P-Flow Tutorial:

Introduction to the 13.021 Java P-Flow applet

The purpose of this document is to familiarize you with the 13.021 Java P-FLOW applet. This applet can be found at http://web.mit.edu/13.021/www/java_pflow/ . It will be used as a tool to solve homework problems. It is highly recommended that you read the "*User Guide* " for requirements and available functionalities.

The older version of P-Flow was available only at certain Athena workstations. The current Java applet has the advantage that it can be used on any PC. However it should be *emphasized* that it is still under construction. On-line announcements will be made each time updated/ improved versions are available (for general 13.021 announcements refer to: http://web.mit.edu/13.021/www/announce.html).

What follows is a short tutorial that will guide you through the basics of the Java P-FLOW. The end result will produce two figures, which you do NOT need to hand in.

1. Visit http://web.mit.edu/13.021/www/java_pflow/.
2. One window will appear. You will see a box that defines the domain and several buttons.
3. In the "ZOOM" box choose ZOOM 10X.
4. Check the box "Plot StreamLines". Once the "Plot StreamLines" is checked when you left click on any point in the domain the applet plots the streamline that goes through the specified point.
5. Check the box "Grid". A uniform grid will appear in the domain. The option "Grid Scale" will be activated and you can choose the desired grid distance. The grid distance *currently* varies continuously as you move the "Grid Scale" button. Notice that while you move the cursor in the domain the location of the cursor is printed at the left lower bottom of the page (under the "Add Singularities" area).
6. **Free Stream**: In the "Add Singularities" area under "type" choose "Free Stream" (second from the top). In the "Strength" box that specifies the free stream velocity type 0.1. In the "Orientation" box that specifies the direction of the free stream type 0. The boxes specifying the coordinates will be disabled as the free stream is uniform everywhere. You will observe an arrow at the left top corner of the domain (a symbol for the free stream) and two numbers that indicate the value of the free stream velocity and the orientation.
7. **2D Dipole:** In the "Add Singularities" area under "type" choose "2D Dipole" (second from the bottom). In the "Strength" box that specifies the strength of the dipole type 100. In the

"Orientation" box that specifies the direction of the dipole type 0. You can specify the origin of the dipole either by typing the coordinates of the dipole origin at the "X" and "Y" boxes respectively or by clicking on the desired point in the domain. Place the dipole at the origin (0, 0). You will observe a filled diamond (*current* symbol for 2D dipole) at the origin in the domain and two numbers that indicate the strength of the dipole and its orientation.

8. Left click on the domain at various points. Observe the streamlines that are plotted.
9. **2D Vortex:** In the "Add Singularities" area under "type" choose "2D Vortex" (third from the top). In the "Strength" box that specifies the strength of the vortex type 10. The "Orientation" box will be disabled. You can specify the origin of the vortex either by typing the coordinates of the vortex origin at the "X" and "Y" boxes respectively or by clicking on the desired point in the domain. Place the vortex at the origin (0, 0). You will observe a filled circle (*current* symbol for vortex) at the origin in the domain and a number that indicates the strength of the vortex. Notice that all the streamlines are now erased.
10. Left click on the domain at various points. Observe the streamlines that are plotted. You can zoom out by choosing ZOOM 2X. You will obtain a more general view of the flow field. Note that it might take longer to plot the streamlines in the current ZOOM option. In addition the streamlines might stop in the middle of the domain: Those features are currently under construction.
11. Printing is not yet available directly through the applet. However, you can "Print Screen" and paste the image at any image editor. You can then print the image. In your PC maximize the applet window and press the "Print Screen" button on your keyboard. Open an image editor (such as "Microsoft Paint" for those using "Windows") and under "Edit" choose "Paste". You will be asked if you want the document enlarged. Press "yes" and the P-Flow image will appear. Then print the image. This will be Figure 1.
12. Center-click. Everything plotted in the domain is cleared but the singularities entered are saved.
13. Check the box "Point Evaluation". Once "Point Evaluation" is checked when you left click on any point in the domain the applet prints the coordinates, velocity and pressure coefficient at the specified point.
14. Left click at the following points: (9.9, 7.9), (-9.9, 7.9), (0, 12.7), (0, -12.7), (12.7, 0), (-12.7, 0) Observe the behaviors of Ux, Uy and pressure coefficients at each point. Print the image. This will be Figure 2.
15. You can press the "Reset" button. All information entered will be erased and you may start over.
16. To exit the Java P-Flow you can either close your browser or specify another web location on the address bar.