Post-doctoral position at the Center for Biomedical and Healthcare Engineering, ARMINES/Mines Saint-Etienne – Laboratoire Georges Friedel (UMR CNRS-5307)

MICROSTRUCTURAL ANALYSIS OF HUMAN AORTIC ANEURYSM RUPTURE MECHANISMS

Keywords: Aortic aneurysm, aneurysm rupture, microstructural analysis, in situ mechanical tests, microstructure segmentation

Academic context: This post-doc position is part of the interdisciplinary AArteMIS - Aneurysmal Arterial Mechanics: Into the Structure - project (2015-2020) awarded to Pierre Badel (www.emse.fr/~badel) under the European Research Council Starting Grant scheme (http://erc.europa.eu/starting-grants). His group at Centre Ingénierie et Santé (a research center of Mines Saint-Etienne) focuses on carrying out fundamental investigations in the domain of arterial mechanics, especially aneurysm rupture in collaboration with vascular surgeons of Saint-Etienne University Hospital. The AArteMIS project also involves the 3S-R lab of Grenoble University for advanced analysis of the microstructure of complex entangled materials.

Scientific context: The rupture of an Aortic Aneurysm (AA), which is often lethal, is a biomechanical phenomenon that occurs when the wall stress state exceeds the local strength of the tissue. Current understanding of arterial rupture mechanisms is poor, as the physics taking place at the microscopic scale in collagenous structures remains an open area of research. Understanding, modelling, and quantifying the micro-mechanisms which drive the mechanical response of such tissue and locally trigger rupture represents the most challenging and promising pathway towards predictive diagnosis and personalized care of AA.

Project summary: Our group was recently able to detect, in advance, at the macroscopic scale, rupture-prone areas in bulging aneurysmal arterial tissues. The results challenge the popular theory that rupture occurs at the location of maximum stress, instead these state-of-the-art results indicate that rupture occurs at a localized strain concentration. The next step is to investigate in detail the extreme condition where the fibrous microstructure is approaching rupture, in order to elucidate and quantify the mechanisms controlling the rupture response. The successful applicant will collect images of the microstructure of human aneurysm specimens using multiphoton confocal microscopy while simultaneously performing *in situ* mechanical tests up to rupture. Alongside developing the method for spatially locating, under the microscope, the rupture-prone areas identified using the existing method, he/she will address specific segmentation strategies for the obtained images, including individual fiber bundle and bundle contact detection. This will allow a deep quantified analysis of the microstructure's deformation up to rupture. Rapid publication is expected.

Student profile: background in experimental mechanics. The ideal applicant also has experience in soft tissue mechanics, 3D image processing, possibly in confocal microscopy, and motivation for work at the interface between disciplines. Fluency in English is required and French, or willingness to learn French, will be appreciated.

Administrative aspects: The employer is Armines, linked by state-approved agreements to Mines Saint-Etienne, one of the most prestigious engineering schools in France. This project is funded for 18 months, starting in Spring 2015 (Gross salary ~ 32 900 €/year; Net salary, including social security ~ 2 400 €/month).

If you are interested, send a curriculum vitae, a cover letter describing previous research experience and interests, the names and contact information of two references. Please, submit via email with "ERC AArteMIS PD1" on the subject line to Pierre BADEL, PhD (badel@emse.fr).