

Lab 1 – Design Parameters and Tradeoffs

Unified Engineering

5 Feb 09

Learning Objectives

- Get familiar with flight performance modeling
- Get familiar with design variable effects and tradeoffs

Preparation

- Study the lab notes document “Flight Thrust, Power, and Energy Relations”

Lab Execution and Deliverables

1) Working in a group of 3–4, create a “Pro & Con” list like the one at the end of the lab notes, for each of the following design variable changes aimed at reducing E_{shaft} (fuel consumption) which is required to carry a fixed payload W_p over some fixed distance d :

- Increase the wing area S , while holding span b fixed
- Increase the wing span b , while holding area S fixed
- Increase the maximum operating lift coefficient C_L with higher-camber airfoil
- Reduce c_d by using thinner airfoil
- Reduce fuselage’s CDA_0 by adding fairing material
- Increase the propeller radius R

For each such change, consider the direct effects as given by the E_{shaft} expression (obvious), and also identify and consider as many of the indirect effects as you can (not so obvious). The C_D component fractions can give some idea as to the relative importance of the competing effects.

Explain the rationale for each Pro and Con with a brief argument. A few sentences and possibly some simple algebra should suffice for each.

2) Rank the design variables in order of decreasing importance for decreasing E_{shaft} . Include the parameters given at the end of the lab notes in this list.

Two written pages should be sufficient to report your findings.

Suggested teamwork process:

- i) Individuals make preliminary lists of pros and cons during preparation
- ii) Team meets and collates all these, agreeing on a rank ordering
- iii) Team splits work if possible to document their final result
- iv) Each team submits one document