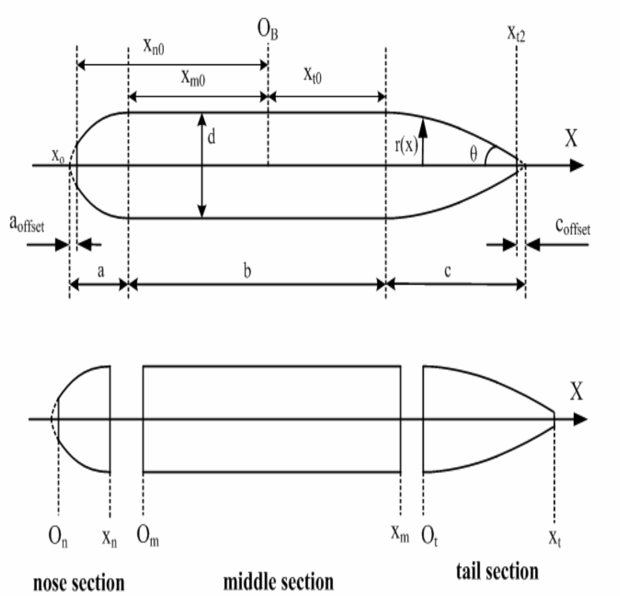
2. Methodology

The underwater vehicle discussed in this thesis adopts the Myring hull profile. This kind of hull shape provides more inner space for carrying equipments while keeping the streamlined characteristics outside when compared to the underwater vehicle shapes. This hull shape is axis symmetric and the specific profile is described by the equations of radius distribution along the main axis. The origin of these equations is set at the front point of the vehicle, the point x_0. The underwater vehicle adopting this kind of profile can be divided into 3 modules: the nose section, the middle section and the tail section



The equation of radius distribution along x axis for the nose section is:

$$R_n(x)=\frac{1}{2}d\left[1-\left(\frac{x-a_{offset}-a}{a}\right)^2\right]^{1/n}$$

The equation for the tail shape is:

$$R_t(x)=\frac{1}{2}d-\left[\frac{3d}{2c^2}-\frac{\tan\theta}{c}\right](x-l)^2+\left[\frac{d}{c^3}-\frac{\tan\theta}{c^2}\right](x-l_f)^3$$

Where $l_f = a+b-a_{offset}$

The middle section is a cylinder with constant radius

$$R_m(x)=\frac{d}{2}$$

Where x represents the x-axis position with its origin at point x_0 ; n is an exponential parameter which can be varied to give different body shapes. a ,b and c are the full lengths for the nose section, middle section and tail part respectively; a_{offset} and c_{offset} are the offset for the nose part and the tail part respectively; 2θ is the included angle at the tip of the tail; d is diameter of the middle part. By using MATLAB coding the hull profile of the under water glider is obtained from radius equations

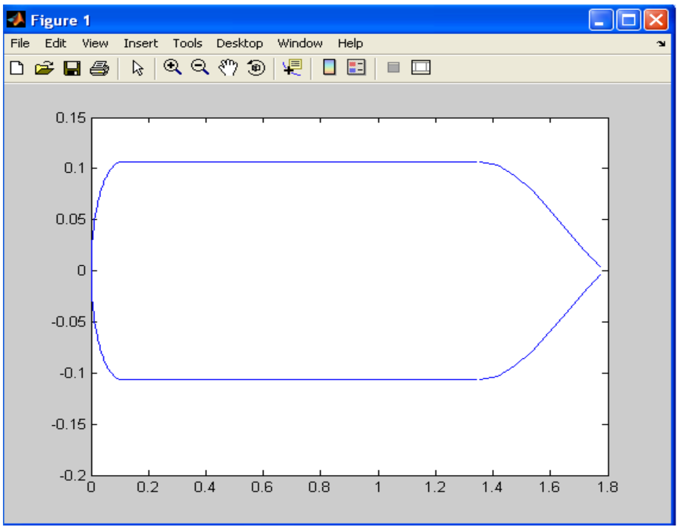


Figure1: Hull profile in MATLAB

3. Analysis using ANSYS

The ANSYS Main Menu contains all of the commands to create, mesh, apply loads, solve, and view results of the FE analysis. By using the coordinates generated from MATLAB, the Under water glider is designed in ANSYS.

