**Internship Offer for Master 2 Research** **Deadline: February 1, 2024**

## Title: Multiscale Characterization of PCL-Based Fibrous Biomaterials for Tissue Engineering Applications

**Keywords: Fibrous materials, Multiscale mechanical characterization**

**Laboratories** 1) LBTI, UMR5305, Claude Bernard University Lyon 1
2) LMGC, UMR CNRS, Université de Montpellier. BIOTIC Team

**Internship Supervisors** Jérôme Sohier (LBTI), Cristina Cavinato (LMGC)

**Detailed Description**

This research project aims to characterize the multiscale mechanical properties of fibrous biomaterials created through a jetspray technique. The process involves the application of a reverse-engineered jetspray device at LBTI, Lyon, allowing precise control over flow, application time, and jet orientation. The resulting Poly(ε-caprolactone) (PCL) fibrous mats, in combination with DGL/PEG hydrogels in various ratios, will be used to produce a range of tunable fiber-reinforced hydrogels, crucial for subsequent characterization (Daniel Ferri-Angulo *et al.* 2023, 10.1016/j.actbio.2023.09.035). The morphology and structure of the fiber-reinforced composites will be examined using multiple microscopic techniques, including optical microscopy, optical coherence tomography, two-photon excitation, and SEM. These methods will provide insights into the 3D structure and metric properties of the fibers. Tensile and extension-inflation tests will be conducted on recreated materials to identify macroscopic and microscopic properties. 2D and 3D-DIC techniques based on multiscale imaging, along with constitutive modeling using hyperelastic laws, will allow a comprehensive understanding of overall and local mechanical responses (Cavinato *et al.* 2021, 10.3389/fcvm.2021.800730).

This project seeks to understand the mechanical behavior of fibrous composites, combining high tensile strength, non-linear, and anisotropic characteristics. The goal is to replicate the mechanical features of native soft tissues, such as skin, mucosa, cardiovascular, and cartilaginous tissues. This work aligns with the need for versatile models that capture the structural complexity of soft tissues while mimicking their mechanical properties.

**Desired candidate profile**

Master's students in Materials Science and Engineering or Mechanical Engineering, ideally passionate about the mechanics of continuous media, with a keen interest in fibrous biomaterials.
Eager to delve into the synthesis, characterization, and mechanical behavior of fibrous structures, particularly in the context of tissue engineering.

**Required skills**

The ideal candidate should possess expertise in fibrous materials and mechanical testing methodologies. Theoretical understanding of hyperelasticity equations or knowledge of biomaterial design and optimization would be advantageous.

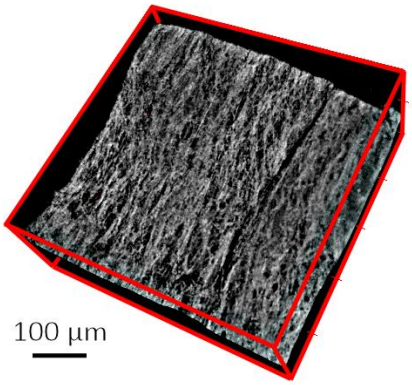


*Figure: 3D rendering of fibrous microstructure of fiber-reinforced polymer with one prevalent orientation created through jetspray technique.*

**Duration, compensation and location**

Compensation: environ 600€ / months (LMGC).
Duration: 6 months (3 months at LBTI, 3 months at LMGC).
Location: Both UMR5305 (Lyon) and LMGC (Montpellier).

**Resources provided**

Portable PC with necessary software suite (Python or Matlab, Fiji, 3Dslicer, etc.).

**Application Procedure**

Send a CV and a motivation email to cristina.cavinato@umontpellier.fr before February 1, 2024.