Task 1

Deliverables

(a)

(1) An estimate of the Reynold's number of the system.

$$Re = \frac{\rho V D}{\mu} = \frac{\left(780\ \frac{kg}{m^3}\right)\left(0.006\frac{m}{s}\right)(0.2m)}{\left(0.0024\frac{kg}{m \cdot s}\right)} = 390$$

(2) Contour plots of (i) velocity magnitude, (ii) y-component of velocity, and (iii) static pressure.

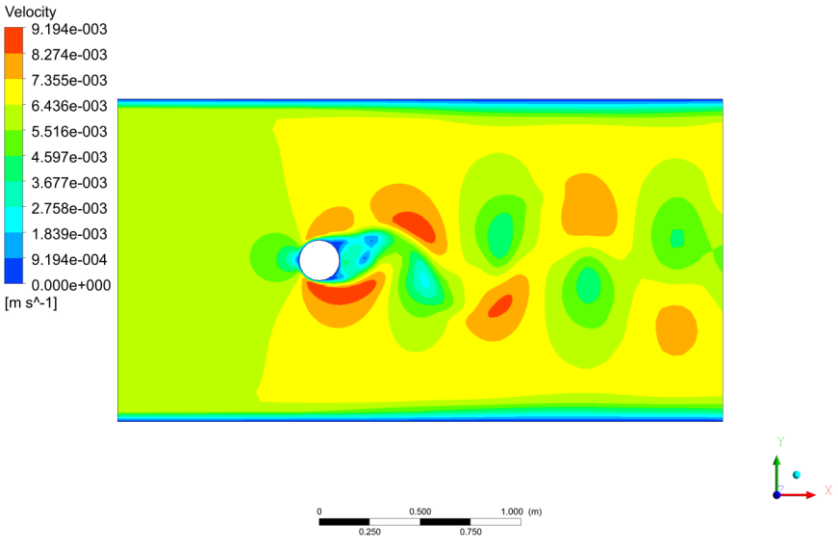

Figure 1: Velocity Magnitude

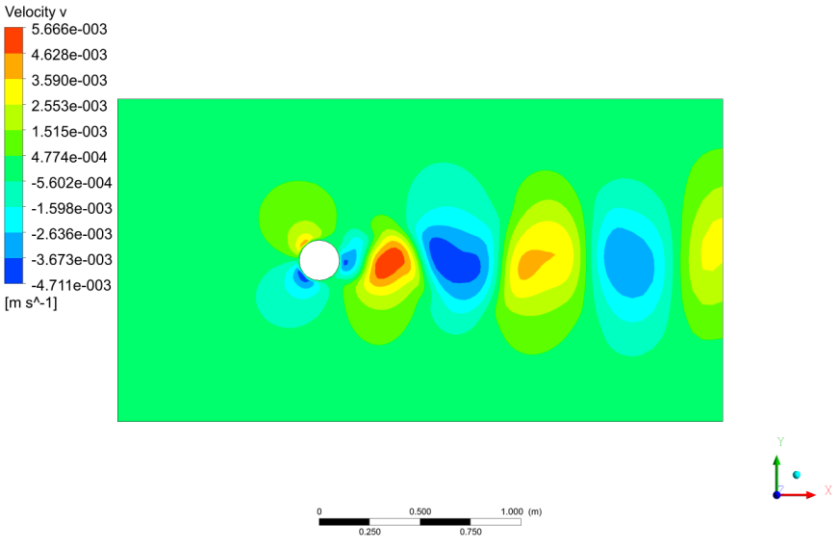

Figure 2: Velocity in the y-component

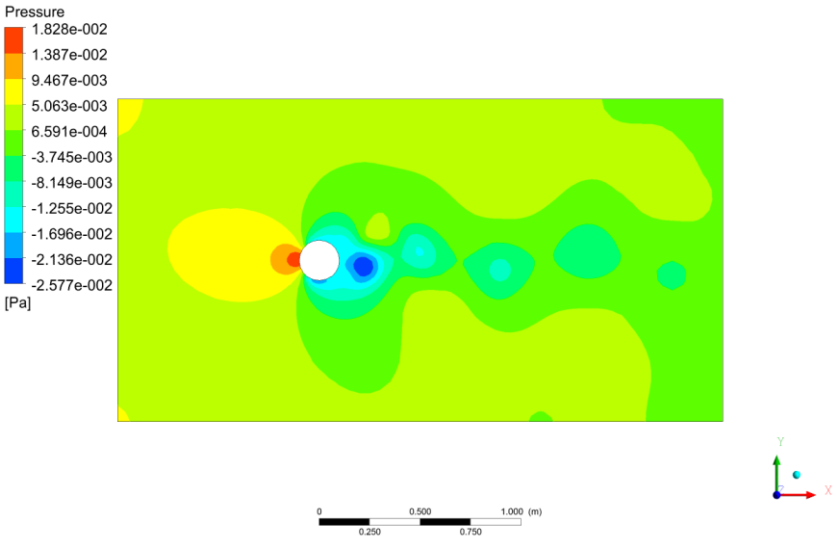

Figure 3: Static Pressure

