Zarvan Damania

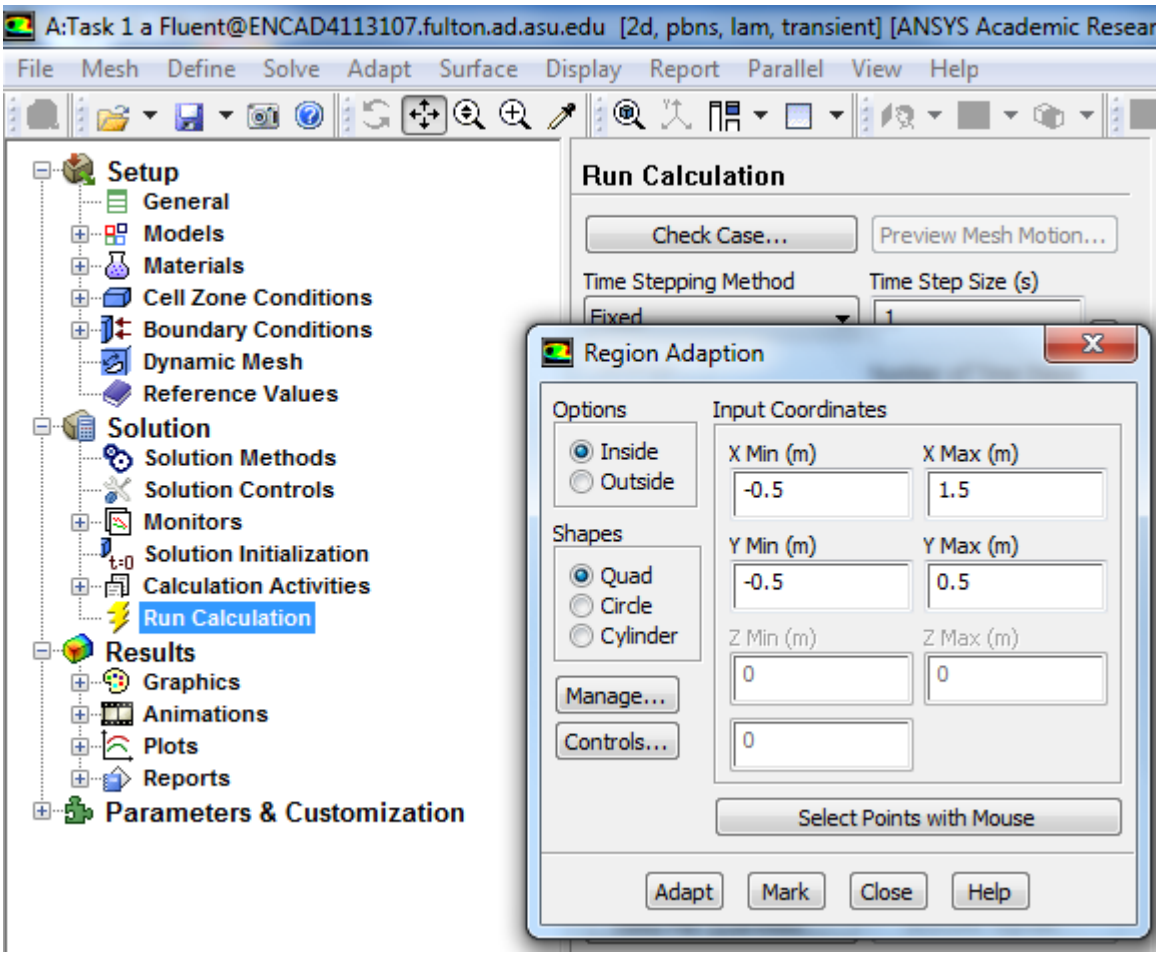
Task 1

For this problem the time is used as transient. The mesh used is Fine. The setup uses **No Slip Condition.**

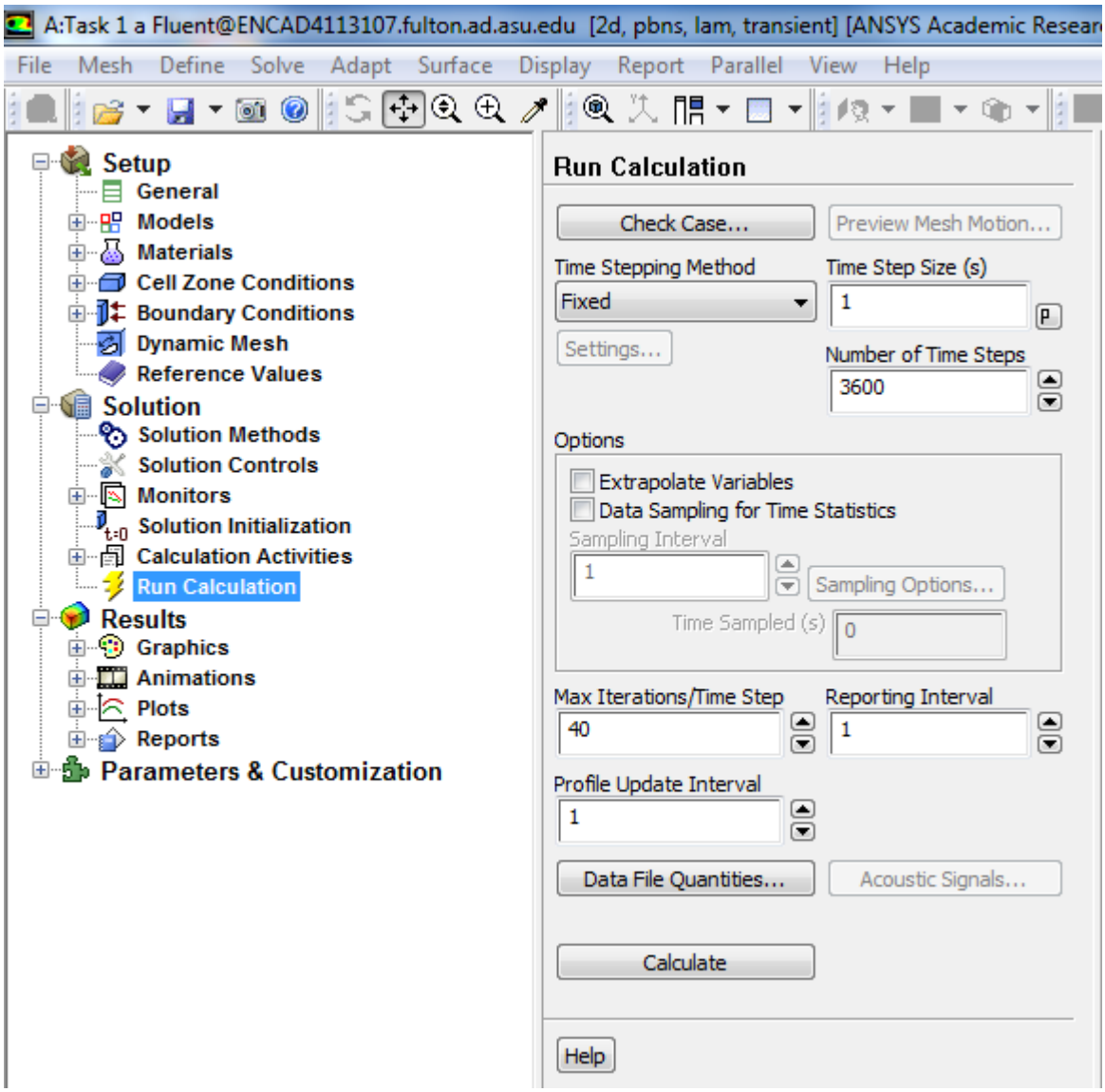
For Task 1 (a) we use **viscous laminar flow** and the material used is **water**.

For Task 1 (b) we use **Viscous-turbulence k-epsilon** and the material used is **air**.

For Mesh refinement we refine the mesh around the cylinder with the co-ordinates given in the problem statement.



