

Title: Automated discovery of material properties using dextrous manipulation, vision tools, and learning agents.

Work package: The project focuses on developing a robust classification framework for solid and semi-solid materials used in automated sampling workflows. Using the FR3 and UR3e robotic platforms, a controlled imaging setup, and existing code infrastructure, the student will design and evaluate new approaches for identifying material properties such as viscosity, adhesiveness, cohesiveness, and granularity. The work includes (1) analysing the behaviour of nine representative materials through vision and manipulation, (2) proposing measurable descriptors and sensing strategies—including force-torque or rheological cues—and (3) implementing and testing classification methods based on robotics, vision, or additional tools the student develops. The outcome will be an improved classification scheme and validated methodology suitable for integration into our automated sampling pipeline.

Tasks: These tasks are subject to changes, depending on the chosen classification framework.

- 1) Decide on a classification methodology framework.
- 2) Build robotic end effectors and tools that supports the framework.
- 3) Write programs to collect material property data.
- 4) Analyse the data and test classification framework.

Requirements: Familiarity in robotics programming tools like python, ROS2. Familiarity in rapid manufacturing tools like CAD, 3D printing. Also, you should be interested in scientific discovery using robotic tools.

Material access: UR3e, FR3 robotic arms. 3D printers and a full manufacturing workshop with dedicated support.

Keywords: AI for science, dextrous manipulation, computer vision, chemistry.

Interested students: Contact Jasper Tan at zhen.tan@epfl.ch. Please provide a CV and a short list of skills that may help this project, as well as a list of skills you may want to work on during this project.

Personnel: Jasper Tan (main supervisor), James Hermus (collaborator, Postdoctoral Researcher in the Robot Learning & Interaction Group), Pascal Miéville (project supervisor, director of SwissCat+ West).