Junior Researcher (fully funded by NWO)
MIMIC: AI-based Identification of Stroke Mimics

Research Line: Medical Image Analysis
Requirement: MSc degree
Duration: 12 months
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Abstract
Approximately one in four individuals is affected by stroke, a major cause of death and disability. Timely and precise treatment is crucial to rescue the brain. This necessitates accurate identification of stroke versus other conditions with similar clinical presentations, known as stroke mimics. Misdiagnosis carries risks of delayed or wrong treatment. To date, stroke mimics account for up to 40% of all suspected stroke hospital admissions. This project seeks to address the clinical challenge via AI-based innovations. This promises to discover novel clinical knowledge and refine stroke diagnosis, reducing healthcare expenses, and above all, enhancing patient outcomes in stroke care.

Background
Stroke is a worldwide major cause of death and permanent disability, with one in four people affected over their lifetime [1]. In the Netherlands, more than 26,000 ischemic stroke patients are admitted to a hospital per year [2]. As a consequence of the aging population, the incidence of stroke is expected to increase by 34% from 2015 to 2030 [3]. This escalation underscores the already significant and continuously expanding public stroke health burden faced by society. Strokes, primarily ischemic, are caused by disrupted blood flow to the brain. In such situations, time is brain. Accurate and immediate diagnosis and treatment are crucial to prevent lasting brain damage and improve recovery [4][5].

Accurate diagnosis is the premise of optimal treatment. In practice, several other conditions, such as epileptic seizure and migraine, may show similar symptoms, known as “stroke mimics”. For example, a Todd paresis after an epileptic seizure causes temporary disruption of neurological function which is typically resolved within 36 hours without permanent damage but signal a high risk of future strokes [6]. Other conditions, such as spreading depression in migraine, may show prolonged symptoms as well. These stroke mimics could lead to misdiagnosis. Stroke mimics account for approximately 40% of suspected stroke admissions at hospitals [7].

Misidentifying stroke mimics and actual strokes is associated with high risks and costs. Missing the correct identification of actual strokes can delay crucial effective treatments, increasing the risk of irreversible brain damage. Misdiagnoses of stroke mimics not only lead to unnecessary and risky treatments but also increase healthcare costs. Therefore, rapid and accurate differentiation between ischemic strokes and stroke mimics is crucial for effective treatment and sustainable healthcare.

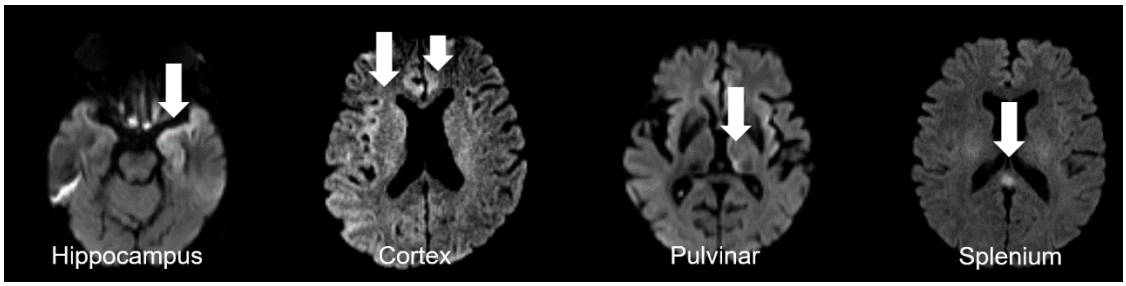

Figure 1 Diffusion patterns related to stroke mimics (epileptic seizures): Involvement of grey matter, thalamus, and commissural fibers.

While being crucial, distinguishing acute ischemic strokes from stroke mimics is, however, challenging. Current diagnostic processes are primarily based on visual inspection of neuroimages by experienced neuroradiologists. For example, in patients with epileptic seizures (Figure 1) or

migraine, imaging appearance may encompass hyperperfusion or hypoperfusion. Current visual assessments lack the precision necessary for distinguishing between these conditions promptly.

Project

In this **fully NWO funded** project, you will be addressing these challenges through investigation of innovative AI-based diagnostic solutions that enhances the accuracy of stroke diagnosis using advanced neuroimaging techniques, thereby improving patient outcomes and reducing healthcare costs. The primary objective is to develop an automated decision support system to identify advanced neuroimaging patterns derived from MRI for accurate identification of strokes and their mimics. This project is part of the collaboration with the **Support Center for Advanced Neuroimaging (SCAN)** at Inselspital, University of Bern, Switzerland. During the project, you are expected to spend part of the time in Switzerland primarily for data preparation purposes. If this project interests you, please feel free to reach out to Ruisheng (**r.su@tue.nl**) for more project details.

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

Reading Materials

[1]. Feigin, V. L., G. Nguyen, K. Cercy, C. O. Johnson, T. Alam, P. G. Parmar, A. A. Abajobir, K. H. Abate, and F. Abd-Allah. "Collaborators GBDLRoS. Global, regional, and country-specific lifetime risks of stroke, 1990 and 2016." N Engl J Med 379, no. 25 (2018): 2429-2437.

[2]. de Ridder, I.R., Dijkland, S.A., Scheele, M., den Hertog, H.M., Dirks, M., Westendorp, W.F., Nederkoorn, P.J., van de Beek, D., Ribbers, G.M., Steyerberg, E.W. and Lingsma, H.F., 2018. Development and validation of the Dutch Stroke Score for predicting disability and functional outcome after ischemic stroke: a tool to support efficient discharge planning. European Stroke Journal, 3(2), pp.165-173.

[3]. Norrving, B., Barrick, J., Davalos, A., Dichgans, M., Cordonnier, C., Guekht, A., Kutluk, K., Mikulik, R., Wardlaw, J., Richard, E. and Nabavi, D., 2018. Action plan for stroke in Europe 2018–2030. European stroke journal, 3(4), pp.309-336.

[4]. Hay, E.L., Shealy, G.J., Hanel, D.P. and Stoddard, L.C., 1985. Lower extremity salvage with microvascular free flaps. Journal of the South Carolina Medical Association (1975), 81(6), pp.311-316.

[5]. Uchida, K., Rinkel, L.A., Ospel, J.M., Diprose, W.K. and Goyal, M., 2024. A systematic review of randomized controlled trials of endovascular therapy for stroke on mortality and disability. Journal of the Neurological Sciences, p.122991.

[6]. Duncan, J., Sander, J., Alim-Marvasti, A., Balestrini, S., Baxendale, S., Bindman, D., Chinthapalli, K., Chowdhury, F., Diehl, B., Eriksson, S. and Foong, J., 2024. Epilepsy and Related Disorders. Neurology: A Queen Square Textbook, pp.247-318.

[7]. Chandratheva, A., Mehta, Z., Geraghty, O.C., Marquardt, L. and Rothwell, P.M., 2009. Population-based study of risk and predictors of stroke in the first few hours after a TIA. Neurology, 72(22), pp.1941-1947.