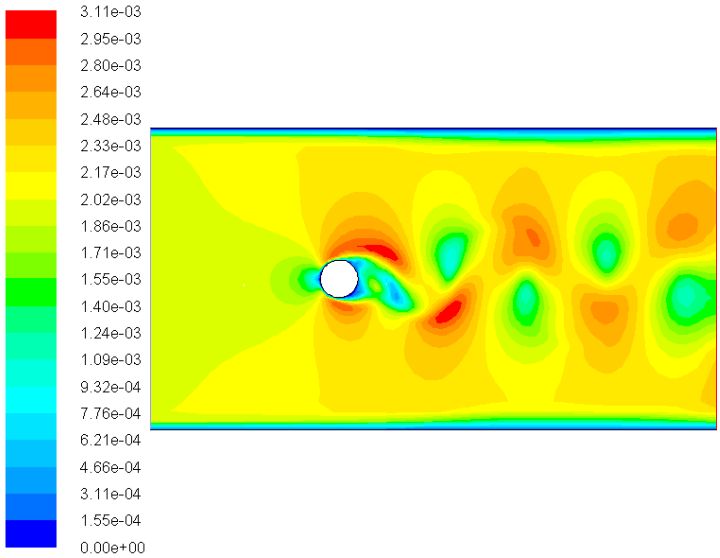
We initialize the solution and run the calculations with time step 1 and for 3600 number of time steps for the period of 1 hour.



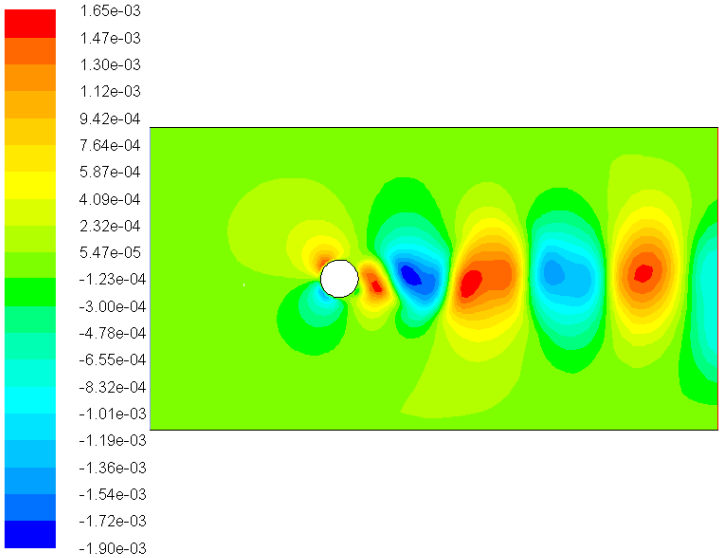
Results

Task 1 (a)

