UNIVERSITY OF NOTRE DAME
Department of Aerospace and Mechanical Engineering
AE 440: Flight Mechanics and Introduction to Design
Fall 1998

Project #11
Due: Monday, November 23, 1998

We wish to continue the "design" of the UAV which has been the focus of our attention for the past few projects. You have determined the lift and moment characteristics for this aircraft and now we want to complete the aerodynamic description of the aircraft and attempt to begin to estimate its performance. This project will require you to:

- develop the drag polar
- determine the characteristics of a proposed propeller
- develop the power required and power available for a given flight condition (and "motor")
- estimate the maximum and minimum level flight speeds and maximum rate of climb
- estimate the takeoff performance using you flight "simulator"

To achieve these goals you will need to perform the following tasks and document them in a technical memorandum. Select the aircraft configuration that you proposed as a result of your efforts on Project 10. Make sure your report completely describes the configuration and all assumptions that you wish to make.

1. Develop a 2-parameter drag polar for your aircraft. The C_{D_0} estimate can be based upon skin friction and the drag due to lift on "corrected" induced drag. Develop the power required for steady level flight for your aircraft at sea level, standard conditions. (Based upon the takeoff weight of 12 lb.)
2. Assume that wish to consider a 14 inch diameter, 8 inch pitch (fixed and constant pitch) propeller. Develop the C_P, C_T, and η for this propeller using the NDProp software which will be described in class and is provided in the coursefolder.
3. Assume that you will be using a small permanent magnet DC electric motor for this aircraft. This geared motor is rated at 0.4 Hp when operated at 24 volts and 5000 rpm. Using this motor and the propeller described above develop the power available for this aircraft when operating at "full throttle".
4. Using the power available and required information discussed above, estimate the maximum and minimum level flight speeds at sea level. Estimate the maximum rate of climb and the velocity at which it would occur. Estimate the range which the aircraft could achieve if it was operating at sea level at its maximum speed and the energy storage was 3 amp-hrs. (you will need a motor and gearbox efficiency for this estimate - assume 95% for each)
5. Use your "flight simulator" to estimate the takeoff ground roll for this aircraft.
6. Summarize the configuration and its performance at this point in its design in a brief table.