(3) Line plots of the x-component of velocity along the vertical lines x = 50 cm and x = 150 cm.

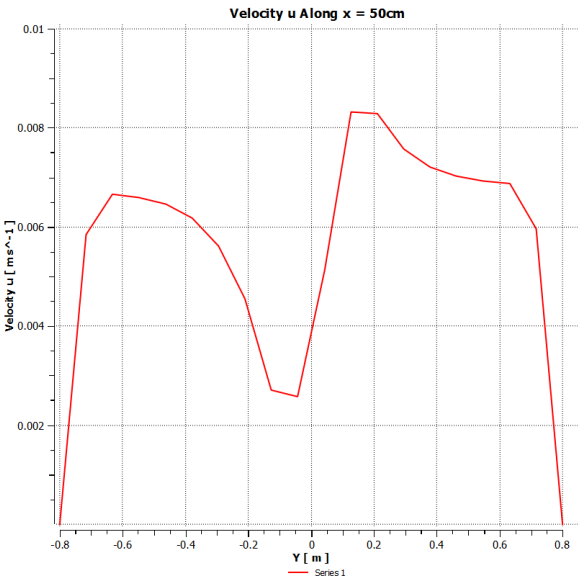

Figure 4: Velocity Along x = 50cm

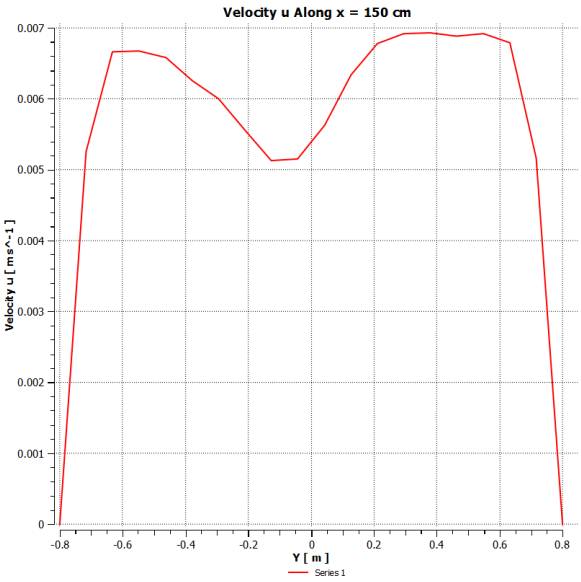

Figure 5: Velocity Along x = 150cm

(b)

(1) An estimate of the Reynold's number of the system.

$$Re = \frac{\rho V D}{\mu} = \frac{\left(998.2\ \frac{kg}{m^3}\right)\left(0.0003\ \frac{m}{s}\right)(0.2m)}{\left(0.001003\ \frac{kg}{m \cdot s}\right)} = 59.8740$$

(2) Contour plots of (i) velocity magnitude, (ii) y-component of velocity, and (iii) static pressure.