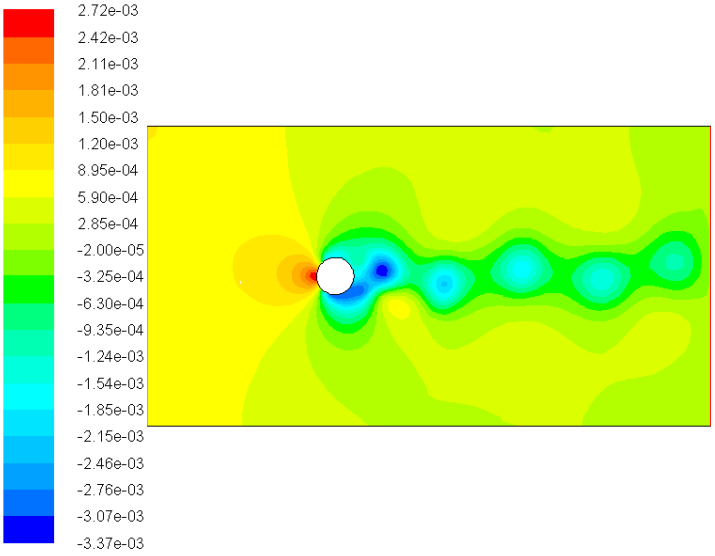
Velocity Magnitude



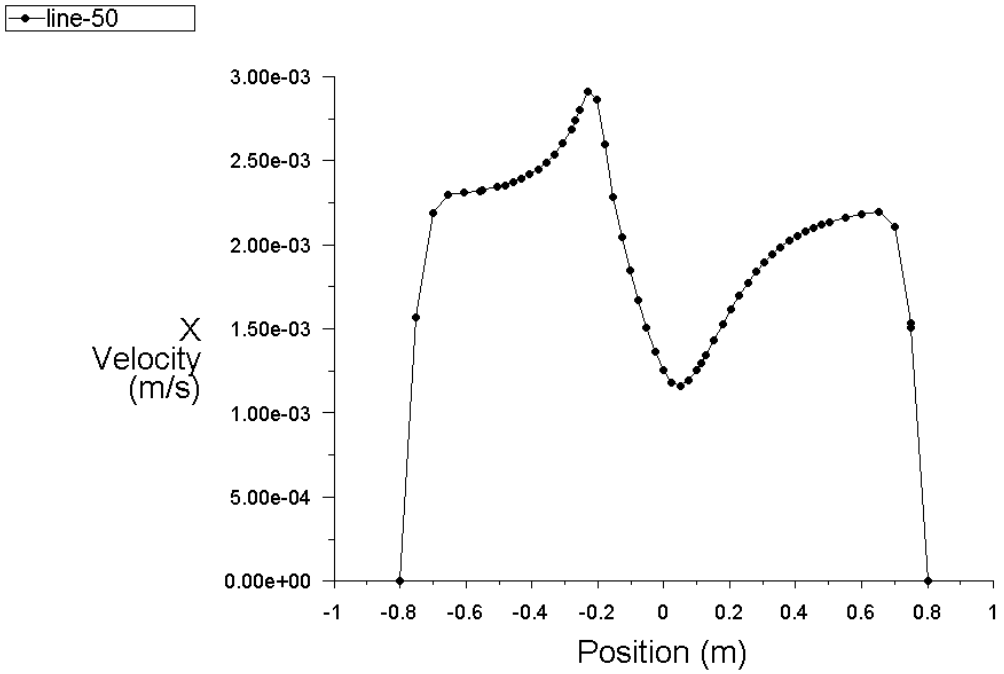
Y-Component of Velocity



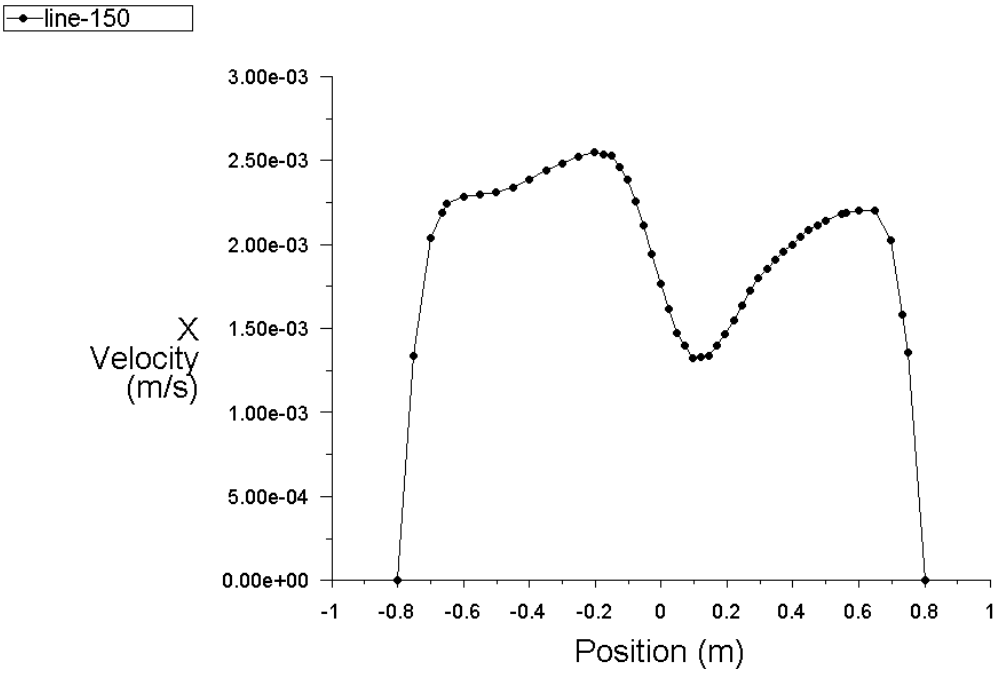
Pressure



Line plot of the x-component of velocity along the vertical line of x = 50 cm



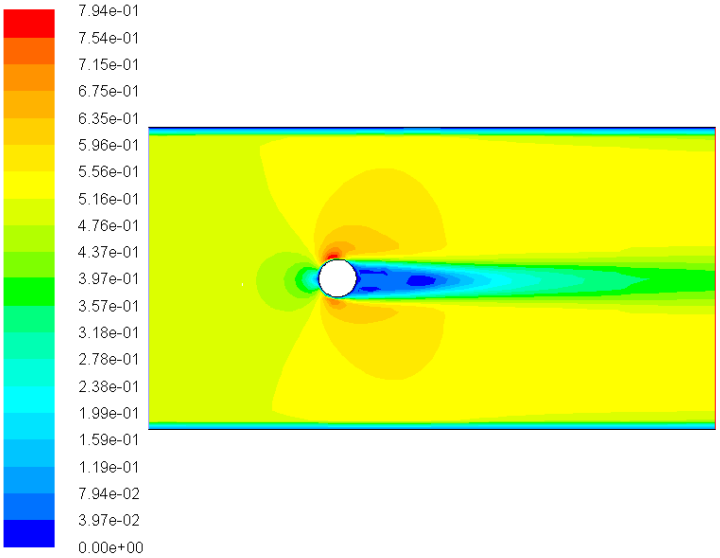
Line plot of the x-component of velocity along the vertical line of x = 150 cm



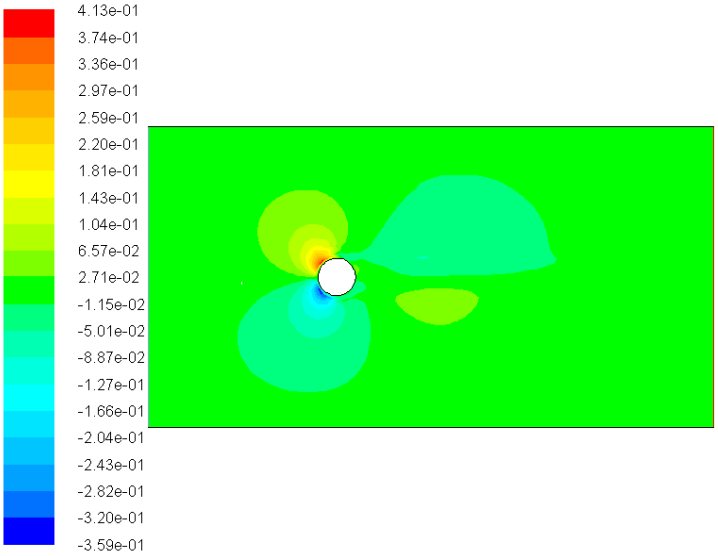
$$\text{Reynolds number} = \frac{\rho v d}{\mu} = \frac{998.2 \times 0.002 \times 0.2}{0.001003} = \mathbf{398.08}$$

Results
Task 1 (b)

