



FLIGHT-2022

**MADRAS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF AEROSPACE ENGINEERING
ASSOCIATION OF AERONAUTICAL ENGINEERS**

FLIGHT 2022

MAY 13, 2022

TIME: 1:30 PM

POSTER PRESENTATION

Event Description:

Posters have become an increasingly popular method for presentation at conferences, as they promote greater interaction between speakers and participants. A poster presentation combines text and graphics to present the topic in a way that is visually interesting.


A brief explanation of the given topic is to be presented in a poster in a visually appealing and easily understandable way. Pictures along with tag lines that describes the exact topic is to be made.

Event format and rules:

TOPIC: Any topic related to Aeronautical, Aerospace or Avionics.


- Maximum of two per team.
- Present your project idea in a single captivating poster.
- You can display the soft copy of the poster and construe.
- Each team will be given 10 minutes to present your idea.
- You may create your poster in any software, but it should be presented in pdf/jpeg format.
- Judging will be based on topic selection, understandability, and readability.
- Judges' decision is final.

A sample poster is given below



Performance Characterization of a Modern Gyroplane

Midshipman 1/C Jacob Dewey
Professor Rob Niewoehner, Aerospace Engineering Department



Abstract

This research project entails a flight testing campaign of the FAA certified Calidus gyroplane to support the need for gyroplane performance research. Flight testing was conducted by adapting classic techniques developed by the U.S. Naval Test Pilot School and the aviation community for fixed wing and rotary wing aircraft. The project will determine the effectiveness and necessary adaptations of the U.S. Navy and industry standard flight test techniques for conventional aircraft as they relate to gyroplanes while characterizing the performance of a modern day gyroplane.


Methods

- Instrument Calibration of Airdata Systems
Wind tunnel and flight testing of two airdata systems was conducted to calibrate and build confidence in the instrumentation.
- Pitot static calibration
The GPS 4-leg method is both a flight test technique and data analysis technique used to calibrate an aircraft's static source, as described in Ward [2], and detailed in Niewoehner [3]. The method has proved effective for fixed wing aircraft flying above 100 kts out to 1.2 Mach. However, the methods applicability to rotorcraft at speeds below 100 kts may require refinement to reduce noise and provide confidence in the accuracy of the data. With validation of this method at slow flight speeds it would prove an effective method in the rapidly growing urban mobility market.
- Level flight performance
Level flight performance has been evaluated using the Speed-power method described in USNTPS-FTM-108 Chapter 4.4.1 [4] and Ward [2]. The speed-power method developed for fixed wing aircraft has been directly applicable in its current form, however the method has never been published for a gyroplane so validation is still required.
- Decent Performance
Decent performance for rotorcraft in instrumentation has been previously used for both gyroplanes and helicopters in order to determine glide ratios, aim to the hodograph for a glider. The smooth decent method provides no novelty specific to gyroplanes, but a rigorous flight test program would be insufficient without it. Additionally, determining the glide ratio of the Calidus and comparing it to the POFI value is valuable to the operator. Smooth decent method is described in USNTPS-FTM-108 Chapter 8.4.1 [5].

Results to Date

- Wind Tunnel Testing
Wind tunnel testing resulted in the above figures demonstrating the need to calibrate both systems before use in flight testing.
- GPS 4-leg Method
With the use of the GPS-4 leg method the position error resulting from the location of the static ports on the calidus was determined with respect to airspeed. Although at speeds above 80 kts the aircraft fails FAR part 23 regulations the aircraft is still sturdy as it does not fly. The results of the confidence bands indicate very tight precision and suitability for use with rotorcraft and in this speed range.
- Speed Power Method
The Speed Power method allowed us to determine the power required with respect to airspeed on the front side of the power curve. Unlike fixed wing aircraft the relationship is very linear within the slow airspeed range. More data points are required to refine and capture the complete power curve.

FAA Certified Calidus



Future Work

Due to Naval Academy COVID restrictions flight testing had been delayed until recently. Pitot-static calibration and level flight performance flights are nearly complete. Further analysis into the effects of rotor rpm as it relates to airspeed and altitude will come with more data. Decent performance in order to capture the back side of the power curve and take off and landing performance are queued up for future flight tests.

Future work outside the cockpit includes a technical note in the *Journal of Aircraft* to update the GPS 4-leg method as its validity extends to rotorcraft and to speeds below 100 kts. Additionally, an abstract has been submitted for the Student Competition within the AIAA Aviation Conference held in June.

References


- [1] Rotorcraft Flying Handbook, Federal Aviation Administration, FAA-81408-21, 2000.
- [2] Ward, D., Stoganes, T., and Niewoehner, R.J., Introduction to Flight Test Engineering, 3e (Volume 1), Kendall-Hunt, Dubuque, IA, September, 2007.
- [3] R. J. Niewoehner, "Refining Static Methods for Pitot-Static Calibration", AIAA Journal of Aircraft, vol. 43, No. 3, pp. 846-849, May-June 2006.
- [4] Fixed Wing Performance Flight Test Manual, US Naval Test Pilot School, USNTPS-FTM-108, 1992.
- [5] "Rotor Wing Performance Stability and Control", US Naval Test Pilot School, USNTPS-FTM-107, 1995.

Acknowledgements

A massive thank goes out to Dr. Murray Saylor (CAPT, USN (ret)), owner of the aircraft, and Research Professor in the Aero Department. He donated his time, money, and expertise to help make this project possible even in a dynamic COVID environment.

Thanks is also in order for Dan Rogerson and Steve Galindo (Technicians in the Aero Department) who donated their expertise and time to make wind tunnel testing possible.

Helicopter ≠ Gyroplane



Participation certificates will be provided.

Prizes worth Rs 1500/-

Entry fee – Rs.149/- only

CONTACT:

NAME: RAMKUMAR M

MOBILE: 9080919120

NAME: SALMA YASMEEN S

MOBILE: 9952012421