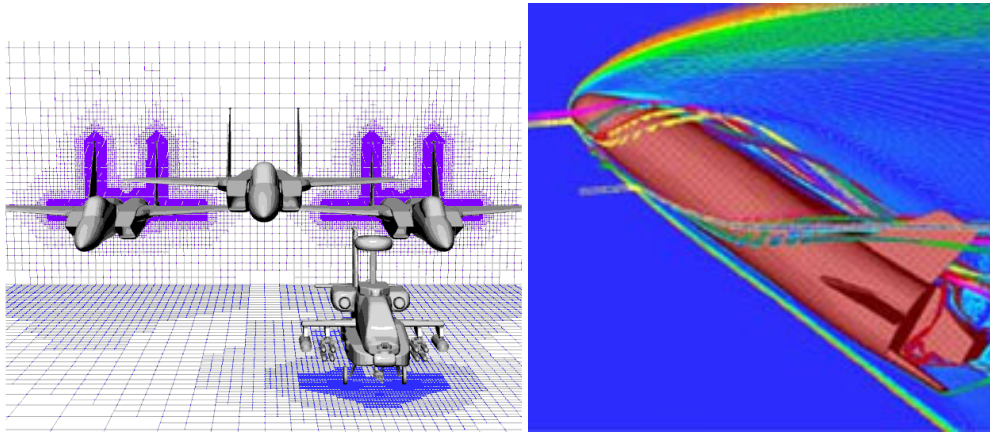


San José State University
Aerospace Engineering
AE269 Advanced Computational Fluid Dynamics, Fa11 2016



Instructor:	Dr. Periklis Papadopoulos
Office Location:	ENG 272-D
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Office Hours:	Tues & Thurs 4:30 pm – 6:00 pm
Class Days/Time:	Thurs / 6:00 pm – 8:45 pm
Classroom:	E164
Prerequisites:	BSAE or instructor consent

Course Description

The class will cover advanced topics in computational fluid dynamics and provide the students the opportunity to use numerical techniques to solve the Euler and Navier-Stokes equations. The students will use, grid generation, CFD, and visualization software for exercises and projects. The students will use leading commercial CFD software, such as CFD-FASTRAN, for aerodynamic and aerothermodynamic applications, specifically designed to model real aerospace industry applications. Course will introduce the students to state-of-the-art multiple moving body problems and the simulation of complex aerospace problems including missile launch, maneuvering and staging, and aircraft flight dynamics and store separation. The students will compute cases with the Navier-Stokes flow solver to benchmark its finite rate chemistry and thermal non-equilibrium modules. Students will be guided through these challenging applications.

Course Goals

Introduce students to:

- *Explicit and implicit time differencing methods*
- *Central, upwind and characteristic spatial differencing techniques*

- *Classical relaxation methods*
- *Multigrid methods*
- *Splitting/factoring methods*
- *FASTRAN benchmark cases and applications*
- *Practical examples and real life lessons*
- *Contemporary methods and codes (FASTRAN)*

Course Learning Outcomes (CLO)

Upon completion of this course students will be able to:

1. *Develop and use of numerical tools*
2. *Perform stability analysis of a code*
3. *Determine the accuracy of numerical methods*
4. *Design computational methods based in linear theory*
5. *Develop a basic understanding of algorithms and methods of practical value (e.g. methods for the Euler and Navier-Stokes equations).*
6. *Perform benchmark studies for code-to-code validations and against experimental data.*
7. *Apply state-of-the-art CFD codes (FASTRAN) for important aerospace applications.*

Required Texts/Readings

Textbook

Fundamentals of Computational Fluid Dynamics by Lomax, Pulliam and Zingg, Published by Springer-Verlag

Other Readings

Instructor Notes

Numerical Computation of Internal and External Flows, Vol. 1 and 2, C. Hirsch, John Wiley & Sons, New York, 1988. Computational Fluid Mechanics and Heat Transfer, D.A. Anderson, J.C. Tannehill and R.H. Pletcher, Hemisphere Press, 1984.

Midterm & Final Project

- *You must average at least 70% on your midterm and final project to receive an A or a B in the course.*

Grading Information

<i>Workouts</i>	<i>100 points</i>
<i>Homework</i>	<i>200 points</i>
<i>Midterm Exam</i>	<i>300 points</i>
<i>Final Project</i>	<i>400 points</i>

Total 1000 points

950 points < A+
900 points < A
850 points < A-
800 points < B+
750 points < B
700 points < B-
670 points < C+
650 points < C
600 points < D
Below 600 points = F

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' [Syllabus Information web page](http://www.sjsu.edu/gup/syllabusinfo/) at <http://www.sjsu.edu/gup/syllabusinfo/>.

AE Department and SJSU policies are also posted at <http://ae.sjsu.edu/program-policies>.

Course Schedule

Week	Date	Topics, Readings, Assignments, Deadlines
1	8/25 & 9/1	Introduction Background on Advanced CFD trends and tools
2	9/8	Computational Geometry
3	9/15	Grid Generation / Computational Geometry
4	9/22	Model Equations / Topological Constructs / Final Project Proposal Due
5	9/29	Advanced Mesh Generation Techniques / Discussion of Boundary Conditions
6	10/6	Linearization, General Solutions, Finite Difference Formulations
7	10/13	Generalization of Compact Difference Schemes
8	10/20	Generalized Schemes of any Order
9	10/27	Central Differencing Schemes / 1 st Interim Project Report Due / 1 st Progress Presentations
10	11/3	Upwind Schemes
11	11/10	Exact vs. Discret Solutions
12	11/17	General Solution of Coupled Systems of Equations
13	11/24	Time Marching Methods / 2 nd Interim Project Report Due / 2 nd Progress Presentations
14	12/1	Inherent and Numerical Stability
15	12/8	Stiffness and Stability Analysis
16	12/15	Final project presentations
Final Exam	Thursday, December 22	ENGR 164 at 6:00 pm – 8:45 pm / Final Project Presentations / Final Project Report Due