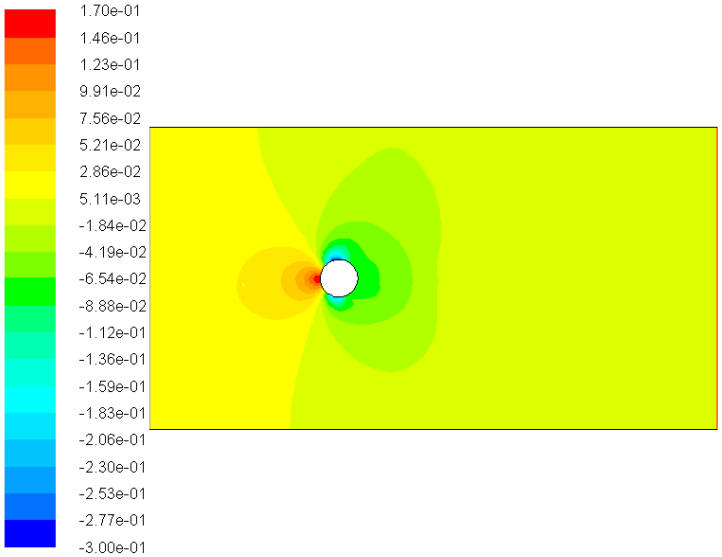
Velocity Magnitude



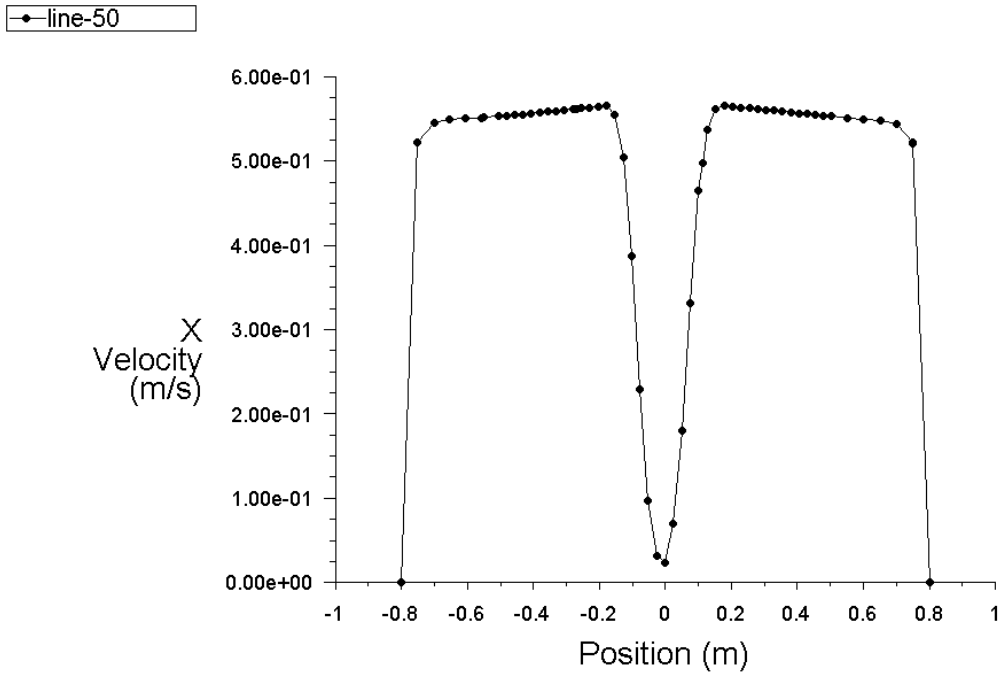
Y-Component of Velocity



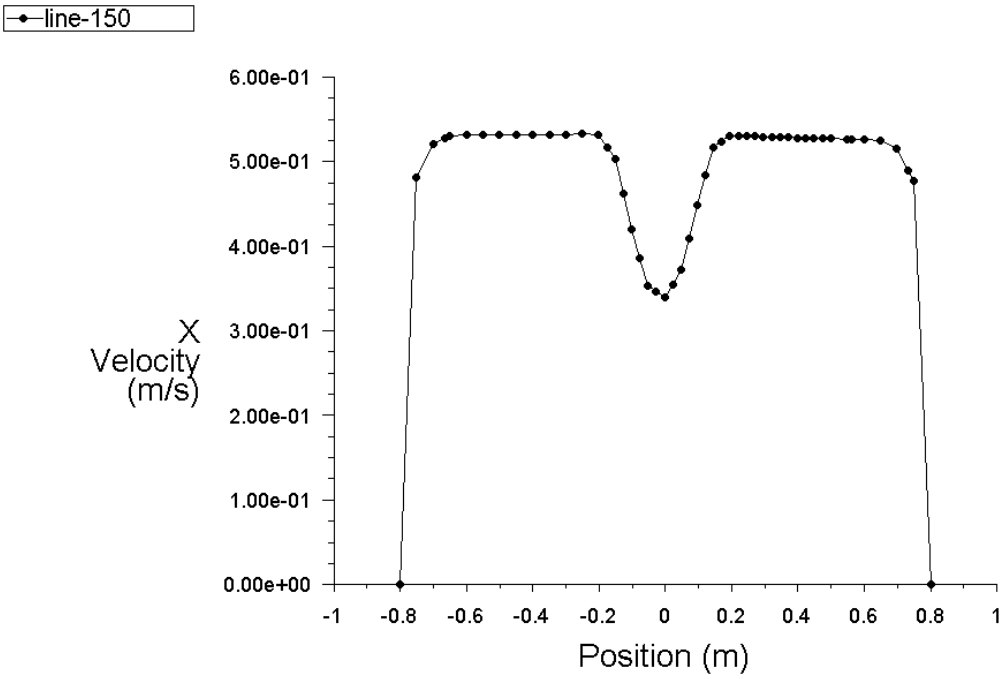
Pressure



Line plot of the x-component of velocity along the vertical line of x = 50 cm



Line plot of the x-component of velocity along the vertical line of x = 150 cm



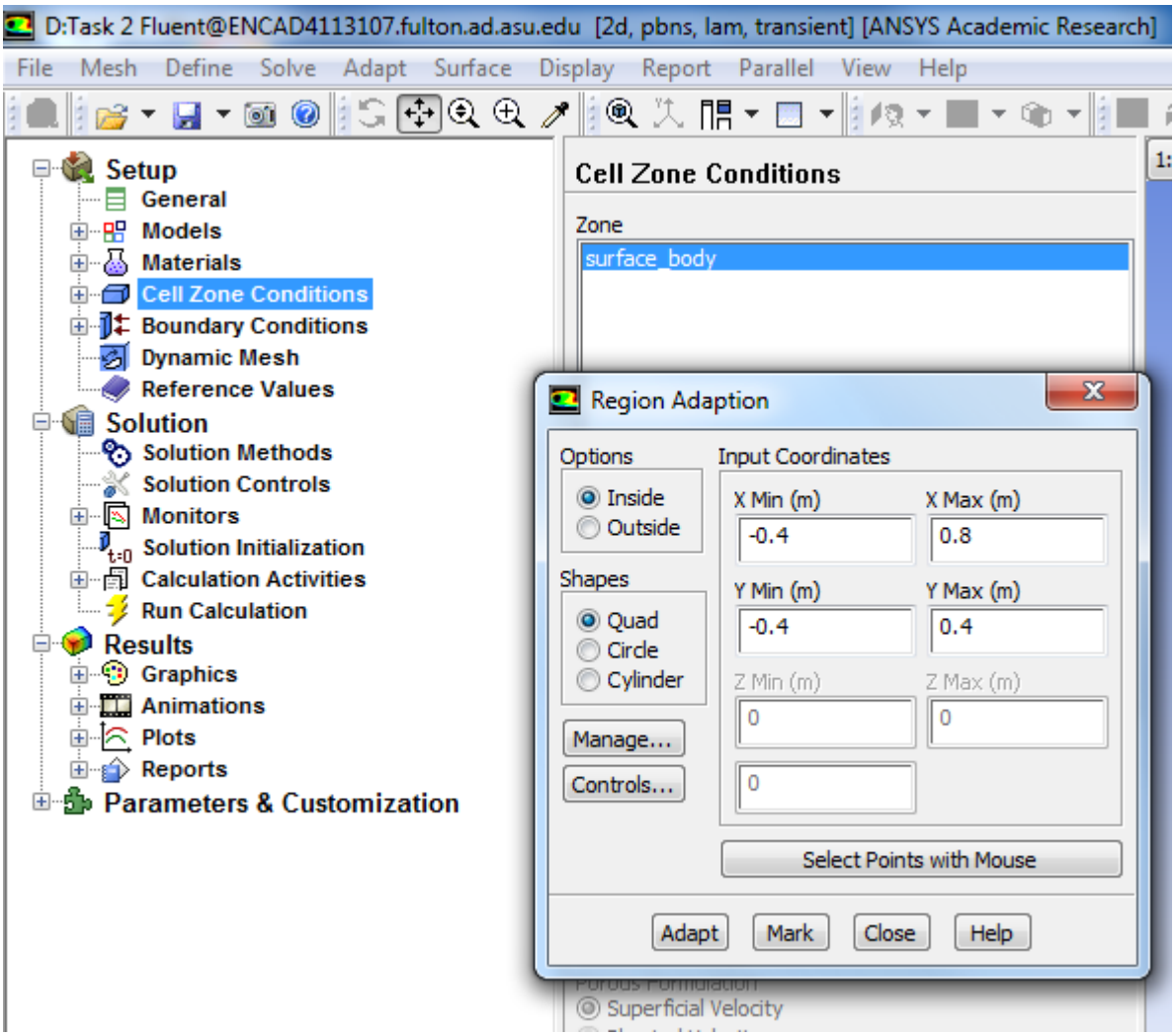
$$\text{Reynolds number} = \frac{\rho v d}{\mu} = \frac{1.225 \times 0.5 \times 0.2}{1.7894e{-}05} = \mathbf{6845.87}$$

Task 2

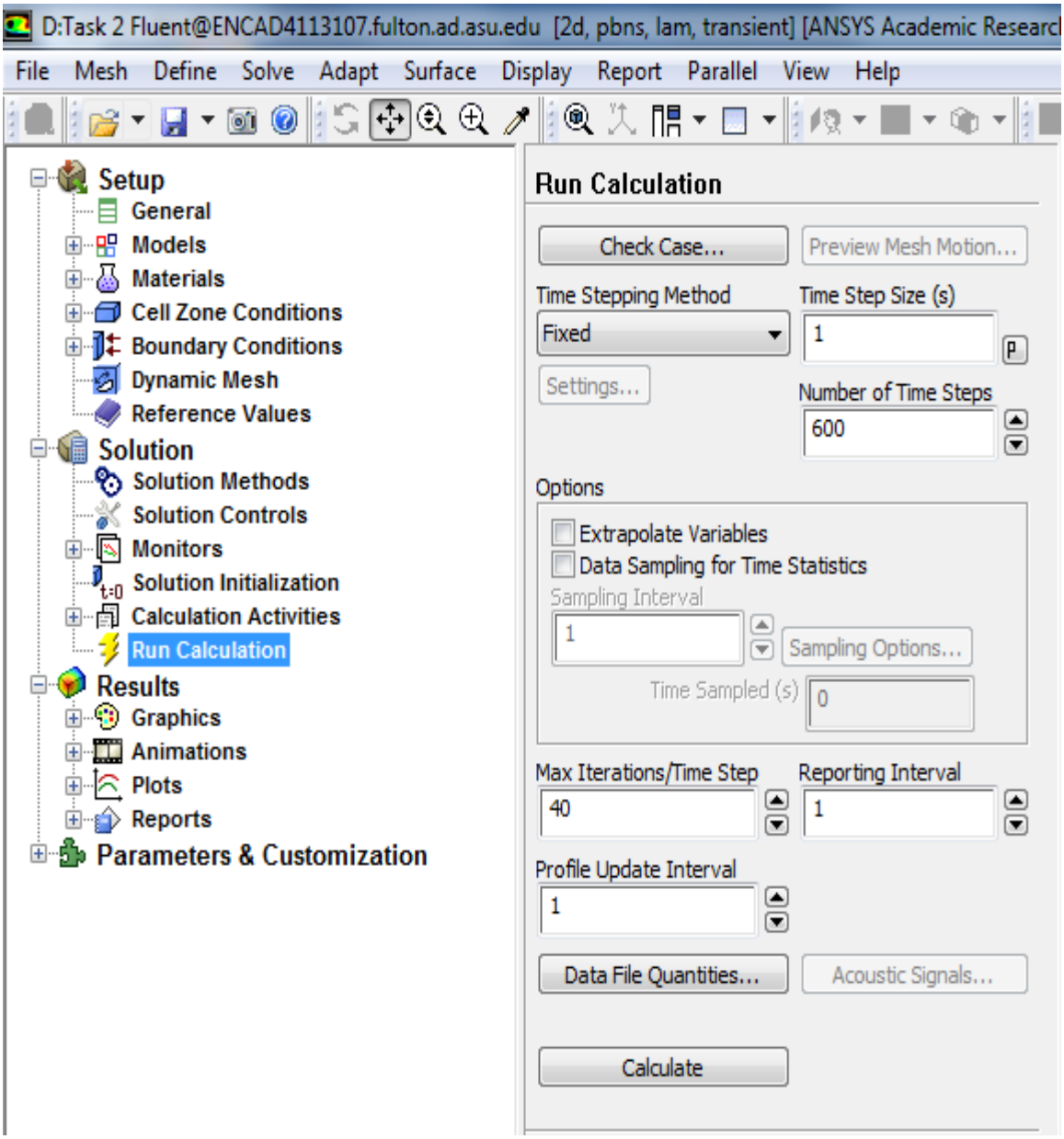
For this problem the time is used as transient. The mesh used is Fine. The setup uses **No Slip Condition.**

We use **viscous laminar flow** and the material used is **water**.

