5 NUMERICAL METHODS IN FLUID MECHANICS

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This course will cover the following topics:

1. Finite Volumes I Method: Introduction and Spatial Differentiation (Computation Network Information and Variable Distribution),
2. Finite Volumes II method: Gauss theorem and calculation of flow quantities through the surfaces of computational cells.
3. Finite Volumes III method: Interpolation schemes, temporal differentiation and linear system solving.
4. OpenFOAM I Open Source Computational Engineering Software: General introduction to the structure, installation and basic use of the software.
5. OpenFOAM II Open Source Computational Fluid Engineering Software: Computational geometry design, creation and modification of computational networks.
6. OpenFOAM III Open Source Computational Fluid Engineering Software: Linear solvers, pressure-speed coupling, spatial and temporal discretization schemes.
7. OpenFOAM IV Open Source Computational Fluid Engineering Software: Simulations of permanent and non-permanent flows, introduction of initial and boundary conditions, running simulations with parallel processing.
8. OpenFOAM V Open Source Computational Fluid Engineering Software: Data processing during calculations, initialization and modification of resolution fields
9. OpenFOAM VI Open Source Computational Fluid Engineering Software: Data transformation, development of complex boundary and initial conditions,
10. OpenFOAM VII Open Source Computational Fluid Engineering Software: Qualitative and quantitative processing of resolution results.
11. Applications in the simulation of complex flows I: Turbulent flows and free surface flows.
12. Applications in the simulation of complex flows (I: Multiphase flows, particulate flows and diffusion flows).
13. Personalized Work Semester: Presentation, Assignment, Elaboration with interactive teaching (solving queries and class corrections).

After the section is completed, the participants are able to:

- They understand the basics of numerical analysis.
- They understand the basic equations of hydraulic and their methods of numerical solution.
- They understand the mathematical description and analysis of fluid mechanics problems.
- Analyze, understand and modify computational codes.
- Evaluate the correctness of numerical results and decide alternative strategies for resolution.
- They use programming tools for different applications (Civil Engineering problem solving, management, analysis and graphical data representation).

Teaching Mode: 3 Hours Suggestion-Workshop / Week