

- Internship Offer -

Development of a hybrid micro force sensor (piezoresistive–optical) for micro-robotic applications

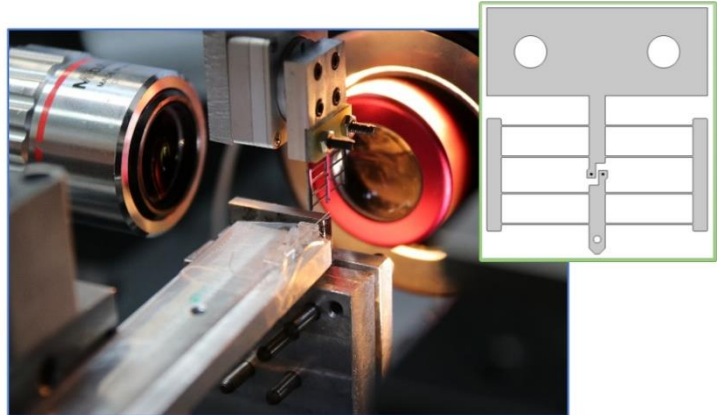
Internship in Engineering Science and Technology

FEMTO-ST Research Institute, AS2M Department (Automatique et Systèmes Micro-Mécatroniques)

Keywords: force–displacement sensor, instrumentation, robotics, multiphysics simulation, CAD design.

CONTEXT AND INTERNSHIP ENVIRONMENT:

As part of this internship, you will join the AS2M Department (Automatique et Systèmes Micro-Mécatroniques) of the FEMTO-ST Institute, a reference in the design, modeling, command/control of micromechatronic and microrobotic systems for several scientific and industrial applications. You will work in an interdisciplinary environment with access to advanced platforms for instrumentation, control, and micro-robotization.



At FEMTO-ST, a micro-robotic platform has been developed for Single Fibre Transverse Compression Tests (SFTCT) [1], including a first force–displacement sensor based on HP codes (visual markers). Building on this foundation, we aim to develop a new hybrid sensor combining:

- **Force measurement via piezoresistive strain gauges** (with potential multi-axis measurement).
- **Displacement/pose measurement via HP codes (camera and microscope vision)**, integrated at the lower part of the sensor to gain compactness and improve metrology (effective fibre compression and system compliance).

These developments will contribute to enhancing the mechanical characterization of plant fibres and the wider industrial deployment of bio-based composites, which offer significant environmental advantages—lightweight, recyclable, and with high performance potential—over petro-sourced materials.

FEMTO-ST (UMLP) is internationally recognized for its pioneering approach of bringing micro-robotics into small-scale mechanical characterization, which has led to its leadership of Pilot 4 (Robotics) within the European RAIDO project [2], which seeks to integrate artificial intelligence to optimize and automate these complex processes. The proposed internship is carried out within this framework.

INTERNSHIP DESCRIPTION:

The main objective of this internship is to design, simulate, and validate a new-generation force–displacement sensor, merging two FEMTO-ST state-of-the-art technologies:

1. Force measurement by piezoresistivity
2. Displacement measurement by optical tracking of HP codes [3]

This hybrid sensor aims to decouple the force and displacement measurements, thereby increasing precision, robustness, and the information richness extracted during compression tests.

The hired person will be in charge of developing the force–displacement sensor, which will include the following missions:

- **Bibliographic study:** Analysis of the state of the art on piezoresistive force sensors and optical measurement systems for micromechanics.
- **Design and Simulation:** Mechanical design of the sensor structure and multiphysics simulation (mechanical, piezoresistive) in COMSOL to validate and optimize the design.
- **Modeling and signal processing:** Development of physics-based and/or data-driven models to describe and process the sensor response. Possibility to use RAIDO AI framework and potential collaborations within the consortium.
- **Manufacturing follow-up:** Follow-up of the cleanroom fabrication process (MIMENTO platform), carried out in collaboration with a specialist.
- **Characterization and Validation:** Definition and execution of calibration protocols, characterization (identify and evaluate resolution, sensitivity, stiffness, etc) and integration into the fibre compression platform.

Deliverables:

Prototype of the hybrid force–displacement sensor, technical report describing the design, simulations and experimental results, and participation in internal presentations or communications. The results may lead to further valorization and potential technology transfer.

Resources provided:

Access to high-end computing resources and software (COMSOL, MATLAB, SolidWorks), cleanroom facilities at the MIMENTO platform, experimental setup (RAIDO Pilot 4), and equipment funded by the CMNR budget to support the sensor development and testing.

PROFILE:

Final-year engineering student or Master's (BAC+5 level) in mechanics, micromechanics, mechatronics or related fields.

- Essential competency in finite element simulation (FEM), preferably COMSOL Multiphysics.
- Solid knowledge in mechanical design (CAD), Strength of Materials.
- Programming skills (Matlab/Python).
- Enthusiasm for experimentation, curiosity, and autonomy, with the ability to work collaboratively within a multidisciplinary research team where members contribute complementary expertise

Internship duration: 6 months starting February 2026

Location: FEMTO-ST Institute, AS2M Department, Besançon, France.

Recruitment procedure: To apply, please send in a single PDF a cover letter, a detailed CV, and your recent transcripts to clevy.cedric@femto-st.fr and/or alandavid.procel@femto-st.fr

Stipend: Around €600/month (in accordance with current legislation)

Bibliography

[1] Jason Govilas. Plant fiber mechanical characterization with high precision micro-mechatronic means: investigation of single fiber transverse behavior and inter-fiber adhesion. *Matériaux composites et construction*. Université Bourgogne Franche-Comté, 2023. English

[2] <https://raido-project.eu/>

[3] Antoine André, Olivier Lehmann, Jason Govilas, Guillaume Laurent, Hamdi Saadana, et al.. Automating Robotic Micro-Assembly of Fluidic Chips and Single Fiber Compression Tests based-on XY Θ Visual Measurement with High-Precision Fiducial Markers. *IEEE Transactions on Automation Science and Engineering*, In press. [\(hal-04153405\)](#)