

# ME685 HW7

Aman Parekh - 180073

October 8, 2021

For calculating the Volume of the circular disc of unit thickness, we need to apply the following formula:

$$V = \int_{-1}^1 \int_{-\sqrt{1-x^2}}^{\sqrt{1-x^2}} dy dx$$

Similarly, to calculate the mass, we apply:

$$M = \int_{-1}^1 \int_{-\sqrt{1-x^2}}^{\sqrt{1-x^2}} \rho(x, y) dy dx$$

X-Coordinate of centre of mass:

$$x_{com} = \frac{\int_{-1}^1 \int_{-\sqrt{1-x^2}}^{\sqrt{1-x^2}} \rho(x, y) x dy dx}{M}$$

Y-Coordinate of centre of mass:

$$y_{com} = \frac{\int_{-1}^1 \int_{-\sqrt{1-x^2}}^{\sqrt{1-x^2}} \rho(x, y) y dy dx}{M}$$

1. The Psuedo Code for the Mass calculation using Trapezoidal Rule is:

---

**Algorithm 1:** Trapezoidal Rule in 2D

---

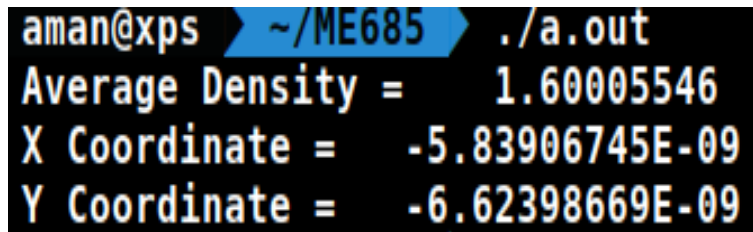
Mesh Data Points are passed to the subroutine

```
for  $i = 1, n+1$  do                                ▷ Looping through discrete points in the x-direction
|    $auc = auc + den(x, 1) * (hy(i)/2)$                 ▷ Adding the first term of the trapezoidal rule
|   for  $j = 2, n$  do                                ▷ Looping through discrete points in the y-direction
|   |    $auc = auc + den(x, y) * hy(i)$                 ▷ Adding 2-n terms of the trapezoidal rule
|   end
|    $auc = auc + den(x, n+1) * (hy(i)/2)$             ▷ Adding the last term of the trapezoidal rule
end
```

---

Please note that to calculate the volume,  $den(x, y)$  is simply replaced by 1, to calculate  $x_{com}$ ,  $den(x, y)$  is replaced by  $den(x, y)x$  and to calculate  $y_{com}$ ,  $den(x, y)$  is replaced by  $den(x, y)y$ .  $hy$  represents an array with discretization in the y-direction at a specific x location.

The code is attached with the submission.



```
aman@xps ~/ME685 ./a.out
Average Density = 1.60005546
X Coordinate = -5.83906745E-09
Y Coordinate = -6.62398669E-09
```

The COM is located at the origin for the given geometry and density distribution. This was expected as it has an axis of symmetry.