Sizing Algorithm Documentation

Team 7

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Contents

0.1 Rationale

We need to determine 2 very important things:

1. The thrust to weight ratio affects:
   - acceleration:
   - climb rate:
   - maximum speed:
   - turn rate:
   - Aircraft Endurance:
2. The stall speed is directly determined by the wing loading and the maximum lift coefficient. Wing Loading will affect:
   - stall speed
   - induced drag
   - take-off distance

0.2 Sizing Methodology

1. First Method:
   (a) Firstly use the stall speed to determine wing loading Stall speed should be independent of engine size
   (b) After figuring out wing loading, determine the thrust to weight ratio based on takeoff distance Rate of climb
2. Second Alternative Method:
   (a) Determine the Thrust to Weight Ratio
   (b) Determine the wing loading by direct computation

q is the dynamic pressure of an aircraft flying. It is defined as

$$q = \frac{1}{2}\rho v^2$$

The equation below was found in page 118,

$$\frac{T}{W} = \left(\frac{\eta_p}{V}\right)\left(\frac{P}{W}\right)$$

wherein η_p represents the propeller efficiency, P represents power of the engines, W represents the weight of the aircraft, V represents the true air speed of the aircraft.
Wing loading is basically the weight of the aircraft divided by the total wing area.

$$L_{wi} = \frac{W}{S} = \frac{1}{2}\rho v_{stall}^2 c_{L,max}$$

Our typical would be around $c_{L,max} \approx 1.2 -> 1.5$, Sweep only reduces your maximum coefficient of lift.

0.3 Textual References

1. Page 117 has table for thrust to weight of typical aircrafts.
2. Page 119 has a table for power to weight ratio of typical aircrafts.
3. Page 124 has a tabel for typical wing loadings.
4. Page 126 has description on typical $c_{L,max}$ values.