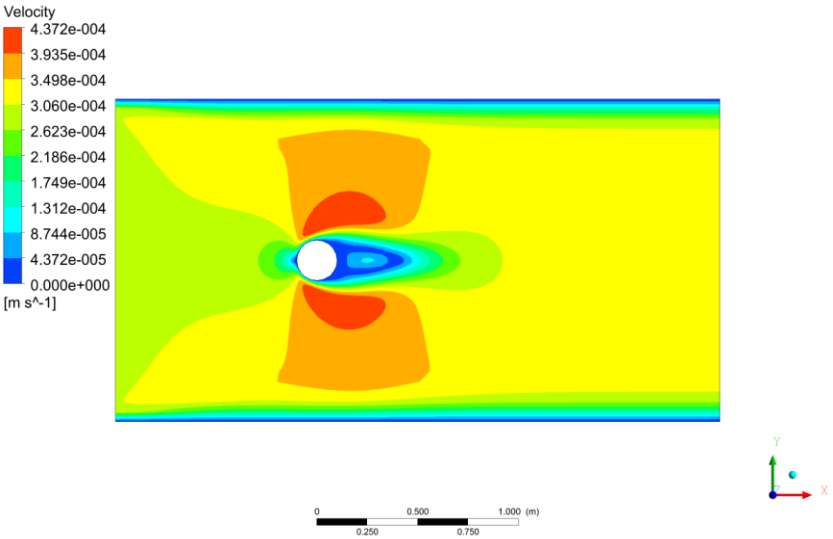

Figure 6: Velocity Magnitude

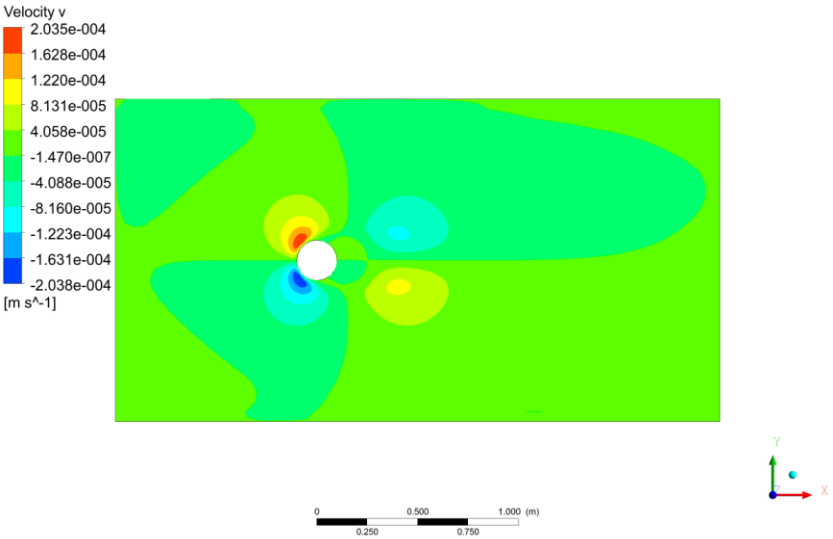

Figure 7: Velocity in the y-component

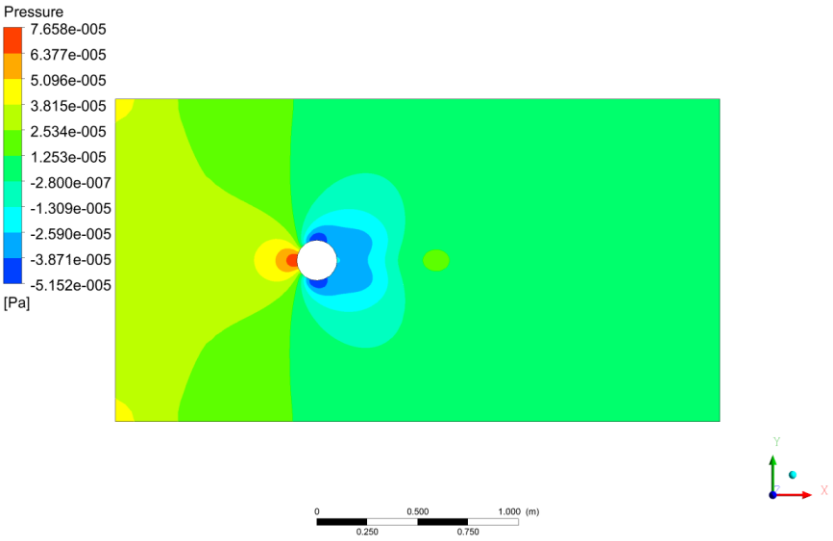

Figure 8: Static Pressure

(3) Line plots of the x-component of velocity along the vertical lines x = 50 cm and x = 150 cm.

