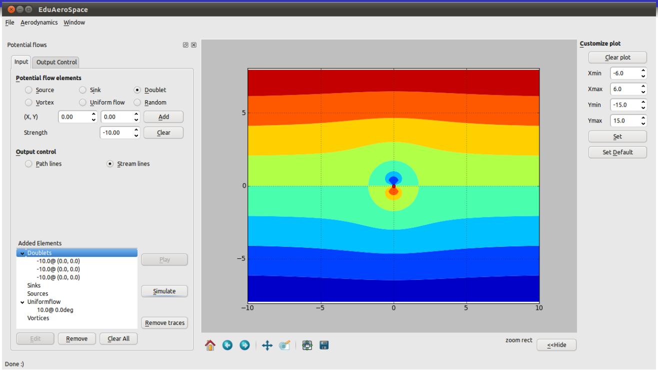
EduAerospace

AE 663 : Software Development Techniques for Engineering and Scientists



1. Outline

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2. CFD-1D
   - Advection
   - Burger
   - ShockTube
   - Special Feartures

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3. Potential Flows

- Implemented Advection Scheme

$$u_t + cu_x = 0 \tag{1}$$

  - Incorporated Schemes: FTFS,FTBS,FTCS,Upwind Scheme,LaxWendroff Scheme
  - FTBS

$$u_i^{n+1} = u_i^n - (c\frac{\Delta t}{\Delta x}) * (u_i^n - u_{i-1}^n);$$

  - LaxWendroff Scheme $\lambda = c\frac{\Delta t}{\Delta x}$

$$u_i^{n+1} = u_i^n - ((\lambda/2.0)(u_{i+1}^n - u_{i-1}^n)) + ((\lambda^2/2.0)(u_{i+1}^n - 2.0u_i^n + u_{i-1}^n))$$

- Boundary Condition Incorporated
  - Free: Ghost Cell values equal to neighbour cell
  - Reflect: Ghost Cell velocity is opposite to neighbouring cell
  - Complement: Ghost Cell value equals to neighbour cell of other Ghost Cell

- Implemented Burger Scheme

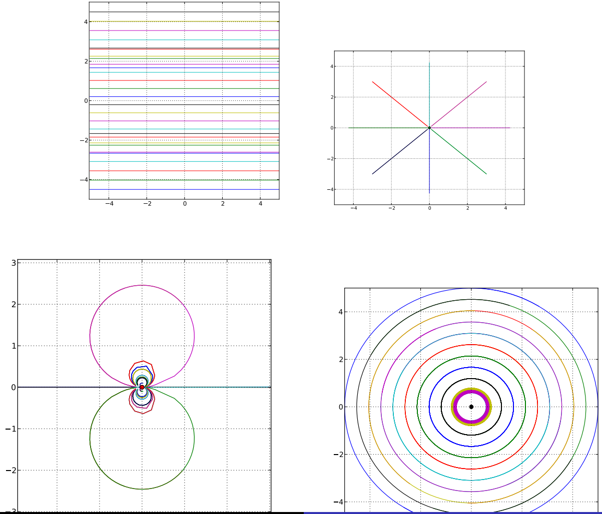
$$u_t + uu_x = 0 \tag{2}$$

- Initial Conditions
  - backward step: For shock propagation and smearing
  - forward step: For expansion evolution and smearing
  - backward ramp: For shock formation from just a smooth slope
  - forward ramp: For expansion evolution from constant slope
- Scheme
  - Lax Method $u_i^{n+1} = \frac{(u_{i+1}^n + u_{i-1}^n)}{2.0} - (\frac{\Delta t}{\Delta x})\frac{({u_{i+1}^n}^2 - {u_{i-1}^n}^2)}{4.0}$

- Implemented 1D Shock Tube Problem
  - Implemented HLL,HLLC,Vanleer, Steger Warming, AUSM, $AUSM^{+}$,$AUSM^{+}up$
  - Incorported the various parameters for $AUSM^{+}$,$AUSM^{+}up$
  - Incorported the various other parameters in Sod Shock Tube
  - Incorporated the Iteration Time step
  - Incorporated the option for various output paramters

- Implemented tests.py, to check the user defined scheme.
- Incorporated runtime messages in Status Bar
- Incorporated user defined iterating time step
- Plot parameters can be changed while simulating
- Incorporated short keys for special buttons
- Incorporated value range for different parameters including decimal points.
- Incorporated mouse increment with parameter type

Basic Elements



Basic input features in GUI

- Add desired potential elements
- Interactive plot : Add $->$ will be shown in the figure, message in status bar
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- TODO : Edit the elements added

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        1. At any X or Y location
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- TODO : Release particles in rectangular, elliptical, parabolic, hyperbolic patches

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- Can set desired axis limits for simulation!!!

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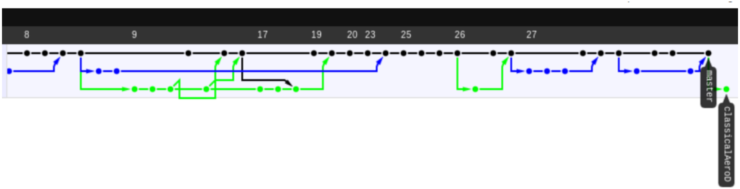
- Continuous potential elements implementation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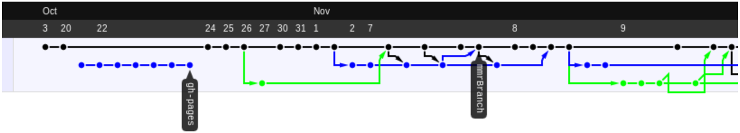
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Thank you