

Specialty COMPUTATIONAL ENGINEERING

Description of the diploma:

Numerical modelling for industrial applications is a rapidly growing discipline, which brings together the power of computers and the biological, chemical and physical sciences. Computer based simulations and their related visualisations play a key role in industrial applications, environmental or biomechanical investigations.

This training aims to train graduates in engineering and science able to master the scientific approach for numerical computations in industrial engineering, environmental tales and biomechanics. This programme also wants to demonstrate how computational engineering is used effectively in solving real-world problems.

Access and recruitment:

- ♦ **Entry level:** L3 Physics, Science or Mathematics. Admission on record.
Possible direct admission in M2 (M1 level required).
- ♦ **Course length:** 2 years in English (a good level in this language is necessary).
- ♦ **Terms:** see www.physique-ingenierie.unistra.fr

Skills:

- ♦ Use discretisation methods for the equations governing physical processes (programming language and numerical techniques).
- ♦ Use simulation tools (commercial solvers, research codes or free software) in industry (Computational fluid dynamics, computational solid mechanics, computational biomechanics, computational chemical engineering, civil engineering).

- ♦ Visualise data and generate meshes around complex geometries.
- ♦ Develop numerical tools to understand physical phenomena and propose optimised solutions.
- ♦ Knowledge of the basics of fluids mechanics and solid mechanical laws, mathematics and numerical modelling.
- ♦ Solve numerically any problems in the fields of fluids mechanics, solid mechanics, heat and mass transfer, biomechanics and civil engineering.

Opportunities:

- ♦ **Functions:** PhD student, research engineer, development engineer, research and development engineer (R&D), environmental engineer, modelling and simulation engineer or numerical analyst, research professor, researcher ... long term, R&D Director, responsible for R&D laboratory, office manager
- ♦ **Sectors:** the world of research (PhD program) or large and small companies where numerical modelling is used. The positions in the industry as well as in all research laboratories, where numerical modelling is used (industry, environment, research, higher education).

Computational engineering

Courses:

Master 1:

- Project management and communication (26 h)
- Numerical resolution techniques for engineering (48 h)
- Languages (16 h)
- Mathematical methods for physics (24 h)
- Computational Fluid Dynamics, incompressible flows (24 h)
- Material modelling and simulations I: elasticity, visco-elasticity and creep (24 h)
- Modelling of mechanical systems (32 h)
- Constitutive laws for rheological fluids (24 h)
- Material modelling and simulations II: plasticity, visco-plasticity and damage (24 h)
- Introduction of simulation of Multiphysics (30 h)
- Study and research work (80 h)
- Finite elements for mechanical and thermal systems (32 h)
- Computational Fluid Dynamics, compressible flows (24 h)
- Turbulence modelling (24 h)
- Parallelisation, big data, data processing (24 h)
- Composite materials and homogenization techniques (24 h)
- Measurement and Identification (24h)
- Computational methods for structural dynamics, shock and vibration (24 h)

Master 2:

- Quality assurance (24 h)
- Language (16 h)
- Applied Computational Engineering for heat and mass transfer (24 h)
- Development and use of simulation tools for chemical engineering (24 h)
- 5 Advanced use of computational solid mechanics codes, CSM project (52 h)
- Visualization and grid generation (24 h)
- Free software in CFD (24 h)

- Advanced use of computational fluid mechanics codes, CFD project (64 h)
- Advanced computation in bio-mechanics (24 h)
- Applied Computational Engineering for bio-mechanics (24 h)

Hosting organism:

Département mécanique et Département électronique du solide, systèmes & photonique (D-ESSP) du Laboratoire ICube, Laboratoire du génie de la conception (LGeCo), Laboratoire d'hydrologie et de géochimie de Strasbourg (LHyGeS), Institut pluridisciplinaire Hubert-Curien (IPHC), Laboratoire des sciences de l'image, de l'informatique et de la télédétection (LSIIT) et Institut Charles-Sadron (ICS).

Industries:

Altran technologie, ArcelorMittal, CEA, EDF, INSA, ISL, ONF, Ruag Space, SIEMENS, SNCF...

Partnership:

INSA Strasbourg, Ecole nationale du génie de l'eau et de l'environnement de Strasbourg (ENGEES), Télécom physique Strasbourg (TPS), Ecole et observatoire des sciences de la Terre (EOST).

Internship:

16 up to 25 weeks in a research laboratory or in a industry. **Example of internship topics:**

- Evaluation and simulation of the bi-prosthetic human femur fracture risk (ICUBE).
- Development of procedure for numerical calculation of the vibration fatigue damage on train bogie (SNCF).
- Design and Simulation of Lab on Chips using Comsol Software (LSCE).
- One phase unsteady numerical study of the quantitative vortex characteristics in a single water pump sump (Deltares).

Contacts / information:

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