INTERNSHIP OFFER – MASTER 2 RESEARCH - 6 MONTHS (Q1-Q4 2026)

MULTISCALE MODELING OF A MEDICAL TEXTILE FOR PELVIC ORGAN PROLAPSE REPAIR

Host Laboratory

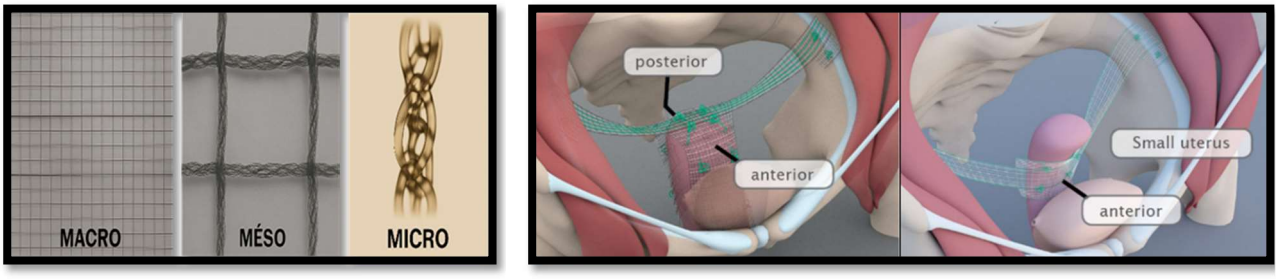
The Laboratory of Applied Biomechanics (LBA) is a joint research unit of the Université Gustave Eiffel and Aix-Marseille Université, located within the Faculty of Medicine on the North Hospital-University Campus in Marseille. Its research program is based on the biomechanical modeling and simulation of the human body (Virtual Human) for health, sports, and safety applications. The laboratory's objectives include understanding trauma mechanisms to improve prevention and treatment of resulting injuries, and enhancing medical devices and associated surgical techniques. The LBA has gained international recognition and influence (https://lba.univ-gustave-eiffel.fr/)

Context

This internship is part of the MICH Excellence Chair research program (Innovative Materials for Health and Safety Applications), funded by the A*Midex foundation from 2025 to 2027. Surgical meshes like DynaMesh®-PRP are warp-knitted textile implants used for pelvic organ prolapse repair. These meshes are made of polymer monofilaments arranged in an open porous knit structure to promote tissue integration while providing mechanical support. We aim to develop a validated multiscale model of the medical textile and understanding its performance, supporting its safe and effective use in pelvic health surgeries.

Objective

Develop a multi-scale finite element model of the medical textile, using previously tested experimental data. The model should suitably replicate the mesh's mechanical response at different scales, and predict its behavior in a representative surgical scenario.



(a) (b)

Figure 1. (a) DynaMesh®-PRP medical textile at different scales (b) Pectopexy with DynaMesh®-PRP implants to treat different types of pelvic organ prolapse

Approach and Expected Deliverables

The internship will be structured as follows:

- Literature review on surgical mesh mechanics, hierarchical multi-scale modeling techniques, embrace the in-house experimental datasets
- Micro-scale (yarn level) model development that includes geometry reconstruction, finite element implementation, subject the unit cell model to uniaxial extension as per the experiments.
- Use image analysis data such as pore size and strain fields to support calibration and fitting of the micro-scale model parameters, ensuring that simulated pore deformation aligns with

experimentally observed behavior.

- Identify an equivalent continuum (homogenized) model of the mesh to bridge the micro-scale (yarn-level) simulations with meso and macro-scale behavior. Use this to assess the robustness of the micro-scale models by comparing global force–displacement predictions.
- Writing a comprehensive synthesis report and preparing a final presentation

Candidate Profile

- Second-year Master's degree (M2) student specializing in Mechanical Engineering, Biomechanics, Computational Mechanics, or Materials Science (or equivalent).
- Experience in finite element modeling, with working knowledge of LS-DYNA, mechanical behavior of textiles, polymers, or soft structures. Familiarity with Python for basic scripting, data analysis, and comparing experimental and simulated curves or strain fields.
- Knowledge of biomechanical applications is a plus.
- Proficient in English (B2, C1)
- Autonomous, rigorous, and able to work collaboratively

Contacts

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