P-Flow Tutorial:

Introduction to the 2.20 Java P-Flow applet

The purpose of this document is to familiarize you with the 2.20 Java P-FLOW applet, which will be used as a tool to solve homework problems.

Tips

The applet is still under construction. The following tips might prove helpful:

In the case the applet "dies" reload the page.

Increase the resolution of your screen to fit the entire applet in your screen. If you can not do this be aware that you will observe that the image is distorted each time you scroll the page; wait for a couple of seconds and the view will return to normal.

The "Point Evaluation" function might fail when you "Clear" the screen (or middle click) or "Reset". If you keep having trouble, reload the applet.

A. Workspace

1. To run the applet you need to download and install the file J2SE 1.4.2 from: http://ocw.mit.edu/OcwWeb/Mechanical-Engineering/2-20Spring-2005/Tools/index.htm
2. To view the applet click on P-Flow applet on the navigation bar. You will see a box that defines the domain and 2 toolbars.

   The toolbar at the top of the page contains the menus:

   - File: to "Save", "Load" or "Print" the workspace
   - Graph: to "Clear", "Reset" or "Zoom" in/out in the workspace area
   - Options: to draw a "Grid", "Plot Streamlines" or find the flow filed properties at given points using "Point Evaluation".

   The toolbar used to "Add Singularities" is located at the bottom of the page.
3. In the Options menu check the boxes Grid and Plot Streamlines.
   - ***Grid*** A uniform grid will appear in the domain. 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).
   - ***Plot Streamlines*** Once "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.

B. Rotating disk

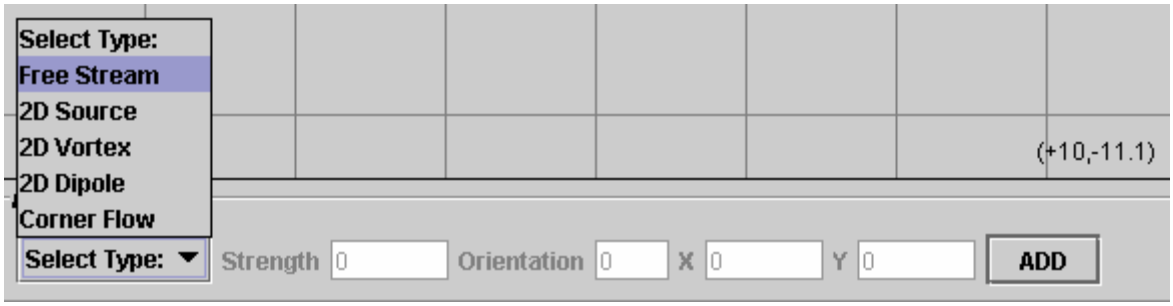
What follows is a short tutorial that will show you how to “build” a flow around a rotating circular disk. The singularity “blocks” that will be used in this case are

- a free stream
- a 2D dipole
- a 2D vortex

The order at which the singularities are added is immaterial, but for the tutorial you will add them with the previous order. This way you can visualize first the free stream, the “simplest” flow. Adding the dipole in the existing free stream will result to a flow around a disk. Finally, the superposition of the vortex will create the required circulation.

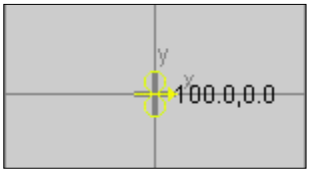
The end result will produce one figure and one table.

1. ***Add a Free Stream*** In the “Add Singularities” area under “Select type” choose “Free Stream” (second from the top). In the “Strength” box that specifies the free stream velocity type 1. In the “Orientation” box that specifies the direction of the free stream in radians type 0. The boxes specifying the coordinates will be disabled as the free stream is uniform everywhere. You will observe a yellow 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.



   You can left click on the domain at various places to observe the streamlines initiating from the point you clicked at. This is the flow field of uniform velocity or free stream.

2. ***Add a 2D Dipole***: In the “Add Singularities” area under “Select type” choose “2D Dipole" (second from the bottom). In the “Strength” box that specifies the strength of the dipole type 10. 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:



which is the symbol for 2D dipole, at the origin in the domain. The numbers indicate the strength of the dipole and its orientation, in radians. Left click on the domain at various points. Observe the streamlines being plotted what you see is the potential flow around a circular disk. From the Graph menu choose “Zoom In”. Plot more streamlines to obtain a closer view of the flow field

3. ***Add a 2D Vortex*** In the “Add Singularities” area under “Select type” choose “2D Vortex” (third from the bottom). 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 closed circle at the origin in the domain and a number that indicates the strength of the vortex. Notice that by adding the new singularity all the existing streamlines are erased.

   You can choose “Reset Zoom” from the Options menu. Click at various points in the domain to get the streamlines in a flow around a rotating circular disk. Observe how the 2D vortex changed the flow.
4. ***Printing*** From the File menu choose Print. This is Figure 1.
5. ***Point Evaluation*** Check the box “Point Evaluation”. Once “Point Evaluation” is checked a new Data window will open. Once the Data window opens, on the first two columns you see the Coordinates of the points you clicked on, which can be edited by writing directly in the box. On the remaining columns you see the horizontal, the vertical velocity and the pressure at the specified points. The pressure is such that stagnation pressure is 1. Again: if the workspace is “Cleared” then “you need to reload the applet for “Point Evaluation” to work.

   Left click at the following points: (1.9, 0.8), (-1.9, 0.8), (0, 2), (0, -2), (2, 0), (-2, 0). Observe in the Data window the behaviors of Ux, Uy and pressure at each point. If you cannot click on the point exactly edit its coordinates on the Data window directly.
6. ***Saving Data*** Click Save to save the Data. Save as .txt file. You will have a number of rows equal to the number of points and 5 columns with x, y, u, v, P implied. This is Table 1. You can open the file for calculations using say Excell. Or Matlab. From Excell >Open >all files >specified delimeter >coma >finish
7. From Graph you can choose “Reset”. All information entered will be erased and you may start over.
8. To exit the Java P-Flow you can either close your browser or specify another web location on the address bar.