CEE 618 – Scientific Parallel Computing: Homework #11

Name:________________________________

April 5, 2013

1. Submit a full proposal of your final project. Refer to NSF grant proposal guideline[1]. Supplementary information can be found at

   - `http://www.indiana.edu/~gradgrnt/proposal-writing-and-research-resources/sample-grant-proposals/`
   - `http://math.asu.edu/about-us/nsf-proposal-template`
   - `http://www.sinclair.edu/about/offices/grants/prof/samples/index.cfm?searchTerm=nsf%20funded%20proposals`

   General proposal format should have

   (a) Project summary (front page), clear view of current problem and proposed solution in a form of abstract

   (b) Introduction and problem statement: what problems are, why they are important, what benefits will be if solved.

   (c) Background or literature review: who did what and why for these problems.

   (d) Methods and tasks of proposed research with time line: which methods you will use, and what specific main/sub-tasks are, and how long each task will take.

   (e) Broad and Intellectual Impacts: when you complete your project, what main knowledge are you will gain and how it does contribute to other areas or applications.

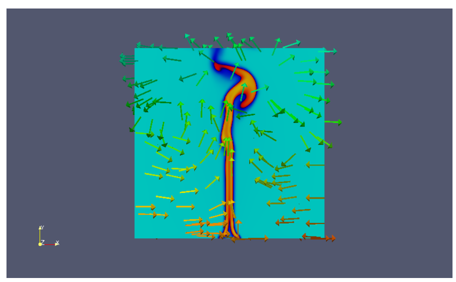
[1] `http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg`

2. Perform smallPoolFire2D simulation of OpenFOAM.

   (a) Visualize your small Pool Fire simulation in 2D. Use 'Surface' method to generate movies of

      i. Temperature profile (T)
      ii. CH4 concentration profile (CH4)
      iii. CO_2 concentration profile (CO2)
      iv. O_2 concentration profile (O2)

      with velocity vectors (U) of which color represents pressure. For example, the first movie shows T with surface plot together with U of scale mode ='off' and color of p. Upload the four movies on your YouTube site and share them with me. The first movie snapshot may look like



   (b) Physically interpret simulation results. What are similarities/differences among profiles of T, CO2, CH4, and O2?

3. Hagen-Poiseuille Flow

   (a) Derive Hagen-Poiseuille equation for laminar fluid flow through a cylindrical pipe. (Refer to class lecture.) Conditions are

      i. pressure gradient is constat along the axial direction: $dP/dz =$ constant
      ii. fluid velocity is zero on the inner wall of cylinder: $v(r = R) = 0$,
      iii. does not diverge at the center of the cylinder: $v(r = 0) =$ finite.

      Represent $v(z)$ in terms of mean speed across the circular area (i.e., cross-section):

$$\bar{v} = \frac{1}{\pi R^2}\int_0^R v(r)\, 2\pi\, r \mathrm{d}r$$

(b) Use OpenFOAM to simulate the flow through a long cylinder. Boundary conditions are

  i. On the wall surfaces: velocity is zero, and pressure has zero-gradient.
  ii. On the left inlet: pressure is a positive constant (i.e., 1.0), and velocity has zero-gradient.
  iii. On the right outlet: pressure is zero, and velocity has zero-gradient.