Reinforcement learning for the smart multiaxial testing of materials

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Host teams:

- LaMcube - Laboratoire de Mécanique, Multiphysique, Multiéchelle
  https://www.lamcube.univ-lille.fr
- Scool, CRIStAL - Centre de Recherche en Informatique, Signal et Automatique de Lille
  https://team.inria.fr/scool

Description:

The goal of this internship is to design, implement and test a reinforcement learning agent able to control a material testing machine. This machine is used to perform research on materials at the LaMcube lab (see Fig. [**?**]). The reinforcement learning part of the internship will be handle in collaboration with team Scool at CRIStAL/Inria.

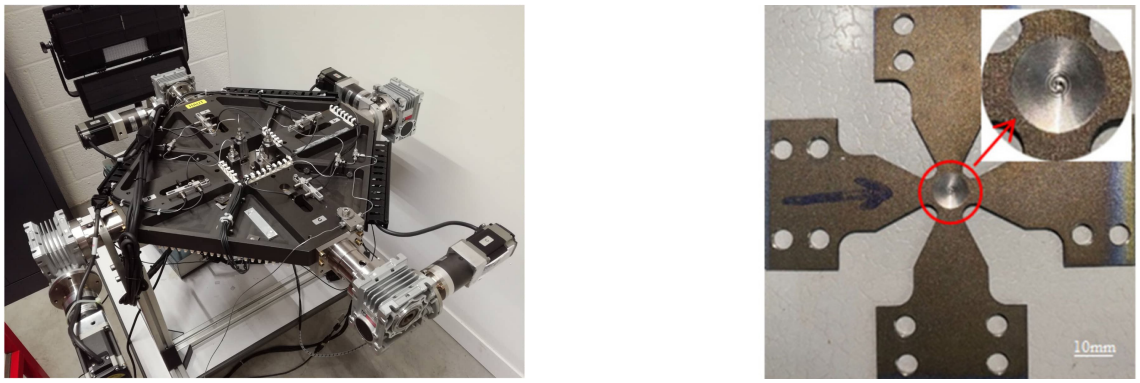

Figure 1: Machine for biaxial testing (left) and associated specimen (right)

Mechanics of materials aims to understand, model and optimize the mechanical response of industrially relevant materials. Here, the scale of observation as well as the size of the specimens are the keystones in order to build an accurate identification strategy. Major improvements have been made during the last four decades, mainly thanks to the renewal of measurement techniques. Still, several material properties and field values

are difficult to measure directly. This is especially true for the interfaces. Moreover, the search for adaptive loading paths able to activate specific fine scale mechanisms is of the greatest interest, regardless of the material.

During this internship, we aim to develop a novel experimental-numerical technique in order to determine such quantities of interest by selecting the optimal macroscopic multiaxial loading paths. Reinforcement learning is coupled with material testing to attain this goal. The objective is to explore several RL algorithms in order to train an agent to control the material testing machine. A simulation environment based on the Finite Element Method will be used to train the RL agent.

Keywords: mechanics of materials, multiaxial testing, artificial intelligence, reinforcement learning.

Duration: 6 months.

Localisation: Cité scientifique, Villeneuve d'Ascq, France.