Abstract

On August 30, 2017, a team of Ohio State researchers and students set world records (pending official review) for speed (147 mph) and distance over an out-and-back course (28 miles) for an autonomous unmanned aerial vehicle (UAV). This talk will detail the design and development of the autonomous jet UAV used to set these world records. The story will begin with definition of the project goal in autumn 2015, and how the mission requirements were driven by the records standards of the sanctioning bodies (Fédération Aéronautique Internationale / National Aeronautic Association) and compliance with FAA regulations. This led to selection of our flight area, launching from Kelleys Island, Ohio and operating over Lake Erie. I'll then discuss the details of the key technical features of the jet UAV, which include custom designed and built flight controller hardware and software with three separate inertial measurement units, a real-time kinematic (RTK) GPS receiver, custom-built 5-hole probe and air data computer, sensor fusion with extended Kalman filter, custom-defined control laws, and outer-layer waypoint navigation routine. The jet is powered by a 42-lb thrust Jetcat engine with a fuel burn of approximately 18 ounces per minute (8 gph!) at full throttle. Vehicle control and downlink is maintained through triple-redundant radio links on 433 MHz, 915 MHz, and 1.5 GHz SATCOM through Viasat in geosynchronous orbit. Surveillance for ATC and other aircraft is provided by an on-board ADS-B in/out transmitter/receiver. I’ll discuss the characterization of the RF link performance, including antenna radiation patterns and determination of vehicle radar cross-section. I’ll also provide an overview of flight testing of the vehicle, including V&V of system autonomy, and a near-disastrous flutter failure just weeks before the record attempt that required a rebuild of the entire horizontal tail. Other interesting challenges with the world record include safety of flight and crew resource management will also be discussed.

Bio

Dr. Jim Gregory is a Professor in the Department of Mechanical and Aerospace Engineering, and Associate Director for UAS of the Aerospace Research Center at The Ohio State University. He received his doctorate and masters degrees in Aeronautics and Astronautics from Purdue University in 2005 and 2002, respectively. He received his Bachelor of Aerospace Engineering from Georgia Tech in 1999, graduating with highest honors. Dr. Gregory’s research interests lie in the field of unsteady aerodynamics – with specific interests in rotorcraft aeromechanics, bluff body wake control, and development of advanced measurement techniques. He is also active in Unmanned Aircraft Systems (drone) research, including flight testing of vehicle performance, systems integration studies, and robust flight of UAS in all weather conditions (wind and icing). He serves as PI
for Ohio State as a core member of the ASSURE FAA Center of Excellence on Integrating UAS in the National Airspace System. Funding for his work includes grants from ARO (Young Investigator Award), ARL, AFOSR, AFRL, FAA, NASA, Sikorsky, Honda R&D, and the Ohio Federal Research Network. He is an instrument rated private pilot, with over 200 hours in single-engine aircraft, and is one of the first holders of a remote pilot certificate.