CASE STUDY
Aircraft Propeller Performance

Antonio Filippone
The University of Manchester
January 2015

Background

Propellers power a number of commercial and military airplanes (Dash8-Q400, ATR42, ATR72, C27, C130J, A400, etc.). They also power the great majority of light and general aviation airplane. Thus, in spite of the advances in gas turbine engines, propellers are still ubiquitous in aviation. That said, propeller data are few and far between; with the exception of some very old data available in the technical literature, the modern propeller is virtually unknown. In fact, the modern propeller is an extremely sophisticated system of transport airplanes. The blade sections are designed for transonic Mach number operation; the blades are swept back and in the azimuth direction to improve noise emissions and aerodynamic performance; propeller control is guaranteed with the so-called PEC (propeller electronic control), and its own FADEC.

![Figure 1: Reconstruction of the F568 propeller, as used by the FLIGHT program.](image)

Solution

Producing a realistic propeller model, such as the one shown in Figure 1 requires a detailed analysis of digital photographs and the propeller’s certification documents. Once the geometrical model is developed, we can calculate the aerodynamics and aero-acoustics, in isolation or fully integrated with the flight mechanics. However, in general, it is a good idea to have performance charts.
Propeller charts are shown with three four main parameters: power coefficient $C_p$, thrust coefficient $C_T$, advance ratio $J$, collective pitch $\theta$. One such example is shown in Figure 2.

The way this propeller chart is integrated in the flight mechanics equations is explained in Refs. [1-2]

![Propeller Chart](image)

**Figure 2: Example of predicted propeller performance chart.**

**Further References**


For enquiries, please write to:

Antonio Filippone  
The University of Manchester  
Manchester M13 9PL  
United Kingdom  
Email: a.filippone_at_manchester.ac.uk