For Mesh refinement we refine the mesh around the half fish with the co-ordinates given in the problem statement.

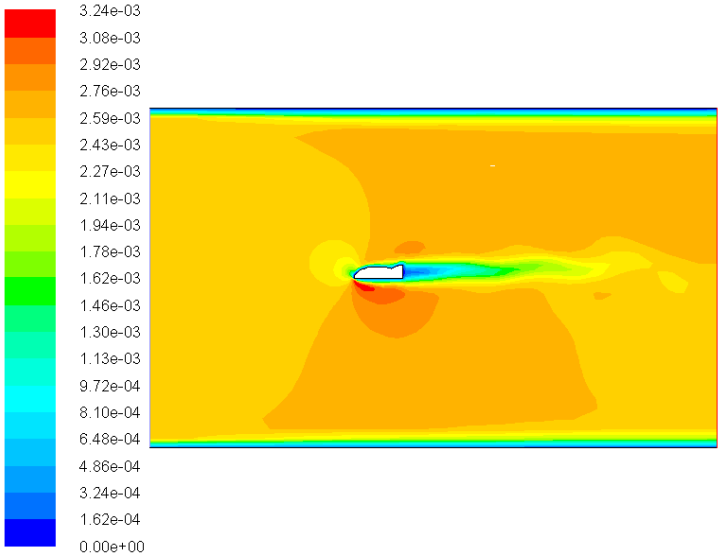


We initialize the solution and run the calculations with time step 1 and for 600 number of time steps for the period of 10 minutes.

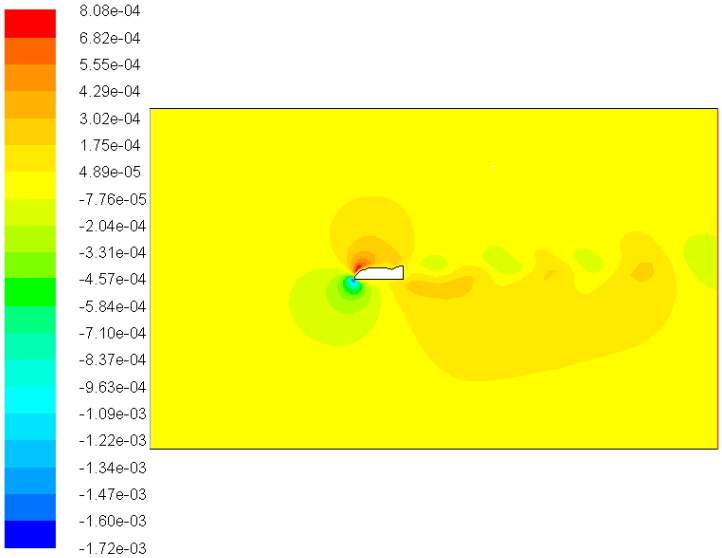


Results
Task 2

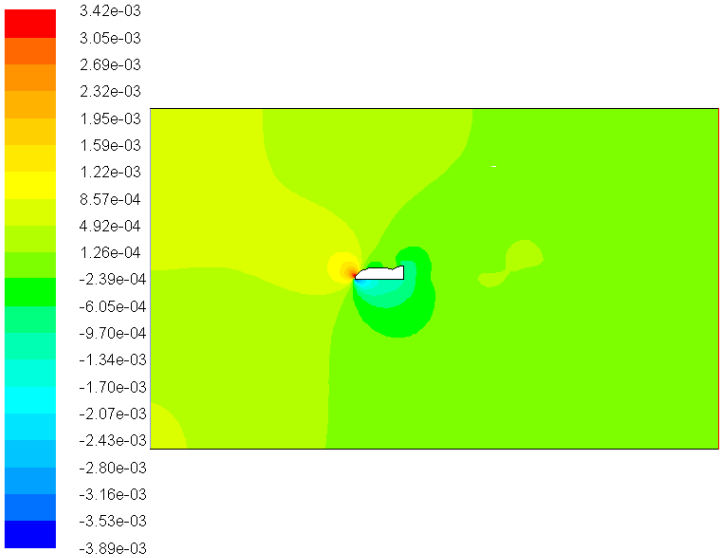
Velocity Magnitude



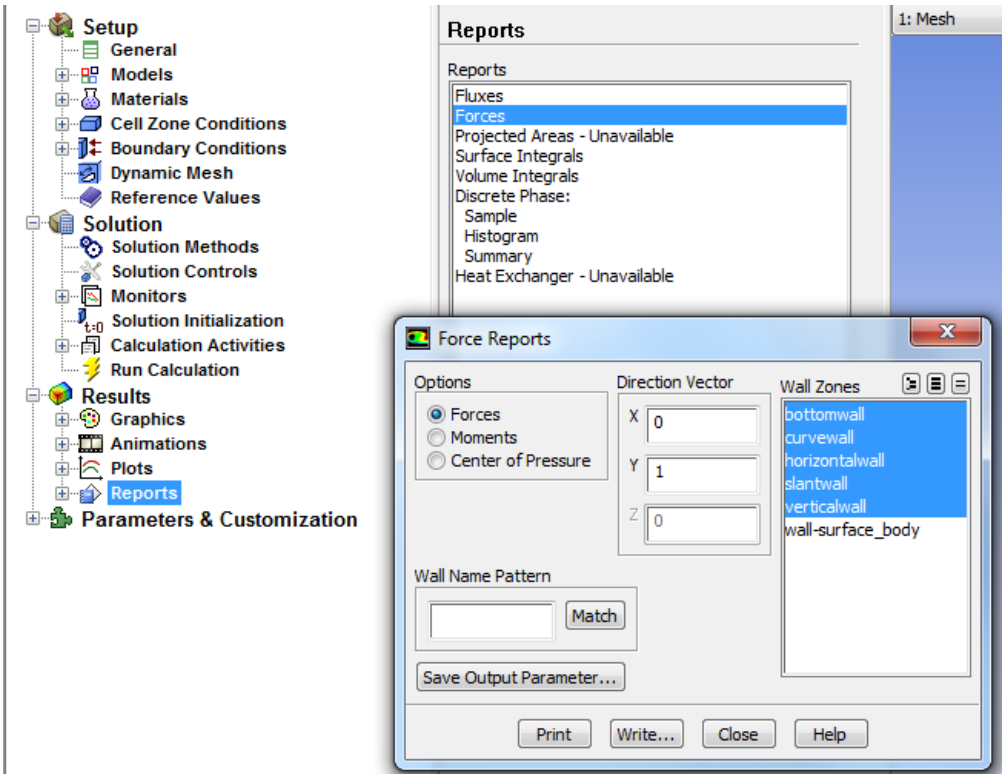
Y-Component of Velocity



Pressure



The lift on the Half Fish




```
Forces - Direction Vector (0 1 0)
                          Forces (n)
Zone                      Pressure            Viscous             Total
bottomwall                -0.00028849812      -5.2016144e-06      -0.00029369974
curvewall                 -1.5696318e-05      7.1400909e-06       -8.5562269e-06
horizontalwall            6.9865669e-06       4.0345776e-07       7.3900246e-06
slantwall                 2.1394808e-06       -7.9726919e-07      1.3422116e-06
verticalwall              0                   5.4576702e-07       5.4576702e-07
------------------------- ------------------- ------------------- -------------------
Net                       -0.00029506839      2.0904321e-06       -0.00029297796
```

The Lift exerted by pressure on the whole half fish = **-0.00029506839 N**

The Lift exerted by viscosity on the whole half fish = **2.0904321e-06 N**

The Lift that is exerted on the whole half fish = **-0.00029297796 N**

The lift is negative. From the Pressure plot we can see that the maximum pressure is exerted on the top curve of the fish. From the image above we can see that maximum lift of 8.55 N is applied on the curve wall of the half fish and it is in the negative direction. The vertical wall will exert no lift so that wont be considered into account. Thus the pressure on top will cause a negative lift on the half fish.