3.1 Design Specifications

3.1.2 Shell details

(a)The entire length of the shell is 1789.2mm
(b)The outside diameter of the shell is 212.7mm
(c)External pressure of 100 bar acts on the shell

3.1.3 Stiffener details

(a)Number of ring stiffeners in the shell: 11
(b)Number of ring stiffeners in the tail: 3
(c)Cross section of the stiffeners: Rectangular
Stiffeners thickness of cylinder is 10 mm while stiffener depth is 20 mm
Stiffeners thickness of tail is10 mm while stiffener depth is 10 m

3.1.4 Specifications of Glider used in present Thesis:

- Weight: 52 k
- Hull Diameter: 21.27 cm
- Vehicle Length: 1.79 m
- Wing Span: 120 cm
- Depth Range: 200 – 1000 m
- Wing span: 0.974m
- Wing Root-Chord: 0.11m
- Wing Tip-Chord: 0.07m
- Wing Area: 0.131m^2
- Mach number:0.0005

3.2 Material Details

The material used for the analysis of the shell is Aluminium 6061-T6 alloy with properties given below
Young's modulus: 7.31 Gpa
Poisson's ratio: 0.33
Density: 2700kg/m^3

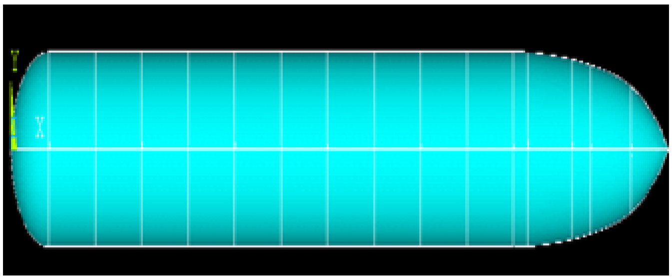


Figure2: Solid model of Glider in Ansys

3.3 Mesh Generation

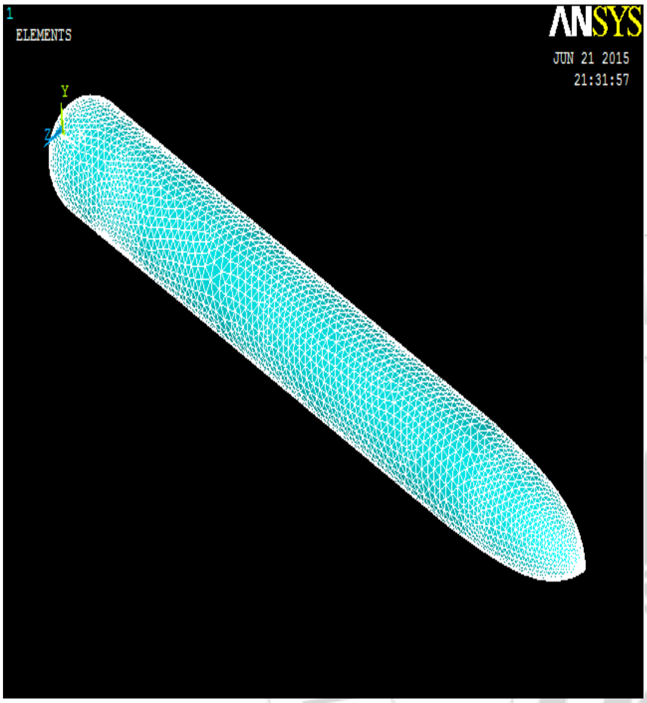


Figure 3: Quad mesh of Glider

4. Results and Discussion

The following type of analysis has been carried out on the under water glider
a) Static analysis
b) Buckling analysis