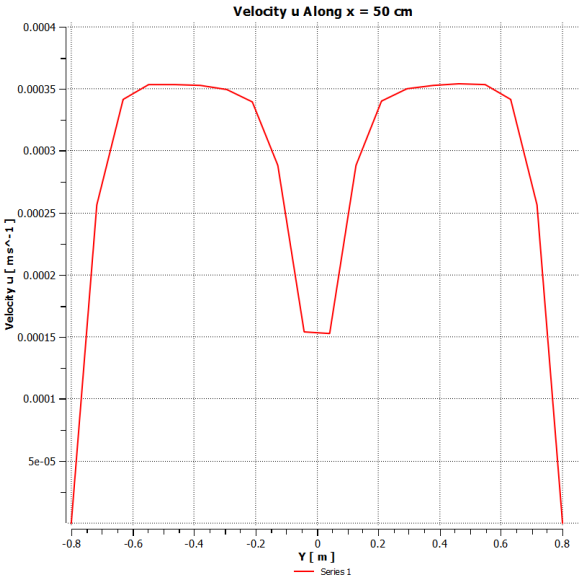

Figure 9: Velocity Along x = 50cm

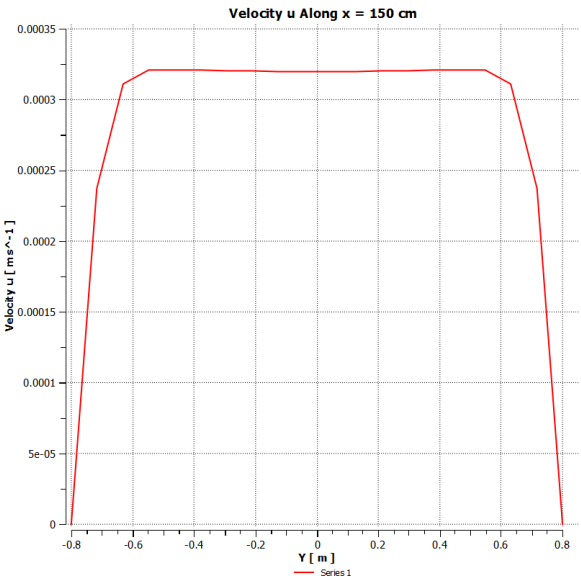

Figure 10: Velocity Along x = 150cm

Task 2

Deliverables

(1) Contour plots of (i) velocity magnitude, (ii) stream function, and (iii) static pressure.

