



POLITECNICO
MILANO 1863

Supervisor Expression of Interest MSCA-IF Marie Sklodowska Curie Action-Individual Fellowship 2020

Supervisor name:	Gabriele Dubini
Email address: Link pagina docente:	gabriele.dubini@polimi.it https://www4.ceda.polimi.it/manifesti/manifesti/controller/ricerche/RicercaPerDocentiPublic.do?EVN_ELENCO_DID_ATTICA=evento&lang=IT&k_doc=60937&aa=2019&n_docente=dubini&tab_ricerca=2&jaf_currentWFID=main http://www.labsmech.polimi.it/
Department Name: Research topic: (https://www.polimi.it/en/scientific-research/research-at-the-politecnico/departments/)	Dept. of Chemistry, Materials and Chemical Engineering 'Giulio Natta' Cell biomechanics in the liver microcirculation
MSCA-IF Research Area Panels	<input type="checkbox"/> CHE_Chemistry <input type="checkbox"/> ECO_Economic Sciences <input checked="" type="checkbox"/> ENG_Information Science and Engineering <input type="checkbox"/> ENV_Environmental and Geosciences <input type="checkbox"/> LIF_Life Sciences <input type="checkbox"/> MAT_Mathematics <input type="checkbox"/> PHY_Physics <input type="checkbox"/> SOC_Social Sciences and Humanities
Politecnico di Milano Areas:	<input type="checkbox"/> Cultural Heritage <input type="checkbox"/> Smart Cities <input type="checkbox"/> Territorial Fragilities <input checked="" type="checkbox"/> Health <input type="checkbox"/> Industry 4.0
Brief description of the Department and Research Group (including URL if applicable):	The Department of Chemistry, Materials and Chemical Engineering 'Giulio Natta' conjugates competences in chemistry, chemical engineering, biological–biomechanical engineering, materials science and engineering. The Laboratory of Biological Structure Biomechanics (LaBS) was established in Feb. 2000 and has the mission to carry out applied research in the field of biomechanics, with a main focus on implantable devices and minimally-invasive procedures. LaBS has a significant expertise



in the use of computational solid and fluid dynamics modelling techniques starting from medical imaging.

Brief project description:
(max 1 page)

Multiscale model of the liver circulation for the study of liver pathologies

The development of computational (in silico) tools to support biological research is a central topic in the field of biomedical engineering. Such tools are crucial in applications where experimental methods either cannot be used or do not provide a complete view of the phenomena, which exhibit inherently a multiscale nature. This is the case when studying the immune response to pathologies of the liver, where the biological mechanisms studied *in vivo* on animal models also have an important biomechanical component at the level of microcirculation.

The liver is organised in functional units of hexagonal structure - lobules - that are characterised by rather a peculiar blood microcirculation. Blood enters the liver lobule from branches of both the hepatic artery and the portal vein, flows through a tangled network of sinusoids and exits from central veins, located at the centre of lobules. CD8⁺ T-cells (CD8Ts) are a particular kind of T-lymphocyte - a type of white blood cell - that kills cancer cells, infected or damaged cells. In the liver pathologies, CD8Ts play a critical role in the immune defence against infections (e.g. hepatitis B virus, HBV) and tumours (e.g. the hepato-cellular carcinoma, HCC).

This research project aims at developing a computational approach to investigate blood cell transport at the level of the liver sinusoidal network. Information derived from local hemodynamic quantities will be utilised to derive tissue quantities (e.g. local tissue permeability, cellular consumption and secretion of different biochemical factors) by means of homogenisation techniques. It is expected that the integration of this microscale model into patient-derived anatomies will lead to macroscopic circulatory models of liver portion (e.g. in terms of pressure and flow distribution) also useful to support clinical decision-making and the design of personalised therapies for the treatment of the liver pathologies (e.g. in terms of distributions of drug or radioactive particles).