IMT Mines Alès
École Mines-Télécom

SCIENCE & CREATIVITY TO INVENT A SUSTAINABLE WORLD

PhD Position in

MECHANICS

Institution	IMT Mines Alès (Ecole Nationale Supérieure des Mines d'Alès)
Main job assignment	Teaching and Research center C2MA
Administrative residence	Alès (Département du Gard – Région Occitanie)

06/10/2025

1. Context

The Institut Mines-Télécom (IMT), a major institution within the meaning of the Education Code, is a public scientific, cultural and professional institution (EPSCP) placed under the principal supervision of the ministers responsible for industry and digital technology. It is the largest group of engineering schools in France, with 11 public engineering schools spread across the country, which train 13,500 engineers and PhDs each year. The ITM employs 4,500 people and has an annual budget of €400M, 40% of which comes from its own resources. IMT has 2 Carnot institutes, 35 industrial chairs, produces 2100 A rank publications annually, 60 patents and carries out 110M€ of contractual research.

Created in 1843, IMT Mines Alès currently has 1,400 students (including 250 foreigners) and 380 staff. The school has 3 research and teaching centers of high scientific and technological level, which work in the fields of materials and civil engineering (C2MA), environment and risks (CREER), artificial intelligence and industrial and digital engineering (CERIS). It has 12 technological platforms and has 1,600 partner companies.

2. Research project

Title: Contribution to the study of muscle tissue fatigue: experimental approach, modelling, and applications in sports traumatology

Keywords: Fatigue, modelling, damage, imaging, sports traumatology.

Muscle tissue, essential for movement and stability of the human body, is subjected to various mechanical stresses in different contexts, particularly during intense sports activities that induce alterations and remodelling of active muscle tissues. Understanding the mechanisms of fatigue[1], damage, and rupture in muscle tissue is crucial, especially for the prevention and management of traumatic injuries. It has been demonstrated that the mechanical properties of muscle tissue, such as viscoelasticity, anisotropy, softening, and damage, play a fundamental role in their response to imposed deformations, thus influencing their behaviour under extreme conditions[2,3].

The role of muscle fibre structure and the extracellular matrix in skeletal muscle fatigue is increasingly recognized. Recent studies highlight the importance of intramuscular components, particularly collagen and non-fibrillar matrix, in load transmission under stress[4,5]. In parallel, advances in imaging and micromechanical modelling offer new perspectives to analyse the complex geometry of muscle fibres and their role in deformation, damage, and rupture phenomena[6,7,8].

The project is structured around three key areas:

1- **Experimental characterization**: In-depth analysis of the mechanical properties and microstructure of muscle tissues (mechanical testing, histology, advanced imaging[9])
2- **Numerical modelling**: Development of hyperviscoelastic models integrating the Mullins effect[10] and the Payne effect to simulate tissue responses under intensive and repetitive stress
3- **Clinical applications**: Validation of the models through a demonstrator (indentation device[11]) enabling practical assessment of muscle fatigue and damage in sports or clinical contexts.

This project offers an interdisciplinary approach combining biomechanics, numerical modelling, and innovative diagnostic tools to address the challenges of preventing and managing muscle injuries.

3. Team supervision and PhD registration

Research and teaching centers: C2MA

Research unity: DMS/LMGC

Doctoral school: I2S 166, Information, Structures and Systems

Thesis supervision:

Caro Anne-Sophie, Professor, IMT Mines Alès, LMGC, DMS

Perrey Stéphane, Professor, UR EuroMov Digital Health in Motion

Supervision team:

Cavinato Cristina, Assistant Professor, Montpellier University, LMGC, BIOTIC

Iaquinta Sarah, Assistant Professor, IMT Mines Alès, LMGC, DMS.

4. Candidate profile

The candidate should have a strong background in material mechanics, ideally complemented by experience or a strong interest in the biomechanics of biological tissues. Skills in numerical modeling (finite elements, programming) are essential, as well as the ability to conduct laboratory experiments. Experience or interest in sports science and muscle physiology would be a valuable asset. The candidate must demonstrate the ability to work in a team and actively contribute to the interdisciplinary exchanges required for the success of this project.

5. Références bibliographiques

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6. Contacts

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