

Université de technologie de Compiègne – Thesis proposal

Part 1: Scientific sheet	
Thesis proposal title	<p>Numerical modeling and optimization of a novel cardiac implant for percutaneous repair of the mitral valve</p> <p>Modélisation numérique et optimisation d'un nouvel implant cardiaque de réparation percutanée de la valve mitrale</p>
PhD grant	ANRT - Segula Technologies (CIFRE)
Research laboratory	<p><i>Laboratory:</i> Biomechanics & Bioengineering Laboratory (UMR CNRS-UTC 7338), UTC Compiègne</p> <p><i>research team:</i> Biological Fluid Structure Interactions</p> <p><i>web site:</i> http://www.utc.fr/~salsacan/</p>
Thesis supervisor(s)	Dr Anne-Virginie Salsac, DR CNRS (HDR), BMBI, UTC Laurent Lanquetin, Pilote simulation numérique, Segula Technologies
Scientific domain(s)	<p>Computer science and information technologies</p> <p>Biology, biomedical and health sciences</p> <p><i>EURAXESS fields:</i> Biomedical Engineering, Mechanical Engineering, Simulation Engineering, 3D Modelling, Modelling Tools, Computational Mathematics</p>
Research work	<p>Mitral insufficiency (MI) refers to heart valve diseases affecting the mitral valve, located between the left atrium and the left ventricle. It is the most frequent valve pathology in Western countries, after calcified aortic stenosis in elderly people. The current standard treatment of MI is open-heart surgery, whether to repair or replace the mitral valve. It requires opening the rib cage, stopping the heart, and establishing an extracorporeal circulation. In addition to its high recurrence rate, it has the drawback of not being applicable on a vast majority of patients, who are too fragile given their age and medical conditions.</p> <p>With the development of medical imaging, minimally invasive techniques have emerged, such as the MitraClip. Its objective is to weld the 2 leaflets of the valve in their middle by fitting a clip so as to improve the coaptation of the leaflets when the valve is closed. This technique is effective for primary mitral insufficiencies, which are linked to valve damage. No significant improvement is obtained for secondary mitral insufficiencies, which are related to defects of the left ventricle. The project is dedicated to the study of a new implant designed to repair the mitral valve percutaneously, for which a patent has been filed.</p> <p>The objective of the project is to perform a digital modeling of the new percutaneous mitral valve repair heart implant and to optimize its design in order to improve its performance. We will simulate the implant on different models of mitral valves, representing different cases of mainly secondary mitral insufficiency. Fabrication of prototypes will be considered in order to study the performance in vitro.</p>
Key words	Cardiac implant, mitral valve, numerical modeling, fluid-structure modeling
Requirements	<p><i>Skills:</i></p> <ul style="list-style-type: none"> - Strong scientific background in solid and/or fluid mechanics and in scientific computing, code development - Notions of biomechanics and bioengineering will be a plus - Proficiency in English – ability to communicate in French (at least basic with the desire to learn) - Excellent interpersonal and communication (written and verbal) skills <p><i>Personal Qualities:</i></p> <ul style="list-style-type: none"> - Ability to work collaboratively as part of a team in an interdisciplinary context - Flexibility, motivation, pro-activity, commitment to high quality - Commitment to continuous educational and professional development - Commitment to UTC's policy of Equal Opportunity, ability to work harmoniously with colleagues and students of all cultures and backgrounds <p><i>Qualification:</i></p> <p>MS degree or equivalent qualification.</p>
Starting time	Fall 2021
Location	BMBI Laboratory, UTC: 40% and Segula Technologies: 60%

Part 2: Job description

Duration	36 months
Additional missions available	
Research laboratory	<p>Université de Technologie de Compiègne: The "Biological Fluid Structure Interactions" team of the Biomechanics & Bioengineering Laboratory (BMBI http://www.utc.fr/bmbi/), led by Dr A.V. Salsac, is one of the leading teams in biomechanics of physiological fluids and microfluidics. It is specialized in the development of in vitro and in silico modeling techniques and innovative technologies for the study of blood flow from the microcirculation to large vessels and innovative techniques for endovascular treatment. It focuses on the study of the fluid-structure interactions that occur between fluid flows and various flexible structures (vessel wall, capsule and cell membrane, biomedical devices, etc.). http://www.utc.fr/~salsacan/</p> <p>Segula Technologies: SEGULA Technologies is a French engineering group, present worldwide in all major industrial sectors. Segula Matra Automotive (SMA) is a subsidiary of SEGULA Technologies, which addresses the automotive and commercial vehicle markets. SEGULA Technologies has its own Research and Innovation center. With extensive experience thanks to 200 computer science engineers in France, the SMA calculation division has the software resources enabling it to respond to market demands. The Group has notably contributed to the creation of numerous simulation methods in various fields of mechanics: statics, crashes, fatigue, thermal and fluid mechanics. The Research and Development policy SEGULA Technologies wishes to study the possible improvements of numerical methods in fluid mechanics and in fluid structure coupling. The transfer of automotive computing technologies to applications in other fields such as biomedical engineering is a strategic area of diversification for the company. This work makes it possible to go beyond the current limits linked to laws of behavior of fluids and calculation times.</p>
Material resources	All of the tools and equipment needed for the project are available in the 'Biological Fluid Structure Interactions' team of BMBI and Segula Technologies: Fluid-structure simulation commercial codes, Workstations, High Performance Computing facilities
Human resources	<p>The BMBI laboratory is composed of about:</p> <ul style="list-style-type: none"> - 40 permanent staff members (27 academic staff, 13 technical and administrative staff) - 31 PhD students - 8 Postdocs - 7 associated researchers - 15 Master students
Financial resources	Conditionned by the beginning of the PhD
Working conditions	What is expected from the candidate is to have a sense of autonomy and to be capable to work in group. His/her mission will be to conduct the research project, present his/her results during the research meetings (meetings with the advisors, lab meetings, etc) and to the rest of the scientific community via publications in international journals and conferences.
Research project	Application to the ANRT for a CIFRE Ph.D. fellowship in Spring 2021
National collaborations	
International collaborations	Ri.MED (Palermo, Sicily)
International cosupervision (cotutelle)	Gaetano Burriesci, Ri.MED (Palermo, Sicily)
Contact	<p>To apply please send a complete CV, a letter of motivation, 2 letters of recommendation or the contact details of 2 referring persons, as well as the result transcripts for all the courses followed at university to:</p> <p>Anne-Virginie Salsac (a.salsac@utc.fr) Laurent Lanquetin (Laurent.LANQUETIN@segula.fr) François-Xavier Gerbeau (Francois-xavier.GERBEAUX@segula.fr)</p> <p>Please note that only candidates who have been shortlisted will be contacted</p>

Please contact first the thesis supervisor before applying online on <https://webapplis.utc.fr/admissions/doctorants/accueil.jsf>