UNIMORE
UNIVERSITÀ DEGLI STUDI DI
MODENA E REGGIO EMILIA

Dipartimento di Scienze e Metodi
dell'Ingegneria

Computational thermo-fluid dynamics

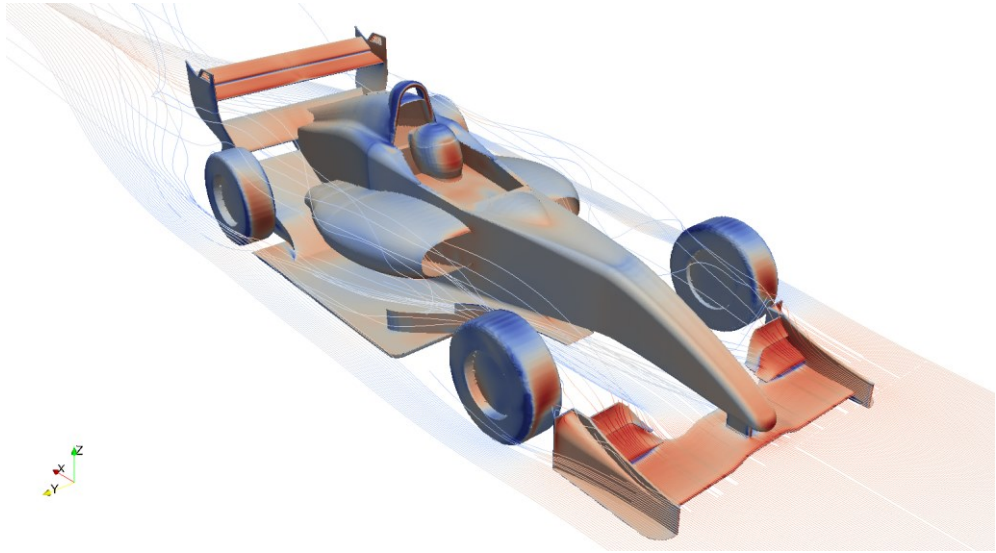
Course overview

Diego Angeli

Master's Degree in Digital Automation Engineering
"Digital Design" Curriculum

Computational thermo-fluid dynamics

Background

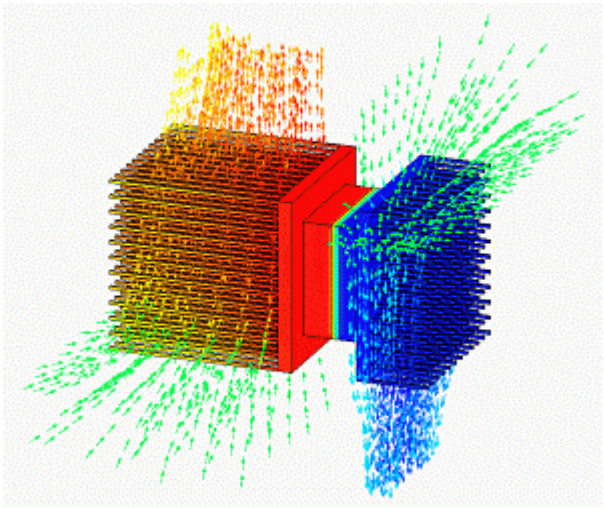


Fluid flow and heat transfer phenomena are omnipresent in industrial processes and products

Modeling and simulation are increasingly widespread as complementary design and verification tools

Digital engineers should be able to construct digital models based on:

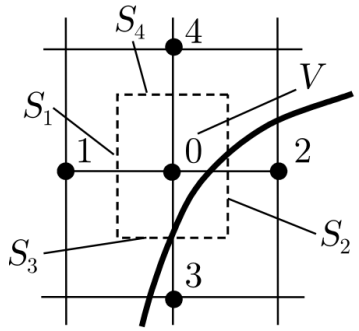
- Deep understanding of modelling techniques and of the underlying physics
- Suitable coding capabilities for the development, modification or integration of digital models
- Conscious and competent use of simulation tools

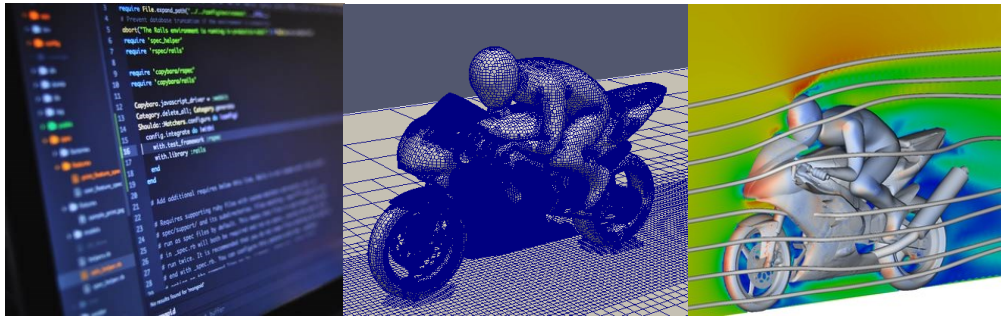


Computational thermo-fluid dynamics
Objectives

Developing a deep knowledge of:

- numerical methods
- discretization techniques
- implementation strategies
- simulation tools





for the analysis of flow and heat transfer problems at different scales.

The CTFD course is linked with the Multiphysics Flow Modeling course, where advanced physical modeling approaches (e.g. turbulence, multiphase flow, etc.) and applications will be covered in detail.

Throughout both courses, the student is provided with a complete set of skills on the simulation and modeling of transport phenomena.

Computational thermo-fluid dynamics
Contents

Theoretical classes (about 3 ECTS):

- Governing equations of fluid flow and energy conservation
- Discretization schemes, Finite Difference and Finite Volume Methods
- Pressure-velocity coupling in incompressible flows and solution algorithms
- Integration of the equations on 1D/2D/3D grids

Practical (laboratory) classes (about 3 ECTS):

- Simulation of 2D/3D problems, using the open source OpenFOAM toolbox (used by 7 out of 10 F1® Teams)
- Implementation of 1D models in Python

Final Exam

- Presentation of a project work
- Oral interview

Computational thermo-fluid dynamics
Practical information

Contacts

e-mail: diego.angeli@unimore.it
phone: +39 0522 522 096
Student reception: by appointment only (via e-mail)
Face-to-face reception at Pad. Morselli / Tecnopolo (HEATECH Lab.)
Online reception on MS Teams

Course materials

- Slides/handouts
- Practical instructions for software installation / ready-made utilities
- Tutorials and exercises carried out in the lab sessions (with solutions)
- Additional material (papers, video tutorials, real-world examples, examples former student presentations, …)

will be made available on the Moodle page of the course (https://moodle.unimore.it) and/or on Teams

Textbooks

- C.A.. Fletcher, Computational Techniques for Fluid Dynamics vol. 1 & 2, Springer
- R.B. Bird, W.E. Stewart, E.N. Lightfoot, Transport Phenomena, Wiley