MuSkLE
PhD programme
Building, maintaining and repairing the functional locomotor system

Co-funded by the European Union

PhD Position 05 job vacancy

Reference:	**PP05**
Title:	**From rubber-like to physiological: a Finite Element modelling approach for the active muscle that does the work**
Hiring institution:	**Lyon1**
Location:	University Claude Bernard Lyon 1, Villeurbanne, France.
Start date:	As from 1st September 2027
Duration:	36 months
Application deadline:	15th January 2027

Job description

Objective:	The recruited doctoral fellow (DF05) will investigate different approaches to improve current implementations of the active skeletal muscle mechanical behaviour in explicit FE codes (eg. LS-Dyna, Abaqus, …), by implementing and testing a new user material (UMAT) to be developed for that purpose. Although material models have been modified or specifically implemented in such codes to model biological soft tissues, including active muscles, they so far rely on the underlying implementation of hyperelastic-type laws, which show limitations when it comes to representing some specificities of these tissues, both mechanically and numerically. Implementing a UMAT requires coding, and some extensive numerical verification and validation process, but it allows tackling the problem using improved or alternative approaches, e.g. (i) at the mechanical level of the behaviour law itself, e.g. to control coupling or decoupling between the apparent longitudinal or transverse stiffnesses in such anisotropic materials; (ii) through implementing and testing *phenomenological*, as opposed to *mechanical* descriptions of the mechanical behaviour, to address specific incompatibilities that exist between hyperelastic and physiological behaviours, e.g. in large strains compression; (iii) at a phenomenological physiological level, to account for key properties influencing the behaviour (type I or II fibers properties, fat content, …) in relation to ageing or a pathology, or to better implement the excitation-activation loop, to improve the simultaneous modelling and control of multiple muscles in synergy; (iv) to improve stability and robustness, validation and calibration of the models as part of a VVUQ process. Along with existing data, expertise and collaborations available at LBMC, relevant *in-vivo* (e.g. echo-/elastography Ultra-Sound) and *in-vitro* (e.g. biaxial tensile loading machine) experiments may be further performed to provide complementary validation data. Succeeding in this endeavour will allow the implementation of the muscle model into more complex (e.g. such as road safety or *in-silico* medicine oriented models) predictive models.
Collaborations and co-supervisions:	The PhD project will take place at Laboratoire de Biomécanique et Mécanique des Chocs (LBMC) in Bron, France. Aline Bel-Brunon, Mélanie Ottenio and Bertrand Fréchède have strong expertise in both experimental characterization and FE numerical modelling of the numerical body. In particular they have worked on the development of soft-tissue and muscle models for the last 15 years.
Supervisors:	Main supervisor – aline.bel-brunon@univ-eiffel.fr Supervisor 2 – bertrand.frechede@univ-lyon1.fr Supervisor 3 – melanie.ottenio@univ-lyon1.fr
Place of work:	Université Gustave Eiffel - LBMC UMR_T9406 25 Avenue François Mitterrand - 69675 Bron Cedex

Required degree	Master's degree or equivalent in (1) Applied Mechanics / Computational Mechanics, or (2) Mechanical Engineering, with Majors in solid mechanics.
Skills/Experience:	Experience: Solid background in solid mechanics, continuum mechanics, numerical methods, computational mechanics, Finite Element theory and implementation, scientific computing. Some interest or prior experience in Biomechanics or anatomy and physiology may be a plus, but is not mandatory. Skills: curiosity, initiative, tenacity, abilities for problem-solving, interest and ability for coding (FORTRAN, Python). Prior knowledge of LS-Dyna and/or Mathematica will be a plus.
Keywords	Continuum mechanics, Finite Element, Soft tissue modelling, Muscle activation and contraction, VVUQ

Mandatory requirements

Eligibility:	The doctoral fellow: - should not have resided or carried out his/her main activity (work, study) in the country where he/she is being recruited, i.e., France, **for more than 12 months in the 3 years before the application call deadline,** unless this time was part of a compulsory national service or a procedure for obtaining refugee status under the Geneva Convention. - **must be in possession of a master's degree** at the date of the call deadline. Applicants who have completed their cursus but not yet been awarded the formal master's degree by that date will not be considered eligible.must be a **doctoral candidate** (not already in possession of a doctoral degree at the date of the application call deadline).
Languages:	Oral and written skills must meet the standards of academic English used in international research.

Job details

Type of contract:	Full time position
Gross salary:	The monthly **living allowance, including employer and employees' social charges, is €3,500.** This amount corresponds to a gross monthly salary estimated to €2,440 and to an estimated net monthly salary before income tax of approximately €1,976. On top of the monthly salary, the doctoral fellow will receive a **mobility allowance,** including employer and employees' social charges of €4,752 over the 36 months of the working contract. This amount corresponds to a gross monthly allowance estimated to €92 and to an estimated net monthly allowance before income tax of approximately €74.
Other benefits:	**Social Protection**: The fellow will benefit from **full social security coverage**, including health insurance, unemployment insurance, and pension contributions. He/she will also have access to occupational health services (*médecine du travail*), as required by French labour law. **Additional Insurance**: The fellow may choose to subscribe to complementary health insurance plans, at affordable rates (approximately €70 *per* month), of which 50% is paid by the employer. **Paid Leave**: The fellow is entitled to up to **33.5 days of paid leave annually** (for 35 hours worked per week), in accordance with national labour law, and will enjoy the same employment rights as other public-sector employees. **Transport**: The fellow benefits from significantly **reduced fares on public transport**, available in all partner cities. Additionally, the host institution will cover 50% of the monthly transportation costs. **Sports and culture:** The fellow will enjoy the cultural environment provided by the Lyon 1 campuses, where numerous exhibitions and activities open to the general public are organised throughout the year. The fellow may play his/her favourite sport in the largest University Sports Association in France, where over 30 activities are on offer year-round through the Sports & Physical Activity University Department. The fellow may also join one of the 70 student associations that unite the University.