Machine learning for assessment of stroke age in non-contrast CT

Research Line: Medical Image Analysis
Project type: Master End Project
Approx. duration: 9 to 12 months
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Background

Ischemic stroke is a worldwide major cause of death and permanent disability. In the Netherlands more than 26,000 ischemic stroke patients are admitted to a hospital per year. In patients with acute ischemic stroke, the time of stroke onset is a major factor in determining whether a patient is eligible for intravenous alteplase or mechanical thrombectomy. In 14 – 27% of the strokes, the time of symptom onset is not known, frequently because stroke symptoms are recognized when the patient awakes from sleeping ("wake-up" strokes). These patients are often excluded from treatment with intravenous alteplase and sometimes even mechanical thrombectomy, which according to current guidelines only allows for the inclusion of patients within 4.5 or 6 hours of stroke onset, respectively. However, a substantial proportion of these "wake-up" strokes likely occur within a few hours before awakening, which would be within the approved time window for treatment. Therefore, it is important to be able to predict the age of the lesion on radiological imaging to identify patients that might benefit from certain treatment.

Currently, MRI is the gold standard to identify patients in the approved time window for intravenous alteplase. However, as MRI is not part of the standard stroke protocol in the acute setting, and not readily available in most institutions, it is desirable to be able to predict lesion age from the initial CT scans. Findings from the literature indicate a possibility of CT-based lesion age prediction, which could could facilitate viable solutions to assess the stroke age and select patients for treatments.

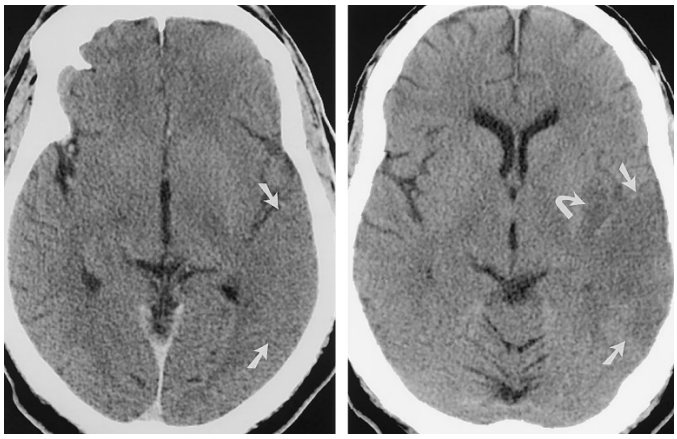

Figure 1 Effect of stroke onset time on NCCT images [4].

Project In this project, we will explore machine learning methods to estimate time from onset to imaging for non-contrast CT scans of acute ischemic stroke patients. Data from the MrClean Registry [1] will be used for training and validation.

Keywords deep learning, python, image processing, interpretability, image classification, contrastive learning, computer vision, statistical analysis, scientific writing, etc.

Reading Materials

[1]. https://www.mrclean-trial.org/
[2]. Ho, King Chung, et al. "A machine learning approach for classifying ischemic stroke onset time from imaging." IEEE transactions on medical imaging 38.7 (2019): 1666-1676.
[3]. Lee, Hyunna, et al. "Machine learning approach to identify stroke within 4.5 hours." Stroke 51.3 (2020): 860-866
[4]. Yao, Xiang, et al. "CT radiomics features as a diagnostic tool for classifying basal ganglia infarction onset time." Journal of the Neurological Sciences 412 (2020): 116730.
[5]. https://teddybrain.wordpress.com/2013/02/11/time-course-of-ischemic-stroke-on-non-enhanced-ct/