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Independent Study

Turbulence modeling

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Description:

The object of the course is to provide a thorough knowledge and understanding of modern turbulence models such as RANS, DES, and LES. Including how these models work and where they can be applied. There will be weekly meetings to discuss the material and ask any questions. Each week exercises from the reading will be assigned and completed. At the end of the course a final project will be done that compares the accuracy of different models for an engineering problem.

Literature:

- D. C. Wilcox, “Turbulence Modeling for CFD,” 3rd Edition, DCW Industries, Inc., La Canada, 2006.
- Durbin, Paul A., and BA Pettersson Reif. “Statistical theory and modeling for turbulent flows,” 2nd Edition, John Wiley & Sons, 2011.

Weekly schedule:

Week 1	Introduction	Durbin: Chapter 1, 2 (42 pp)
Week 2	Reynolds averaged Navier–Stokes equations	Durbin: Chapter 3 (10 pp)
Week 3	Algebraic models	Wilcox: Chapter 3.1-3.3, 3.8 (19 pp)
Week 4	The k – ε models	Durbin: Chapter 6.2 (15 pp)
Week 5	The k – ω model. SST-Menter model	Durbin: Chapter 6.3
Week 6	Spalart-Allmares model	Spalart, P. R. and Allmaras, S. R., "A One-Equation Turbulence Model for Aerodynamic Flows"
Week 7	The question of transition	Durbin: Chapter 6.5 (8 pp)
Week 8	Eddy viscosity models	
Week 9	Galilean invariance and frame rotation and Realizability	Durbin: Chapter 8.1 (8 pp)
Week 10	URANS models	
Week 11	DES and DDES models	Wilcox: Chapter 8.4 (6 pp)
Week 12	LES	Pope “Ten questions concerning the large-eddy simulation of turbulent flows”
Week 13	LES Smagorinsky model	Meneveau, Katz “Scale-invariance and turbulence models for large-eddy simulation”
Week 13	LES: Dynamic Smagorinsky model	Meneveau, Katz “Scale-invariance and turbulence models for large-eddy simulation”
Week 14	LES: WALE	
Week 15	LES:Numericals effects	