Table 1: Static analysis

S. No	Thickness (mm)	Wt (kg)	Max Stress (Mpa)	No. of stiffners
1.	8	26.5	131.37	14

From the table 1 the maximum stress the glider can withstand is 131.37 Mpa

Table 2: Buckling analysis

S. No	Thickness (mm)	Wt (kg)	Buckling factor	No.of stiffners
1.	8	26.5	6.865	14

From the table 2 the buckling factor of the glider after Buckling Analysis is 6.865

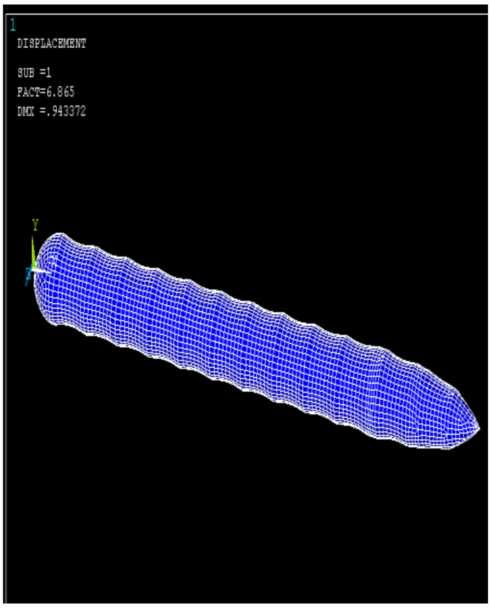


Figure 4: Deformed shape of under water glider

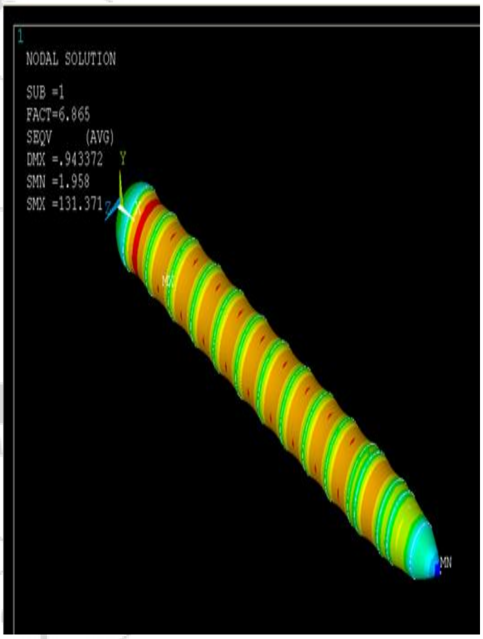


Figure6: Buckling analysis of under water glider

5. Conclusion

Acceleration of hydrodynamic coefficients of the underwater glider pressure hull are estimated by using Strip theory and Lambs inertia coefficients Strip Theory computes each coefficient as sum of coefficient of unit length slices by using empirical formulae given by Newman. The Lambs inertia coefficients for the vehicle are computed by assuming the total body as an ellipsoid. K1,K2 and K3 obtained from the calculations are used for computing the coefficients .Hydrodynamic coefficients of underwater glider body obtained by using strip theory and Lamb's inertia coefficent are found to be in close agreement.

Static stresses on the pressure hull when subjected to 10 Mpa External hydrostatic pressure were computed by using ansys structural software . Maximum Vonmoses stress was 140 Mpa which is much below than allowable stress of the aluminium alloy Material (240 Mpa -0.2% proof strength)

Maximum deformation was 0.8 which is considered safe. Buckling factor for the pressure hull was 6.8 with 10 Mpa External pressure which is considered very safe from design considerations

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Author Profile

Degaala Shravya sree received Bachelor's Degree in Aeronautical Engineering from Marri Laxma Reddy Institute of Technology in 2012. I am interested in Mathematical modeling and Analysis of structures