FLUENT - Compressible Flow in a Nozzle- Step 1

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Step 1: Pre-Analysis & Start-up

Since the nozzle has a circular cross-section, it's reasonable to assume that the flow is axisymmetric. So the geometry to be created is two-dimensional.

Start GAMBIT

Create a new folder called *nozzle* and select this as the working directory. Add `-id nozzle` to the startup options.

Create Axis Edge

We'll create the bottom edge corresponding to the nozzle axis by creating vertices *A* and *B* shown in the problem specification and joining them by a straight line.

Operation Toolpad > Geometry Command Button [ ] **>Vertex Command Button** [ ] **>Create Vertex** [ ]

Create the following two vertices:

Vertex 1: (-0.5,0,0)
Vertex 2: (0.5,0,0)

Operation Toolpad > Geometry Command Button [ ] **> Edge Command Button** [ ] **> Create Edge** [ ]

Select vertex 1 by holding down the *Shift* button and clicking on it. Next, select vertex 2. Click *Apply* in the *Create Straight Edge* window.

Create Wall Edge

We'll next create the bottom edge corresponding to the nozzle wall. This edge is curved. Since

$A = r^2$

where r(x) is the radius of the cross-section at x and

$A = 0.1 + x^2$

for the given nozzle geometry, we get

$r(x) = [(0.1 + x^2)/]^{0.5}; -0.5 < x < 0.5$

This is the equation of the curved wall. Life would have been easier if GAMBIT allowed for this equation to be entered directly to create the curved edge. Instead, one has to create a file containing the coordinates of a series of points along the curved line and read in the file. The more number of points used along the curved edge, the smoother the resultant edge.

The file vert.dat contains the point definitions for the nozzle wall. Take a look at this file. The first line is

21 1

which says that there are 21 points along the edge and we are defining only 1 edge. This is followed by *x,r* and *z* coordinates for each point along the edge. The *r*-value for each *x* was generated from the above equation for *r*(x) . The *z*-coordinate is 0 for all points since we have a 2D geometry.

Right-click on vert.dat and select *Save As...* to download the file to your working directory.

Main Menu > File > Import > ICEM Input ...

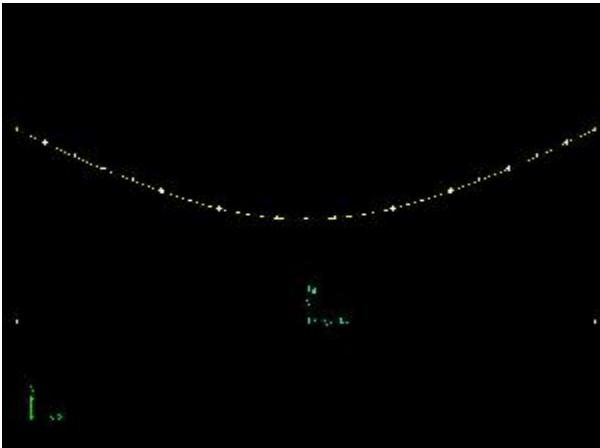Next to *File Name:*, enter the path to the `vert.dat` file that you downloaded or browse to it by clicking on the *Browse* button.

Then, check the *Vertices* and *Edges* boxes under *Geometry to Create* as we want to create the vertices as well as the curved edge.
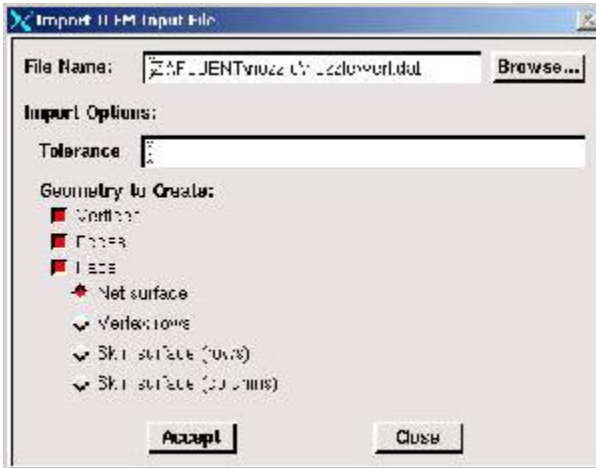
Click *Accept*.

This should create the curved edge. Here it is in relation to the vertices we created above:

Higher Resolution Image

Create Inlet and Outlet Edges

Create the vertical edge for the inlet:

Operation Toolpad > Geometry Command Button **> Edge Command Button > Create Edge**

Shift-click on vertex 1 and then the vertex above it to create the inlet edge.

Similarly, create the vertical edge for the outlet.

Create Face

Form a face out of the area enclosed by the four edges:

Operation Toolpad > Geometry Command Button **>Face Command Button** **>Form Face**

Recall that we have to *shift-click* on each of the edges enclosing the face and then click *Apply* to create the face.

Save Your Work

Main Menu > File > Save

This will create the nozzle.dbs file in your working directory. Check that it has been created so that you will able to resume from here if necessary.