Task 3

For this problem the time is used as transient. The mesh used is Fine. The setup uses **No Slip Condition.**

The transient simulation time t=10 minutes

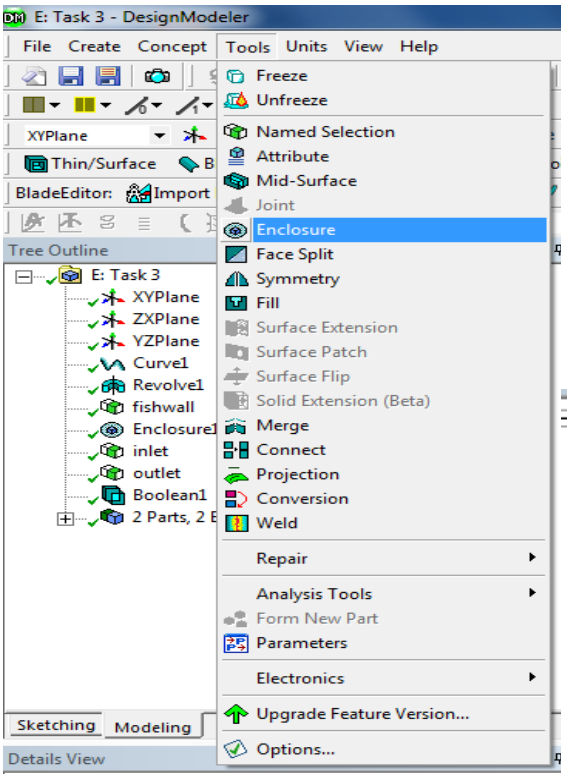
We use **viscous laminar flow** and the material used is **water**.

The Mesh is refined with a 3-D sphere centered at (x,y,z) = (0,0,0) with a radius of 40 cm.

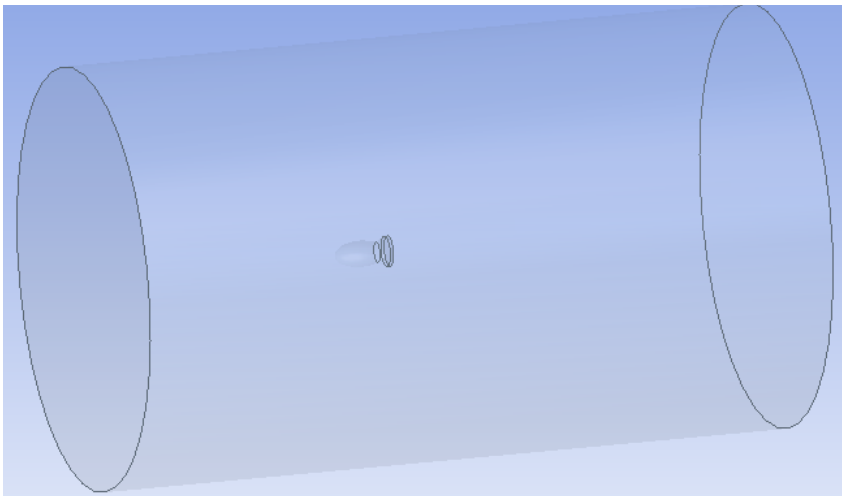
Problem Setup

Geometry

1) Use the text file and import it in geometry using 3D curve. Use the revolute command to create the 3D object.
2) Using the name selection we name the 3D object.
3) Create the cylindrical enclosure using the Enclosure command in the Tools Tab in the toolbar. Select Cylinder under the Shape.
   Input in the dimensions of the cylinder.



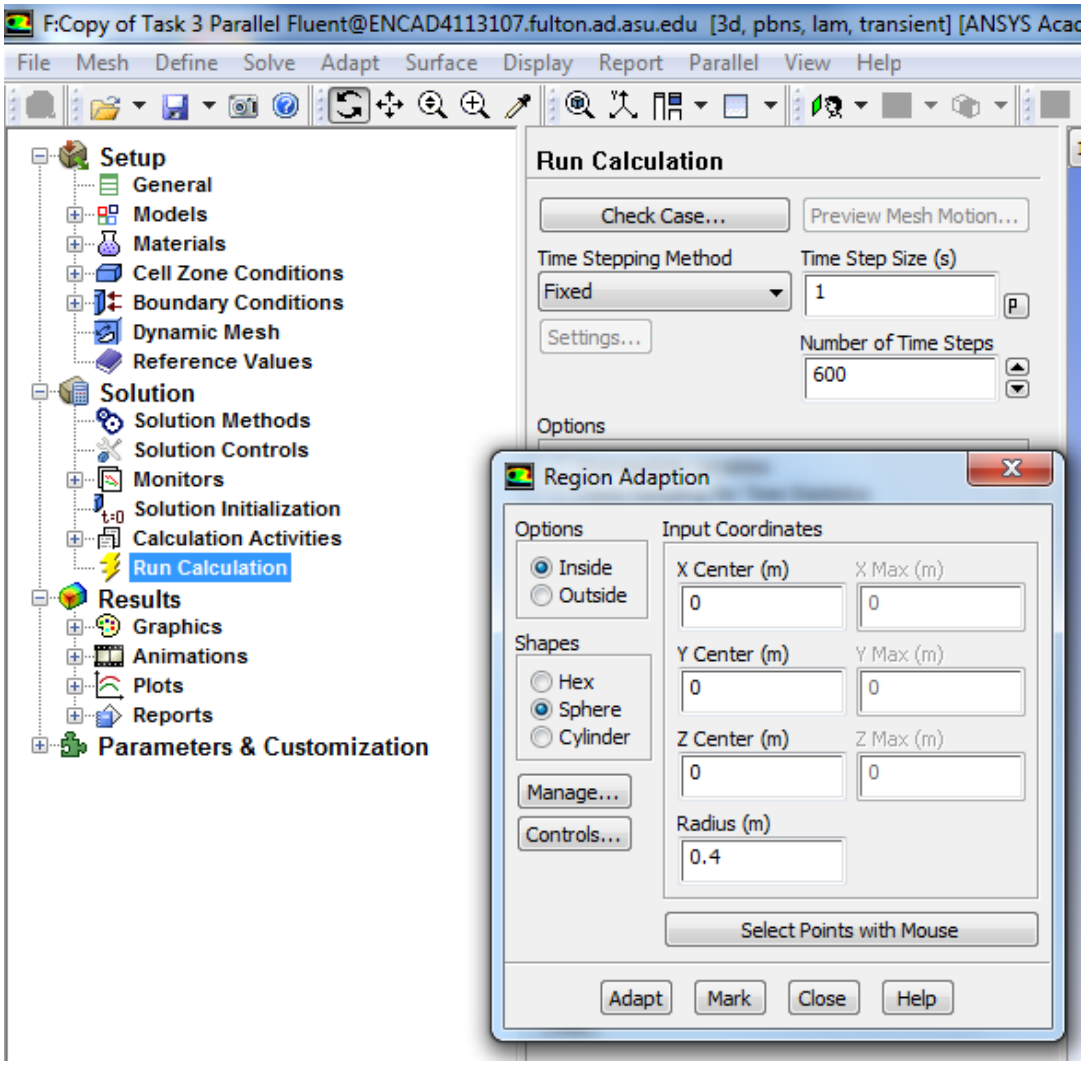
Details of Enclosure1	
Enclosure	Enclosure1
Shape	Cylinder
Cylinder Alignment	Automatic
Number of Planes	0
Cushion	Non-Uniform
FD1, Cushion Radius (>0)	60 cm
FD2, Cushion (>0), +ive Direction	120 cm
FD3, Cushion (>0), -ive Direction	80 cm
Target Bodies	All Bodies



