Sikorsky Aircraft
Stratford, Connecticut

NASA Space Grant Opportunity:

☒ Fellowship ☒ Project

Modeling of Helicopter Pitot Static Systems

Available for: 1 student (US Citizen Not Required)

Organization: Sikorsky aircraft
Systems Engineering

Technical Lead: Don Anttila

Sikorsky Grant Project Coordinator: Steven Weiner 203-386-3776, Robert Frawley 203-386-3033

Description

Helicopters measure airspeed, altitude, and Vertical Velocity by installing two or more external probes into the air mass that surrounds the helicopter. By measuring the ram air effect combined with the static (non-ram) air pressure on the surface of the helicopter, a calculation of Airspeed, altitude, and vertical velocity can be made.

The air mass surrounding a helicopter is complex due to the variable effect of rotor downward and rearward thrust, and further complicated by the pneumatic noise produced by the rotor blade passage frequency over the fuselage. Additionally, the vortices from the rotor tips generate pneumatic noise that adversely affects the computation of altitude and vertical velocity (a derivative of altitude).

The pitot pressure and the static pressure pneumatic signals are routed through tubing to analog instruments and to Air Data Computers (ADC). While mechanical instruments have inherent damping characteristics, ADCs do not. Thus, when the ADC calculates Indicated Airspeed (IAS), True Airspeed (TAS), Calibrated airspeed (CAS), Altitude, and Vertical Velocity, the pneumatic noise degrades the presentation of these parameters to the cockpit crew.

Current design techniques to filter the pneumatic noise employ both volume chambers and restrictors located at various places along the tubing. Each chamber and restrictor is then adjusted or tuned to achieve a balance of noise free presentation and acceptable latency. Tuning the tubing volume, the chamber volume, and the restrictors involves a cut and try approach in which combinations are evaluated in flight and then adjusted depending on the results measured in the flight tests.
This type of testing is expensive.

It may be possible to develop an analytic tool that would allow a better estimate of the restrictor sizes and locations, and to evaluate the effects of various volume chambers by modeling the behavior of the pneumatic noise generated by the helicopter blades under various conditions. To do this it would be necessary to :

1. Measure the actual pneumatic characteristics of the incoming pitot and static ports on an actual helicopter under several flight regimes.
2. Replicate the pressure noise using an acoustic source that would in effect simulate the actual noise signatures

3. Experiment and model the effects of various tubing volumes, chamber volumes, and restrictor combinations in the lab with a goal to produce a model of how pneumatic pressure behaves in a helicopter plumbing system.
4. Iterate/experiment to determine if the noise can be filtered more efficiently and a balance can be achieved between dynamic performance (minimal lag) and noise (acceptable for display purposes).
5. Once matured, use the model to pre estimate the restrictors and chambers that would be most efficient for initial flight testing.

Skills Required

- The ideal candidate will have an interest in the application of basic fluid mechanics

Helpful Skills

- Willingness to learn