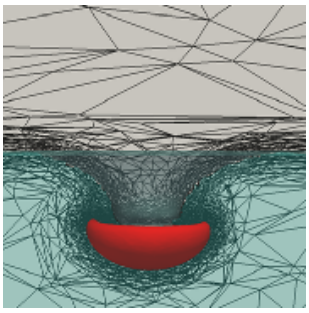
Spécialité Doctorale
Mathématiques Numériques, Calcul Intensif et Données

**ANMS 2021 Spring**

# Méthodes Numériques Avancées et Simulation
# Advanced Numerical Methods and Simulation



## Lecturers

Elie Hachem
Aurélien Larcher
Youssef Mesri
Thierry Coupez
Jeremie Bec
Rudy Valette
Philippe Meliga
Franck Pigeonneau
Jonathan Viquerat
Patrice Laure

## Schedule

30h Courses + Exercises

| **Week 03** | |
|---|---|
| 12. January | I/E102 |
| 14. January | I/E102 |

| **Week 04** | |
|---|---|
| 19. January | I/E102 |
| 21. January | I/E102 |

| **Week 05** | |
|---|---|
| 26. January | I/E102 |
| 28. January | I/E102 |

| **Week 06** | |
|---|---|
| 02. February | I/E102 |
| 04. February | I/E102 |

## Objectives

The course covers several numerical methods to solve time-dependent Partial Differential Equations using adaptive stabilized finite elements.
Advanced methods for turbulence modelling, multiphase flows, complex fluid flows, and aerothermal modelling of complex systems will be introduced.
Finally, the course will be completed by *a posteriori* error estimation techniques needed for anisotropic parallel mesh adaptation.

## Course content

1. Numerical methods
   - Parallel computing and HPC
   - Convection Diffusion Reaction : stabilized finite elements
   - Navier-Stokes : variational multiscale approaches
   - Mesh adaptation
   - Error estimators and anisotropic remeshing
2. Modelling and simulation
   - Turbulence modelling
   - Two-fluid flows
   - Newtonian and Non-Newtonian Fluids
   - Flow control and optimization
   - Deep Reinforced Learning for Fluid Mechanics

## Evaluation

The course is evaluated based on the results obtained during numerical simulation labs and a final written examination covering the theoretical arguments developed during the lectures :

| | |
|---|---|
| Lab exercises | 25% |
| Examination | 75% |