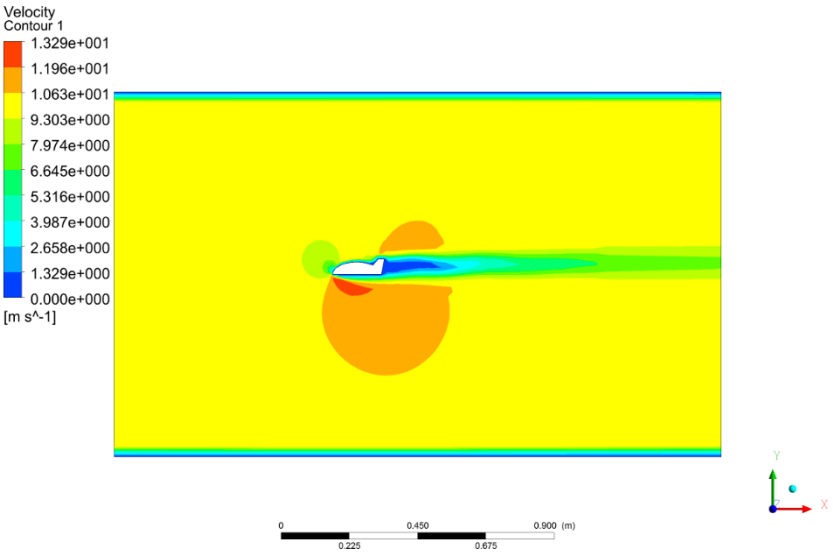

Figure 11: Velocity Magnitude

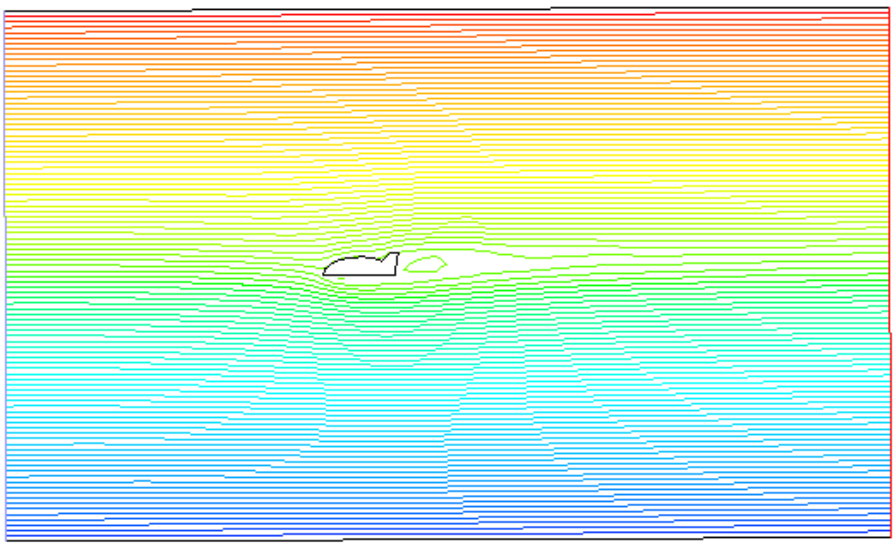

Figure 12: Stream Function

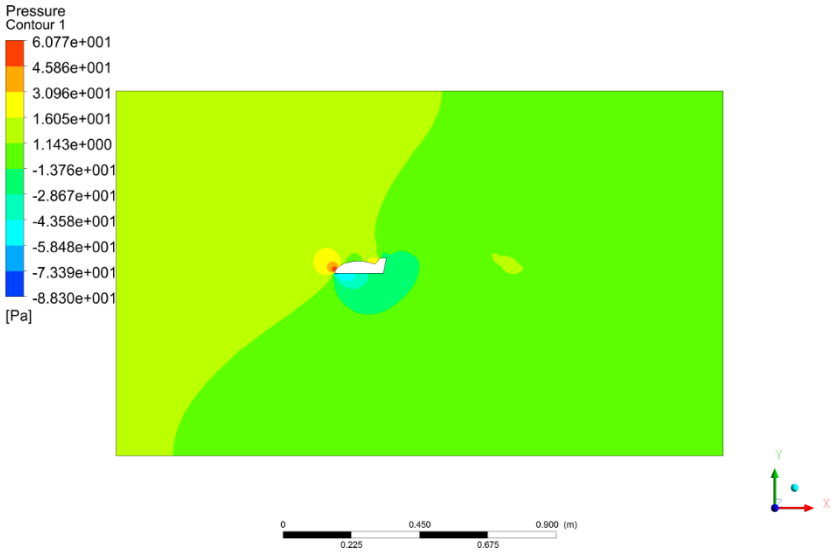

Figure 13: Static Pressure

(2) Contributions of lift by pressure and viscosity.

Table 1: Lift Forces

Lift (N)	
Pressure	-8.0011
Viscous	0.0021
Total	-7.9990

(3) Contributions of drag by pressure and viscosity.

Table 2: Drag Forces

Drag (N)	
Pressure	2.4855
Viscous	0.0317
Total	2.5166

Task 3

Deliverables

(1) Mesh of the system.

