

Title: Patient-specific bone implants design: theory and hand-on practice

Teacher: ELISABETTA ZANETTI

Contact: elisabetta.zanetti@unipg.it

Indicative period: planned on request

ABSTRACT.

The design of patient-specific bone implants has been given a strong input by the availability of additive manufacturing techniques, which make possible producing single items at affordable costs.

The design of these implants must accomplish 3 main targets that are: designing a geometrical shape well conformed to the existing bones or bone portions; secondly, the stress distribution between the implant and bone must be calculated in order to check that strength limits are not exceeded; finally, the bone must be properly stimulated in order to induce bone remodeling and to exclude bone resorption.

The course illustrates this design workflow, with reference to specific case studies with hand-on laboratories.

PROGRAM

- 3D models repositories and 3D CAD model of inner anatomic structures from CT scans (2h).
Exercise: from CT scan to 3D model (2h)
- Mechanical properties of living tissues and simulation of their behavior (2h)
- Assessing physiologic loads and boundary conditions (2h).
Exercise in OpenSim: calculating musculo-skeletal loads for a given task (2h)
- Finite element models of inner anatomic structures: the bones. Realization of a whole model of a human bone: the femur (4h)
- Finite element models of an implanted femur: virtual implantation of a prosthesis and numerical simulations (4h)
- Model validation (2h)