Term Project: Problem Set C

Instructor: Prof. Chongam Kim
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Due: June 10th
Room: 301-1256

- Governing equation: Two-dimensional Euler equation
- Basic discretization: Finite volume method
- Flux function: Roe's FDS, RoeM2, AUSM+, AUSMPW+
- High-order interpolation: MLP3 (or MLP5) and choose one more between [MUSCL with slope limiter / WENO]
- Time integration method:
  - Steady problem: Choose at least one among [4th- or 5th-order Runge-Kutta method with local time stepping / LU-SGS / AF-ADI]
  - Unsteady problem: Choose at least one between [3rd-order accurate TVD Runge-Kutta method / dual time stepping wth LU-SGS or AF-ADI]
- **Pick one for steady and one for unsteady computations. Compare efficiency (total and modular computational cost), accuracy and robustness between flux functions.**

1. Steady problem

(1) Transonic flow over NACA0012 airfoil

- Computational mesh (O-type) will be given on the website.
- Free stream condition: $M = 0.8$, $\alpha = 1.25°$
- Plot: convergence history; surface pressure distribution; aerodynamic coefficients (*Cl*, *Cd*) values

(2) Supersonic flow over a blunt body

- Geometry & mesh: mesh type 1 (semi-circle), mesh type 2 (quater-circle)
- Free stream condition: $M = 8.0$, $\alpha = 0.0°$
- Plot: convergence history; pressure (or density) contour; pressure (or density) along the center line

2. Unsteady problem

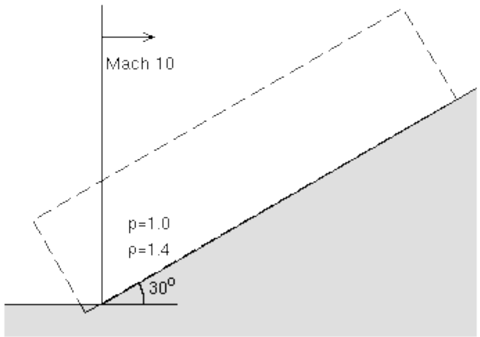
(1) Explosion test

- Grid system: [-1,1]$\times$[-1,1] with 100$\times$100 cells
- Initial condition: $(\rho, u, v, p) = \begin{cases} (1.0,\ 0.0,\ 0.0,\ 1.0) & R < 0.4 \\ (0.125,\ 0.0,\ 0.0,\ 0.1) & \text{else} \end{cases}$,

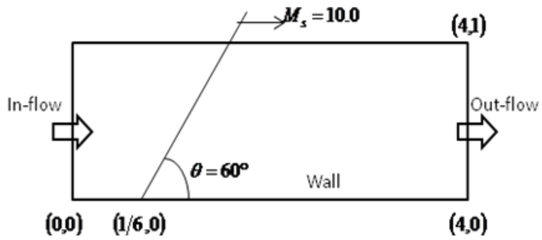
  where R is the radius from the center
- Plot: density (or pressure) contour; distribution of density (or pressure) along the line $y = 0, x \geq 0$ at $t = 0.25$

(2) Double Mach reflection

- Grid system: [0,4]$\times$[0,1] with 480$\times$120 and 960$\times$240 cells
- Initial configuration:



(a) Physical configuration



(b) Computational domain

- Plot: density contour