Post-doc offer at Laboratoire Sainbiose (INSERM - Mines Saint-Etienne - Lyon area in FRANCE)

COMPUTATIONAL MODELING OF AORTIC ANEURYSM PROGRESSION

Keywords: mechanobiology, finite-element, constrained-mixture theory, smooth muscle cells.

Academic context: This project will take place at Sainbiose (UMR INSERM-U1059 - Mines Saint-Etienne, France), in a group working in the domain of arterial mechanobiology, in collaboration with vascular surgeons. It is funded by an ERC consolidator grant.

Scientific context: The mechanical response of arterial tissue is a consequence of the arterial microstructure morphology. In the past decade, the different fiber networks (namely the collagen and elastin networks) have been investigated because of their important role in the arterial mechanics. Their maintenance is achieved by different intramural cells (smooth muscle cells, fibroblasts). Our objective is to investigate computationally how the impairment of important biological pathways involved in this maintenance can have dramatic effects on the integrity of fiber networks and lead to an aneurysm and a dissection in the aorta.

Project summary: During the past years, within the ERC project Biolochanics*, our group developed a mechanobiological model of the arterial wall. It can predict the non-linear mechanical behavior of arteries from their microstructure and simulate the growth and remodeling effects using the constrained mixture theory and the concept of maintaining stress homeostasis in the vessel wall. Presently, only the effects of proteolytic injury have been considered as triggers of growth and remodelling. However, recently published contributions show that impairment of mechanosensitivity and mechanotransduction of smooth muscle cells is a major driver of aneurysm development. Using our computational models and existing experimental data in our group, and integrating innovative theoretical developments, the successful applicant will investigate these effects computationally to eventually propose patient-specific simulations of aortic aneurysm progression. He/she will also be in charge of validating the proposed model.

Student profile: background in computational mechanics and mechanobiology. The ideal applicant has motivation for work at the interface between disciplines.

Administrative aspects: This is a 12-month position, renewable, starting 1st October 2020.
If you are interested, please send, via email, a curriculum vitae and a cover letter, to Prof. Stéphane Avril (avril@emse.fr).

* https://www.mines-stetienne.fr/en/research/projects/biolochanics/