Experimentation and Data Collection For Improved Performance and Stability in Tiltrotor Aircraft

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ABSTRACT:

The overall objective of the WRATS (Wing and Rotor Aeroelastic Test System) project was to increase the performance capabilities of tiltrotor aircraft by integrating a four bladed semi-articulated soft-inplane rotor system into an environment where only stiff-inplane systems had been used before. In doing this the rotors would have reduced weight and strength requirements, which would allow for increased speed stability and maneuverability. The four blade system is also a potential candidate for a heavy lift rotor craft.

The main focus of the testing I was involved in was to measure the free-play in the drive system, measure the mast dampening of the model in airplane mode, and measure the moment of inertia for the parts of the stiff-inplane hub. We used a dynamically scaled 1/5 size semi-span model of the V-22 mounted in a 30x30-ft hover cell to perform the tests. The free-play was determined by attaching a straight edge to the drive shaft and measuring the distance that the straight edge sweeps. Trigonometry was used to calculate the free-play angle. Mast damping was determined by placing a torsional couple on the drive shaft and exciting the system. Sensors were attached to the model that measured how the model responded to the excitation. The sensors were monitored by a data acquisition program that recorded and analyzed the models behavior. Additionally, the moment of inertia of the stiff-inplane hub was calculated using a moment of inertia instrument that outputs the time, T, of one period of oscillation. The period is used in an equation to determine the moment of inertia of each piece.

The information gathered in these test will assist the team in correcting the free-play in the system. In previous tests, the rotor system had shown that low damping maybe particularly caused by the free-play. The moment of inertia measurements that were collected will be used to compile a computer model of the 3 blade gimbaled hub. The model will be used to test designs for a tiltrotor UAV.

KEYWORDS: tiltrotor, soft-inplane, free-play, damping, moment of inertia

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