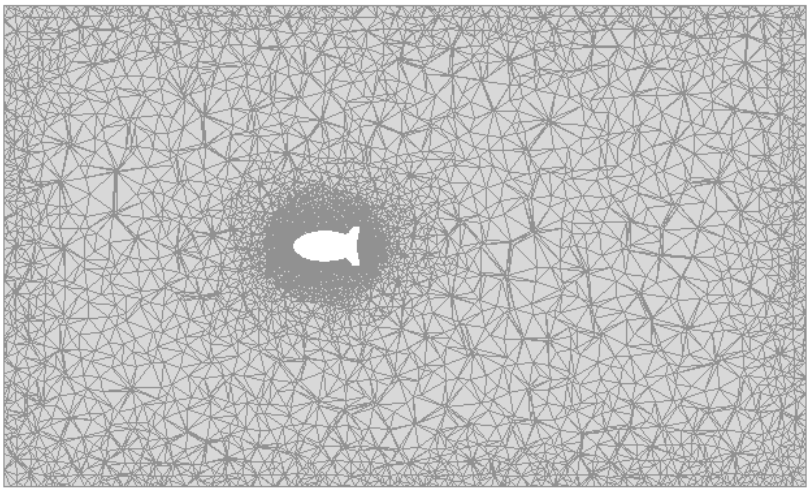

Figure 14: Mesh of the Model

(2) Contour plots of (i) velocity magnitude on the x-y plane, (ii) static pressure on the x-y plane, and (iii) x-component of velocity on the vertical plane at x = 25 cm.