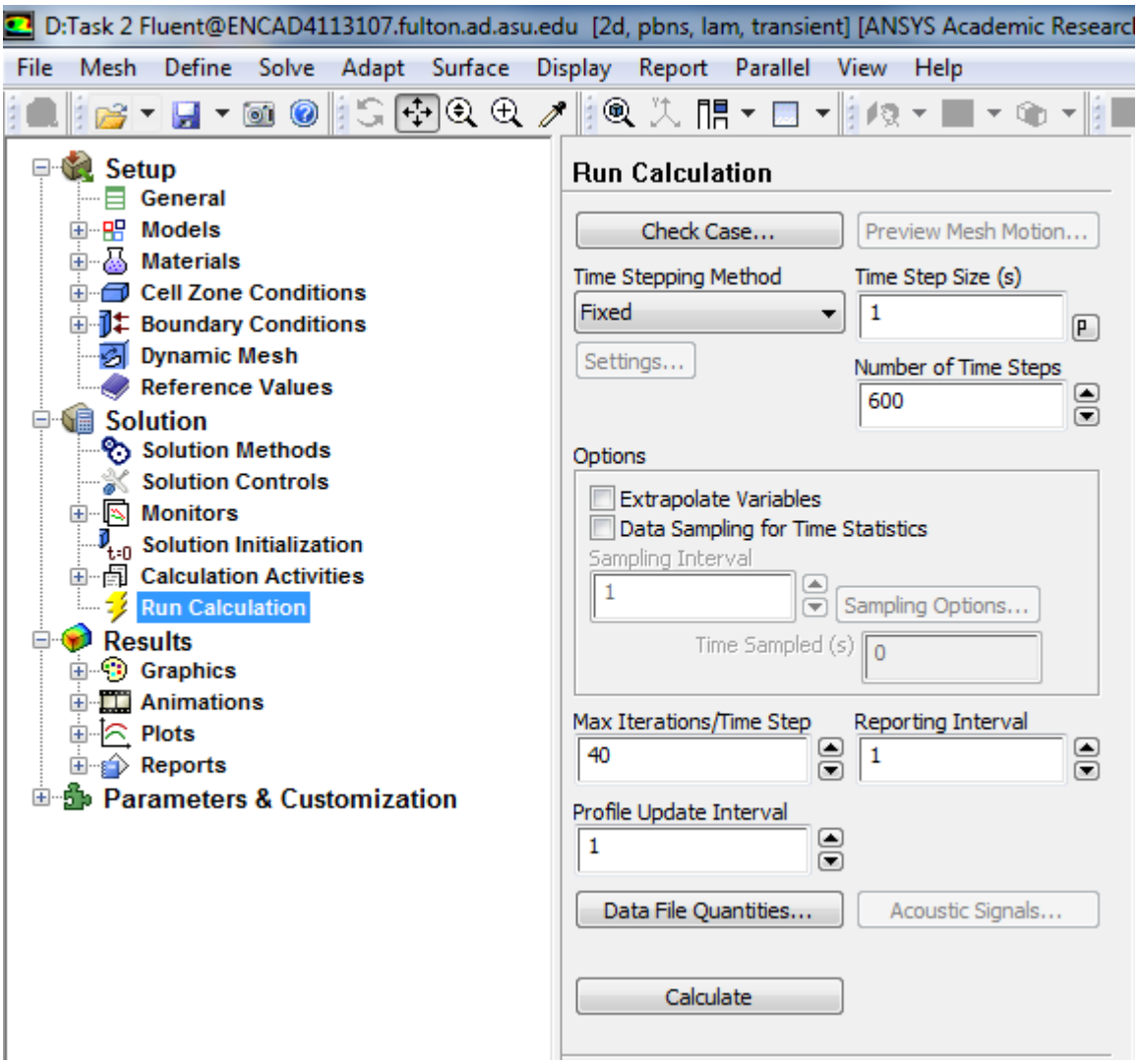
4) Using the Boolean operation subtract the Target Body (enclosure) and the tool body (3D fish).
5) Name the Velocity-inlet and Pressure-outlet on the enclosure.

Setup

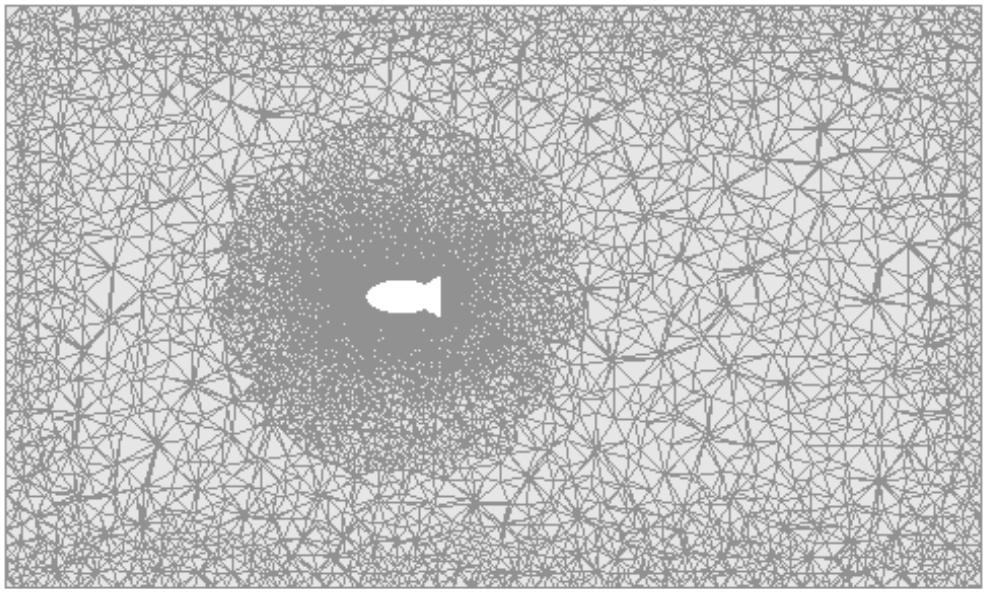
For Mesh refinement we refine the mesh around the cylinder with the co-ordinates given in the problem statement.



We initialize the solution and run the calculations with time step 1 and for 600 number of time steps for the period of 10 minutes.

