

European Project Semester

PROJECT OUTLINE

Project dates: March – June 2026

Title: Ramanglide: Design and Prototyping of In-Situ Raman Measurement Devices for Contact Analysis

Project activity areas: mechanical design, mechatronics, instrumentation, tribology, CAD/rapid prototyping, data acquisition & control, experimental methods

Keywords: Raman spectroscopy, tribology, instrument design, in-situ measurements, 3D printing, creep/relaxation, friction

Tutor's name and coordinates

Client – End-user: UTTOP – LGP (Laboratoire Génie de Production)

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Project origin

UTTOP - LGP

Project technical background:

In-situ Raman spectroscopy offers unique insights into material transformations at contact interfaces. The goal is to design and prototype modular instruments that couple to an existing Raman spectrometer and its motorized stage, enabling measurements on semi-transparent/transparent contacts in **static** and **dynamic** conditions. The project targets two complementary prototypes:

1. **Normal loading module** for creep/relaxation studies with **controlled vertical displacement** and **applied normal load** (measurement + feedback).
2. **Tribology module** providing **controlled vertical and lateral displacements** and **measured verticale and lateral forces** for friction experiments.

Existing preliminary concepts are available, but the team may start from scratch. Designs must respect the **geometrical envelope** and **mounting constraints** of the Raman microscope/motorized stage and remain compatible with a potential **external optical arm/extension**. A dedicated operating budget will support the build from design to fabrication. Collaboration with LGP members is planned.



Fig. 1: Raman spectrometer at LGP.



Fig. 2: prototype on the Raman spectrometer stage

Studied topics:

- E1. **Requirements & specifications:** optical access, stiffness, positioning resolution, load/force ranges, thermal envelope, safety.
- E2. **Interface definition** with the Raman stage (footprint, alignment, clear aperture), incl. provision for an optical arm extension.
- E3. **Concept design & CAD** for the two modules; materials selection for rapid prototyping (polymer 3D-print) then conventional fabrication.
- E4. **Actuation & sensing choices:** displacement, normal load, lateral force, (op. temperature measurement); basic control loops.
- E5. **Prototyping & assembly:** 3D-printed mock-ups for form/fit, then functional parts; fixtures and sample holders.
- E6. **Integration & tests:** alignment on the Raman, functional checks (creep/relaxation and friction), data logging.
- E7. **Validation use-cases:** short experimental protocols demonstrating in-situ Raman capability under each condition.

Expected deliverables:

- D1. **Specifications document** (requirements, constraints, interfaces).
- D2. **CAD package** (source files, drawings) and **BOM** with sourcing plan.
- D3. **Two modular prototypes** (normal load, thermal, lateral friction) — rapid 3D-print versions + refined fabricated parts as feasible.
- D4. **Control & acquisition scripts** (basic routines) and **user manuals** (alignment, operation, safety).
- D5. **Test & validation report** with performance metrics and improvement roadmap.

Team & skills

- **Team size:** 3–5 students (multidisciplinary).
- **Useful skills:** CAD & rapid prototyping; basics of mechanics & tribology design; sensors/actuators integration; Data acquisition and control (LabVIEW, Arduino, Python), experimental methods; data handling & plotting.
- **Transversal skills:** Project management & teamwork ; Technical writing & oral communication ; Marketing & project dissemination ; Basic cost & budget analysis ; Sustainability & ethical design awareness.

Equipment & budget (provided by LGP/UTTOP)

- Access to a **Raman spectrometer with motorized stage**, lab benches and metrology tools; standard 3D printing for rapid prototypes; workshop access for conventional fabrication (as available).
- **Operating budget** to cover components, consumables and prototyping costs (managed with the supervisor).