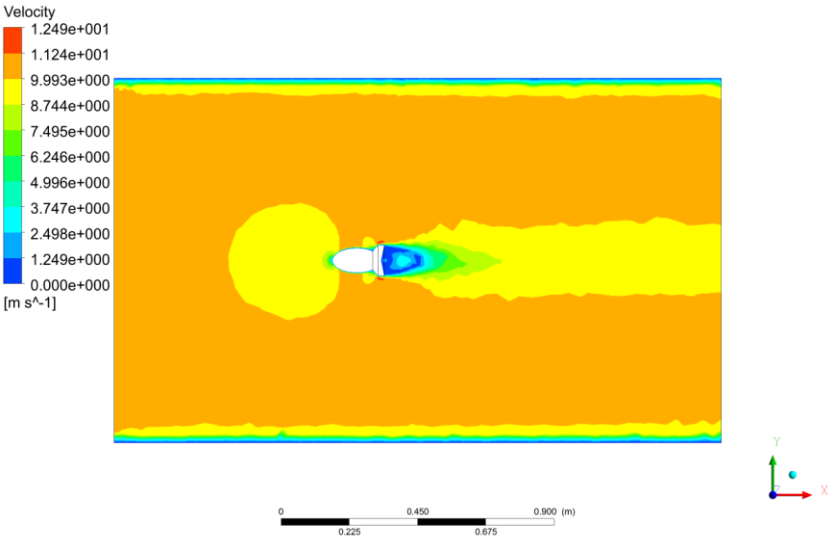

Figure 15: Velocity Magnitude

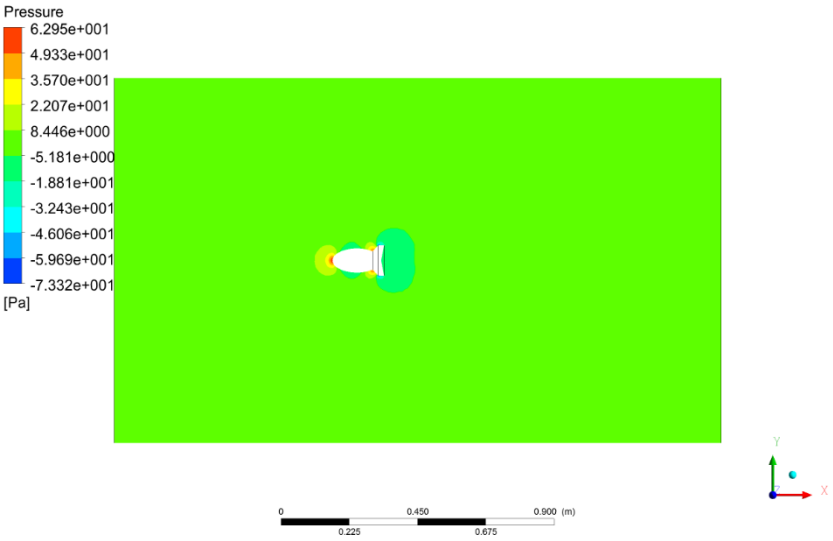

Figure 16: Static Pressure

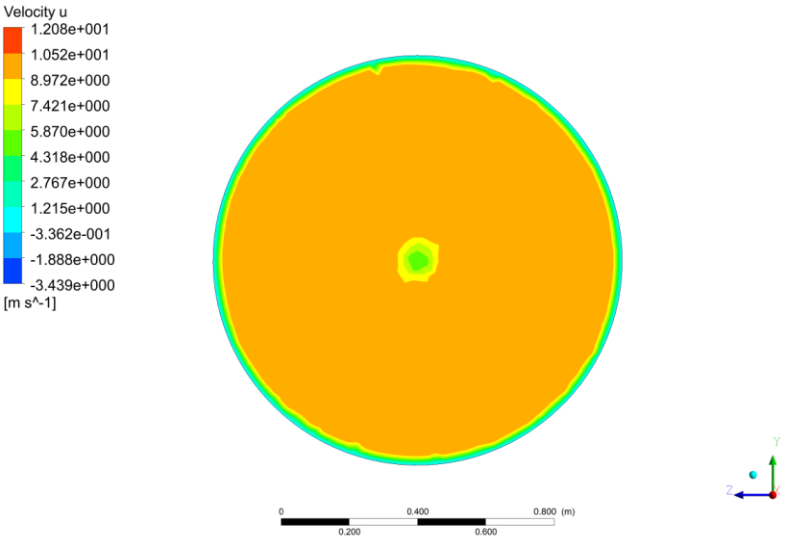

Figure 17: Velocity at x = 25cm

(3) Calculation of the drag on the whole "fish".

Table 3: Drag Forces

Drag (N)	
Pressure	0.1959
Viscous	0.0121
Total	0.2080

Task 4

Deliverables

(1) Contour plots of (i) velocity magnitude on the x-y plane, (ii) static pressure on the x-y plane, (iii) x-component of velocity on the vertical plane at x = 25 cm, and (vi) x-component of velocity at the inlet and provide printout of UDF.