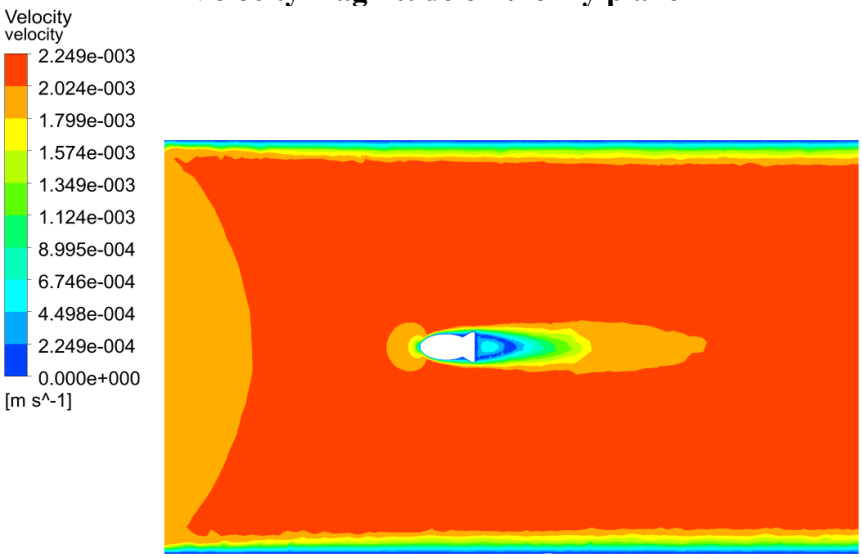


Mesh of the system

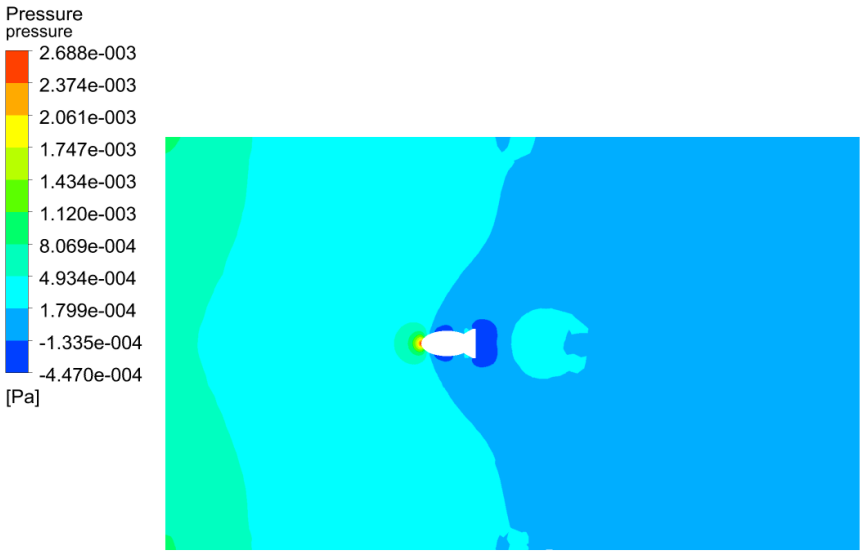


Results
Task 3

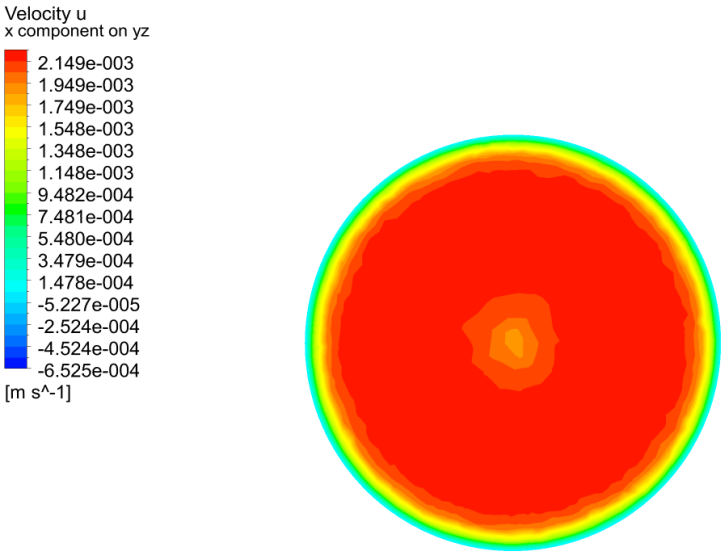
Velocity magnitude on the x-y plane



Pressure on the x-y plane



X-component of velocity on the vertical plane at x= .6 m



Task 4

It uses the same setup as Task 3.

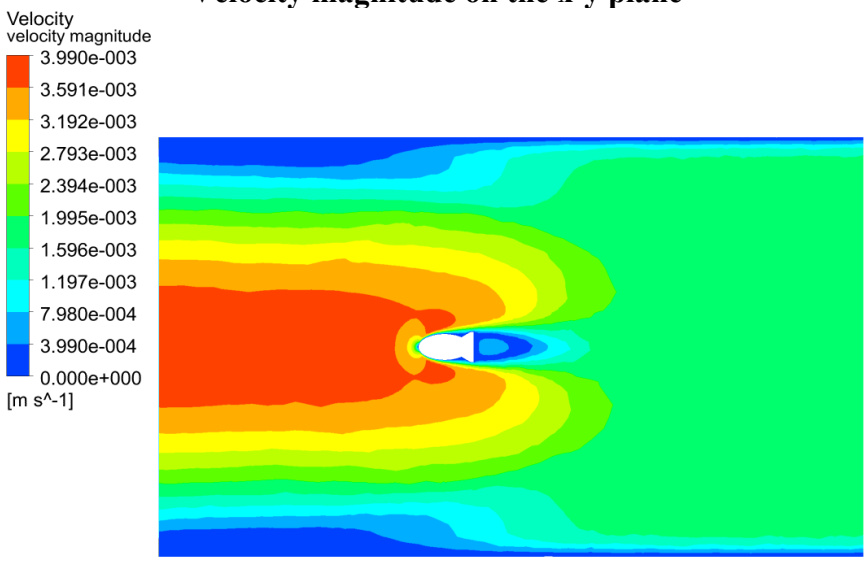
Instead of constant inlet velocity, a parabolic profile is created by using the User Defined Function.

UDF Code

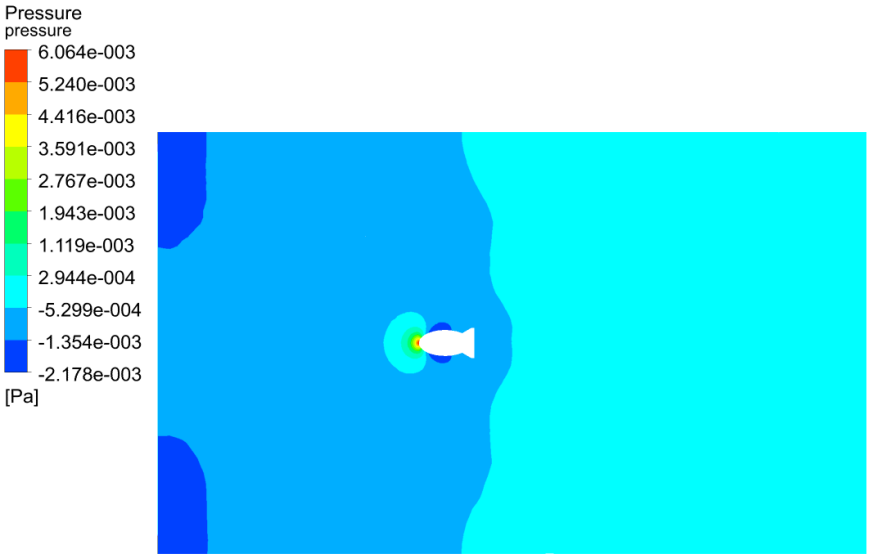
```
#include "udf.h"
DEFINE_PROFILE(inlet_x_velocity, thread, position)
{
real x[ND_ND]; /* this will hold the position vector */
real y;
real z;
real R = 0.6;
real V_max=2*.002 ;
face_t f;
begin_f_loop(f, thread)
{
F_CENTROID(x,f,thread);
y = (x[1]);
z = (x[2]);
F_PROFILE(f, thread, position) = 2*.002 - y*y/(R*R)*2*.002 - z*z/(R*R)*2*.002;
}
end_f_loop(f, thread)
}
```

Results
Task 4

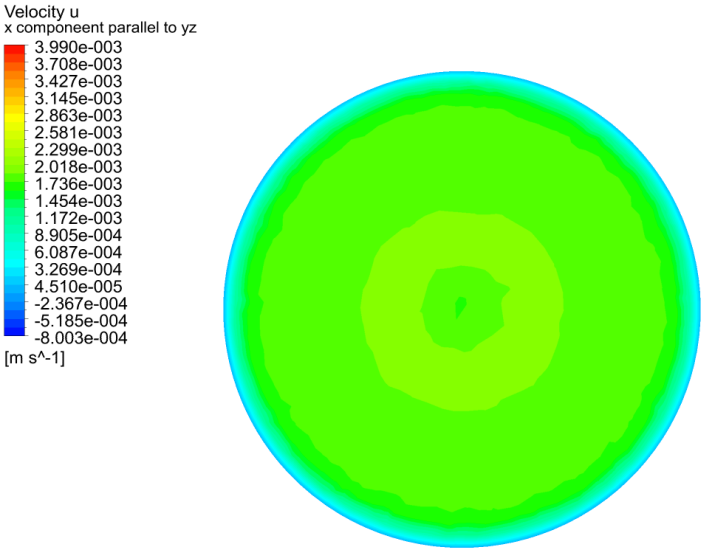
Velocity magnitude on the x-y plane



Pressure on the x-y plane



X-component of velocity on the vertical plane at x = .6 m



X-component of velocity at the inlet