

# PURDUE MECHANICAL ENGINEERING

*Spring 2018/ME49601: Introduction to Computational Fluid Dynamics*

**Instructor:** Dr. Carlo Scalò, Assistant Professor of Mech. Eng.  
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**Description:** Computational Fluid Dynamics (CFD) is a branch of fluid mechanics that uses computer software to solve and analyze problems that involve fluid flows. The governing flow equations are discretized on a computational mesh (see figure on the right) and solved element by element. The course aims at providing a fundamental introduction to the topic. Basic knowledge of fluid mechanics is expected (e.g. ME309-level) as well as some familiarity with either Matlab or Python programming language.

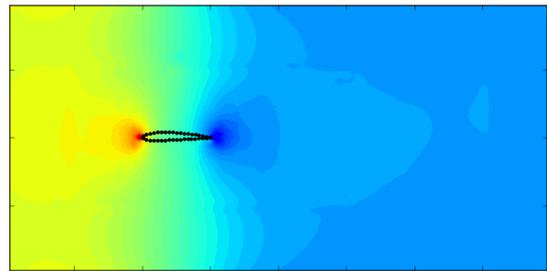
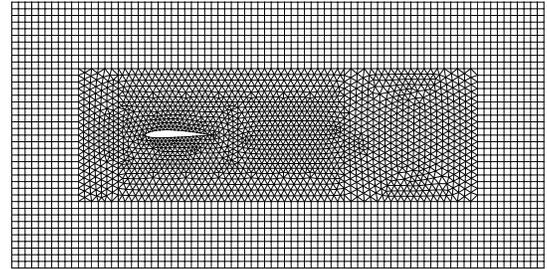
**Objectives:** By the end of the semester students will be able to set up and solve common fluid dynamic problems with popular commercial software, such as ANSYS Fluent, while also being able to appropriately discretize governing fluid dynamic equations for very simple flow problems, inspired by problem sets from ME309. Special emphasis will be placed on correctly interpreting the results of these simulations to understand the physics of the problem being modeled.

**Topics:**

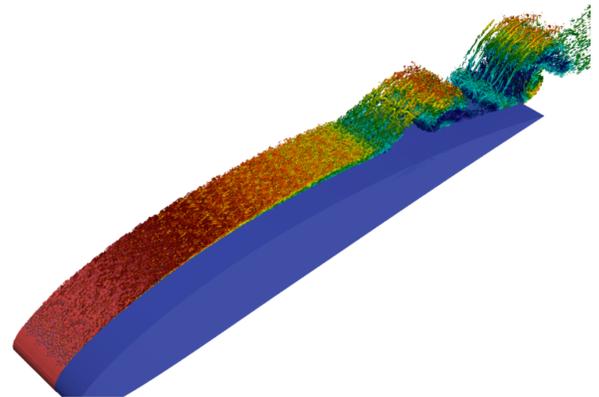
- Review of ME309 (Control Volume Analysis and Navier-Stokes)
- Advection and Diffusion
- Navier-Stokes Equations (more advanced than in ME309)
- Laminar and Turbulent Flow
- Fluid Machinery/Compressible Flow

**Activities:**

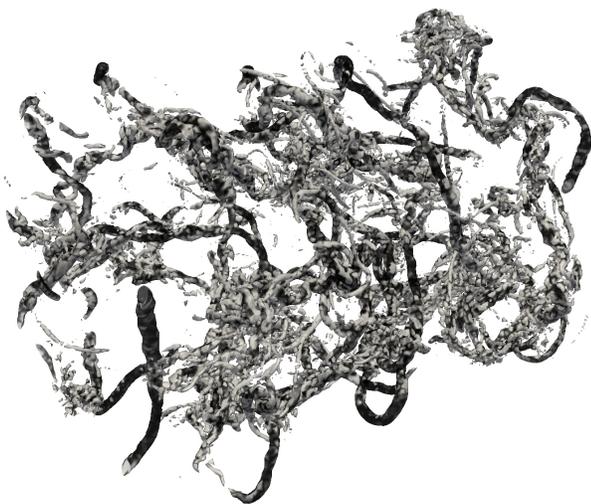
- Matlab/Python tutorial
- ANSYS Fluent tutorial on Purdue's supercomputers
- Control Volume Analysis
- CFD simulation of laminar boundary layer
- CFD simulation of turbulent boundary layer
- CFD simulation of nozzle flow and shock wave propagation



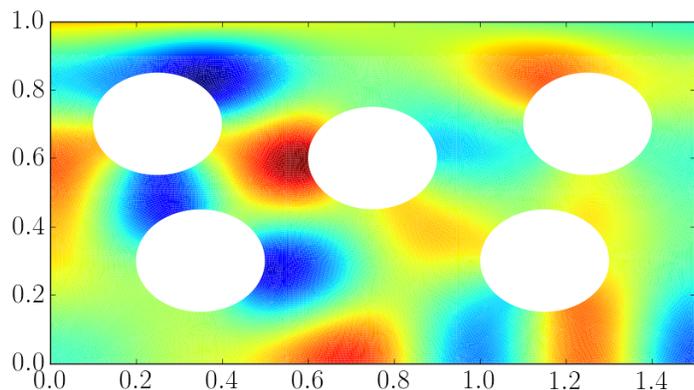
Unstructured computational mesh (top) and pressure field (bottom) from a simulation of flow around an airfoil.  
(*Danish Patel. ME 608, Spring 2016.*)



Flow control on the wake of a NACA-4412 airfoil.  
(*Bodart et al. AIAA SciTech 2017.*)



Turbulent simulation of vortex dynamics.  
(*Yu and Chapelier AIAA 2018.*)



Acoustic wave propagation inside porous media.  
(*Patel et al. AIAA SciTech 2017.*)