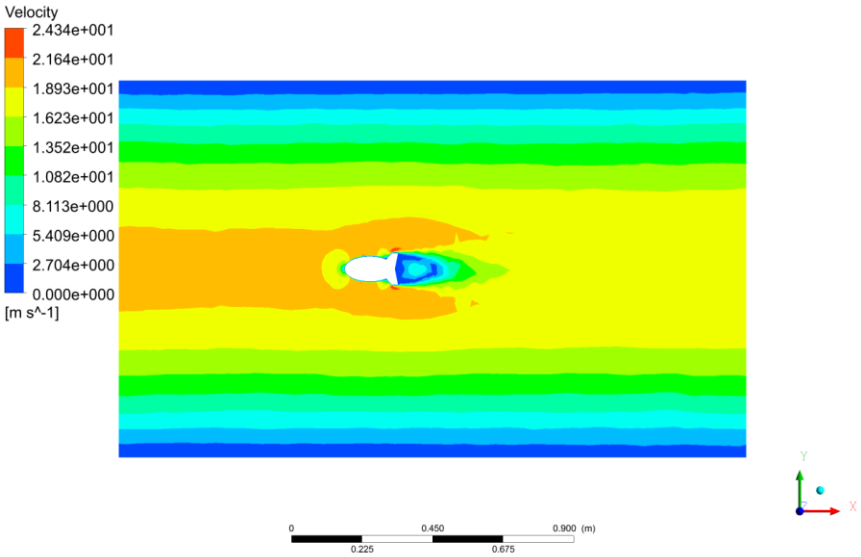

Figure 18: Velocity Magnitude

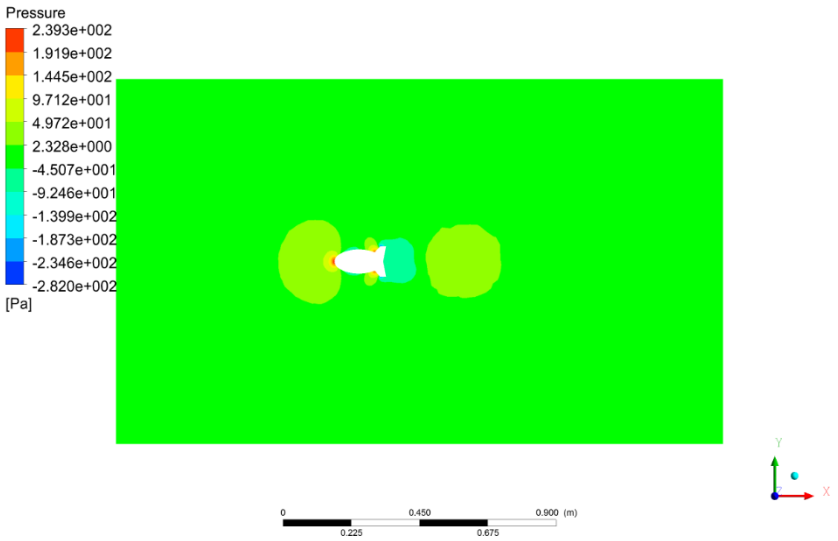

Figure 19: Static Pressure

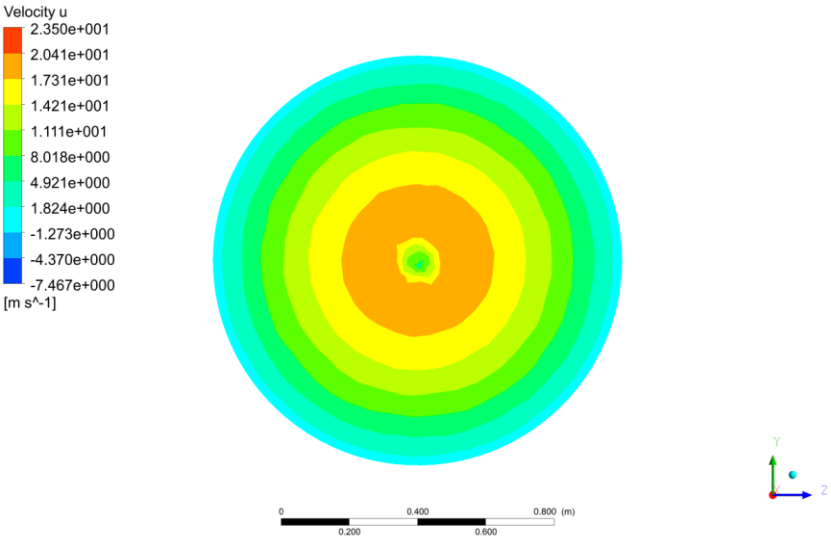

Figure 20: Velocity u at x = 25cm

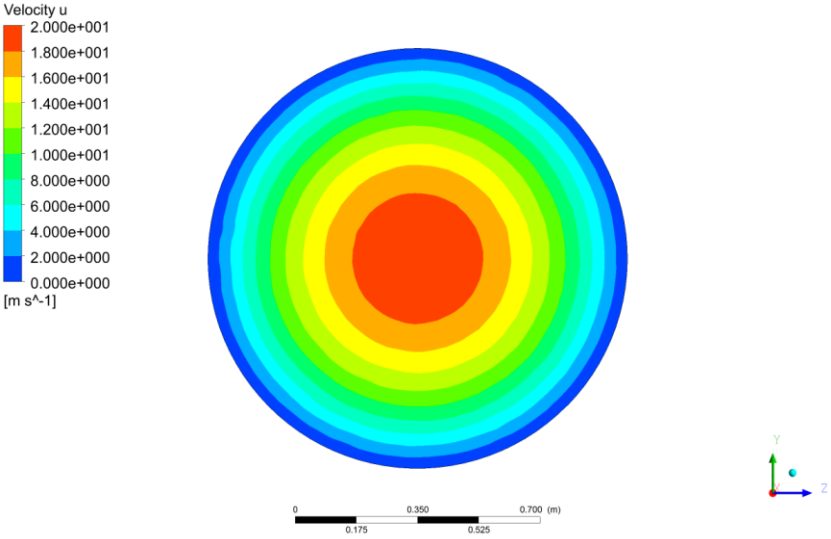

Figure 21: Velocity at the inlet

(2) Calculation of the drag on the whole “fish”.

Table 4: Drag Forces

Drag (N)	
Pressure	0.7615
Viscous	0.0312
Total	0.7927

(3) UDF Script

```
#include "udf.h"
```

```
DEFINE_PROFILE(NUV, thread, position)
{
real x[ND_ND]; /* position vector */
real yy;
real zz;
real r;
face_t f;
begin_f_loop(f, thread)
{
F_CENTROID(x,f,thread);
yy = (x[1]);
zz = (x[2]);
r = sqrt(zz*zz+yy*yy);
F_PROFILE(f, thread, position) = 2*10*(1-(r/.6)*(r/.6));
}
end_f_loop(f, thread)
}
```