis in DSA images forms the basis of many biomarker extraction and quantitative analysis applications. In this context, graduation projects are available on (a combination of) the following subjects:

- Change detection and correspondence learning between pre-operative and post-operative DSA images [1]
- Deep learning for motion correction in DSA [2]
- (Multi-modality) Functional outcome prediction in DSA.
- Conditional diffusion models for DSA image synthesization in acute ischemic stroke.[3]

Keywords deep learning, graph neural networks, multi-modal learning, spatio-temporal learning, image registration, contrastive learning, interpretability, python, image/video processing, computer vision, statistical analysis, scientific writing.

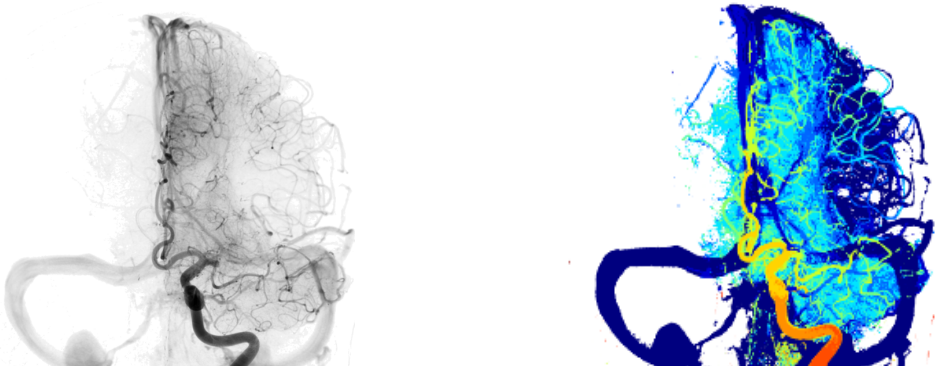

Figure 1 Left: minimum intensity map (MINIP) of a DSA acquisition; right: DSA perfusion imaging showing contrast flow time information in brain vessels and tissues.

Reading Materials

[1]. Sarlin, Paul-Edouard, et al. "Superglue: Learning feature matching with graph neural networks." Proceedings of the IEEE/CVF conference on computer vision and pattern recognition. 2020.

[2]. Su, Ruisheng, et al. "AngioMoCo: Learning-Based Motion Correction in Cerebral Digital Subtraction Angiography." International Conference on Medical Image Computing and Computer-Assisted Intervention. Cham: Springer Nature Switzerland, 2023.

[3]. Kuipers, Thijs P., et al. "Generating Cerebral Vessel Trees of Acute Ischemic Stroke Patients using Conditional Set-Diffusion." Medical Imaging with Deep Learning. 2024.