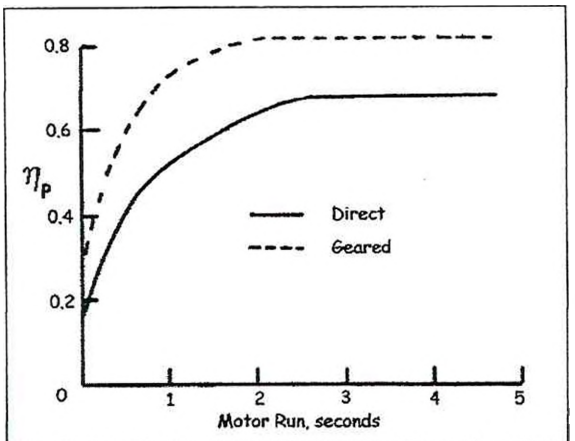

Fig. 19 Prop Efficiency History for Direct and Geared Propellers

How do we explain this discrepancy?

The previous simulation was based on the change of one variable: the zero lift drag of the wing. All other factors were constant. Keeping all factors constant from flight to flight is difficult when flying the same model, let alone comparing different models flown by different fliers. In order to show the effect of some of the other variables between models and fliers, simulations were conducted on propeller efficiency, increased engine power, propeller gearing and launch velocity.

Presented in Figure 16 is the gain or loss in total altitude due to changes of: 10% engine power increase, doubling the launch velocity, and reduction in propeller efficiency of 10%. The direct-drive propeller is used in all cases.

As indicated, doubling the launch velocity gives an increase of approximately 30 feet. As expected, increasing the power or decreasing the propeller efficiency results in a loss or gain in altitude of slightly less than 10%.

The final variable investigated was a comparison of the geared propeller versus direct drive. A comparison of the flight trajectories is shown in Figure 17. Total altitude is shown in Figure 18. The geared prop has an advantage of 100 feet in total altitude. The reason for this advantage is shown in Figure 19 where the variation in propeller efficiency is shown. The geared larger prop has greater than 20% efficiency throughout the motor run and starts the transition at a higher speed. Both the greater efficiency and speed result in more altitude. The down side to the large geared prop is the chance of a bad prop fold which can lead to large losses due to increased sink rate or a possible spiral dive into the ground as any rubber modeler can attest to.

Conclusions

A numerical simulation of wing geometry on a generic F1C model has shown the following:

- Altitude at motor cut-off is little changed for models having either fixed, flapped or folding wings. The folder has a slight advantage.
- Variable geometry wings either flapped or folded have a significant still-air advantage over fixed wing models. This advantage is due to the reduced sink rate of the variable geometry wing.
- The folded wing concept has a slight advantage if all things except airfoil geometry are equal. This finding is true, even when the wing drag of the folder is increased 20%.
- Increasing the power of the model by 10% increases the overall altitude by a lesser percentage.
- Doubling the initial launch velocity (hard throw) can increase the total altitude by approximately 30 feet.
- Significant altitude advantages may be gained by the use of geared large diameter propellers.

Acknowledgement

The author would like to thank Michael Achterberg, Gilbert Morris, Faust Parker and Aram Schlosberg for their help in defining present day F1C trends. Also Mike Woodhouse for the header photo.

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