APREX - Learning through digital experience

Digital simulation in civil engineering

Numerical simulation allows to model simple or complex physics problems (mechanical, thermal, etc.) but too often remains confined to research.

Teachers often use physical experiments to illustrate their lessons and to allow students to visualize the phenomena studied, to learn by example. However, physical experiments are limited either as they cannot be used to illustrate all the subjects or for reasons of cost, or because the phenomena are too difficult to observe or to measure.

On the contrary, numerical simulation makes it possible not only to faithfully and inexpensively reproduce what the physical experience would be, but also to visualize the maps of stresses, plastic deformations and possibly to observe the effects of boundary conditions or the quality of the material.

This project plans to develop at least 12 modules in collaboration with a minimum of four teachers or teacher-researchers (i.e. on average 3 modules per teacher) from ISA-BTP, in the fields of engineering sciences in mechanics or thermal engineering.

A module can consist of course materials, practical work materials or autonomous digital practical work, which will be available for the entire University via e-learn. The teacher-researchers participating in the project will invest in the specifications of the modules and in the educational support; they will receive a bonus / discharge of 15 hours, which will be half-funded by E2S UPPA and ISA BTP. The numerical simulations and the formatting of the results for the module will be performed by the post-doc hired for the occasion under the supervision of the project leader.

The numerical practical works will exploit the variation possibilities in the simulation parameters. Numerical simulation is not the focus of the study but simply a tool for visualizing and understanding physical phenomena. To do so, the Cast3M multiphysics finite element simulation software will be used and distributed free of charge for educational and research purposes by the CEA. This software can be configured and operated via a web interface. Students will use the interface to access numerical simulations, but the more curious can also access the data files generated for the simulation code used.

A secondary objective of the project is to familiarize the students with the digital tool. Thus, even if this one is not the object of the study, the illustrations will give them an idea of the different possibilities provided. They will certainly approach courses related to numerical simulation with a greater interest and may consider using simulation tools when they encounter a problem.

The experience can of course be generalized for any teaching unit that can rely on digital simulation tools.