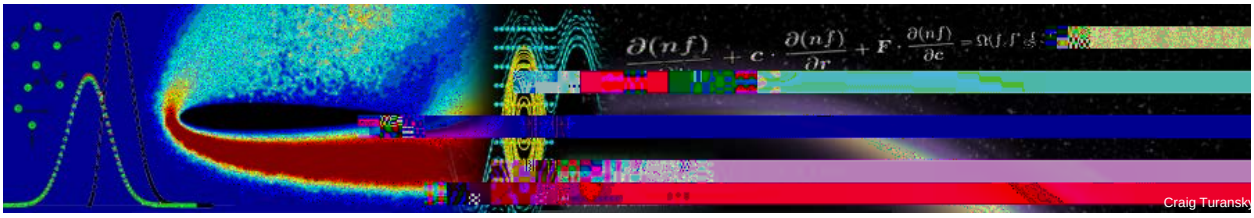
ASEN 6061
MOLECULAR GAS DYNAMICS and DSMC



Instructor : Professor Brian M. Argrow

Office : ECOT 634

Contact : email: brian.argrow@colorado.edu; tele: 303-492-5312

Course w ebsite : http://learn.colorado.edu

Applications: High-Knudsen-number modeling and simulation for physics-based, gas-surface interaction; on-orbit satellite drag and trajectory analysis; high-speed atmospheric entry; weakly-ionized and reacting rarefied flows; flow in miniature and MEMS devices...

Learning Goals

- Learn fundamentals of kinetic theory, the basis for the molecular description of a dilute gas.
- Learn the foundations, implementation, and applications of the Direct Simulation Monte Carlo (DSMC) method for modeling rarefied-gas flows

Learning Outcomes

- Understanding of basic kinetic theory and molecular models
- Understanding of the appropriate applications and limitations of kinetic theory and DSMC
- Ability to obtain and verify simple one- and two-dimensional DSMC results

Course Overview : Description of the composition and flow of gases on a microscopic level to examine the behavior of the molecules that make up a macroscopic flow system. Thermodynamic properties, transport phenomena, and the governing Boltzmann Equation are derived from molecular collision dynamics and the kinetic theory. Kinetic theory and DSMC are introduced in project-based assignments and in-class discussion.

Prerequisites : Familiarity with compressible flows and thermodynamics, with some differential equations and tensor notation. Simple programming and numerical methods using a “high level language” such as C++ and/or a computing environment such as MATLAB or Mathematica.

Course Outline:

1. Kinetic Theory
2. Binary Elastic Collisions
3. Basic Kinetic Theory
4. Equilibrium Gas Properties
5. Inelastic Collisions and Surface Interactions
6. Collisionless (Free-Molecular) Flow
7. Transition Regime Flows
8. DSMC Topics

Text: G. A. Bird, Molecular Gas Dynamics and the Direct Simulation of Gas Flows , Oxford, 1998.

Additional References:

Bird, G. A., The DSMC Method, Version 1.1 , 2013, ISBN 9781492112907 (https://www.createspace.com/3689652).

Vincenti and Kruger, Introduction to Physical :u (,)]TJynamicalM nc Re.