From Rocks to Clots:
Simulating Thrombus Permeability in Acute Ischemic Stroke

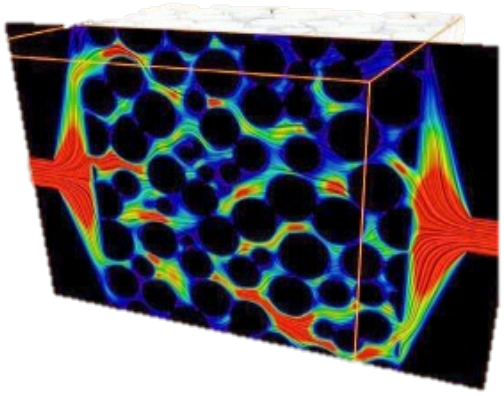
Introduction

Permeability is an important physical magnitude used for example in petrophysics to quantify the capacity of rocks and sediments to transmit fluids, such as water or oil. Permeability is closely related to porosity. Permeability depends on the number of pores, but also on the geometry of these pores, their arrangements and packing. Quantifying the rock permeability can help the petrophysical industry determining the time needed to extract a certain amount of fluid or deciding which equipment is most suitable to perform the extraction.

A similar situation can be considered in an acute ischemic stroke onset. An ischemic stroke is caused by the occlusion of an intracranial vessel by a thrombus, which restricts blood supply to the brain. The deprivation of blood to the brain rapidly causes brain tissue ischemia, which, if not treated, can end up as an infarction with often fatal consequences or long-term disabilities for the patient. The occluding thrombus is commonly formed by a fibrin fibre network trapping red blood cells (RBC), platelets and other molecules. These clots have been proven to be permeable, which may reflect the ability of blood to go through the trapped molecules. Having a permeable thrombus does not imply that the blood supply to the tissue is covered (in these acute cases, treatment is always needed), but, it may support patient's chances for successful treatment outcome.

Goal

The goal of this project is to apply the permeability models used in petrophysics to an ischemic stroke onset. You will conduct a literature review of well-known permeability models used for oil extraction, and apply them to blood clots in the brain. You will perform some simple calculations and simulations of these models.



Tasks

- Research literature of petrophysical models describing permeability (pore-grain permeability or any other model of your choice)
- Adjust these models to thrombus permeability
- Perform some calculation and simulation
- Write a scientific report

Contact

Nerea Arrarte Terreros
Dept. Biomedical Eng. and Physics
Email: n.arrarteterreros@amc.uva.nl

Henk Marquering
Dept. Biomedical Eng. and Physics
Email: h.a.marquering@amc.uva.nl