Development of a stratospheric measurement platform for space weather

SPACE ENVIRONMENT TECHNOLOGIES
Enabling Human Evolution Into Space

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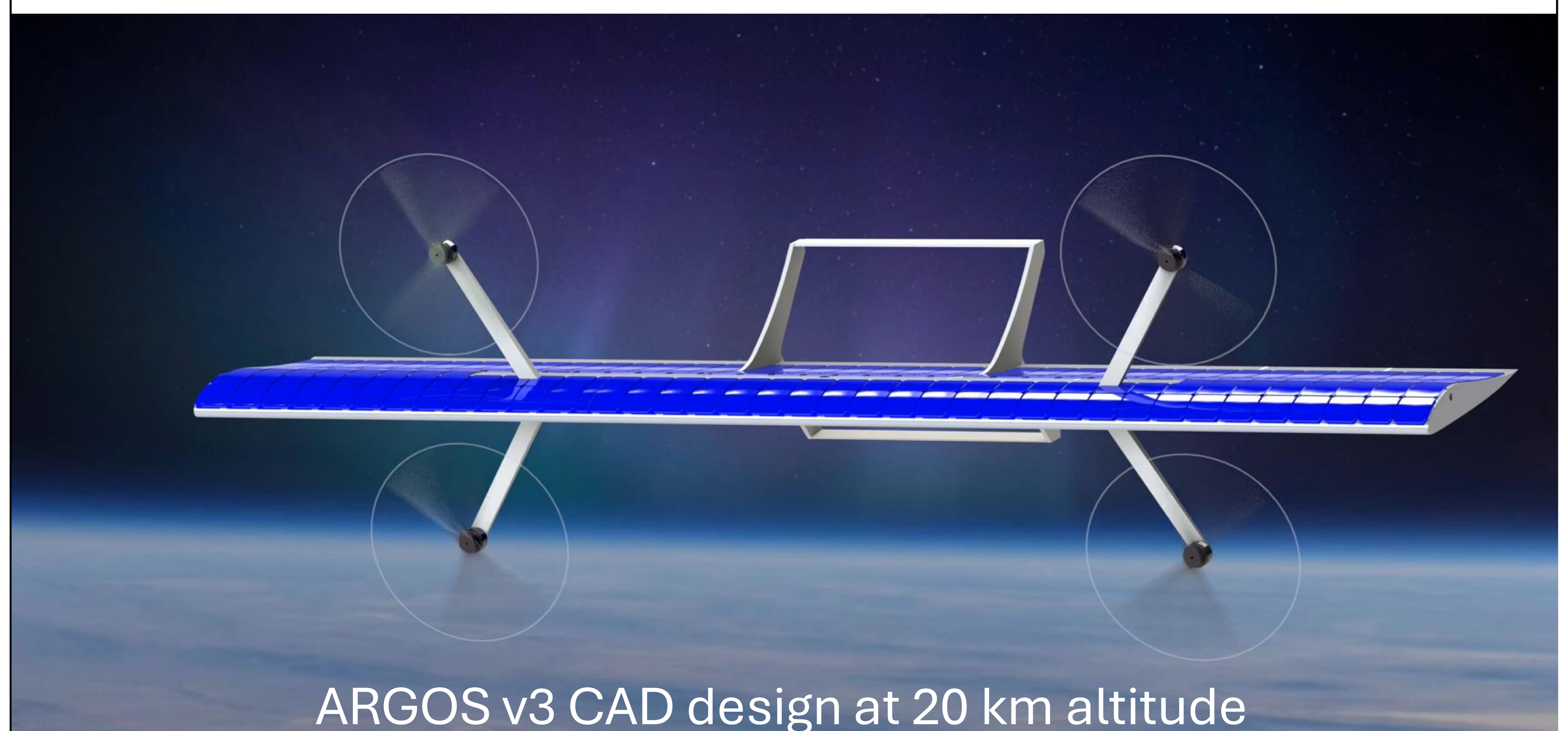
Abstract

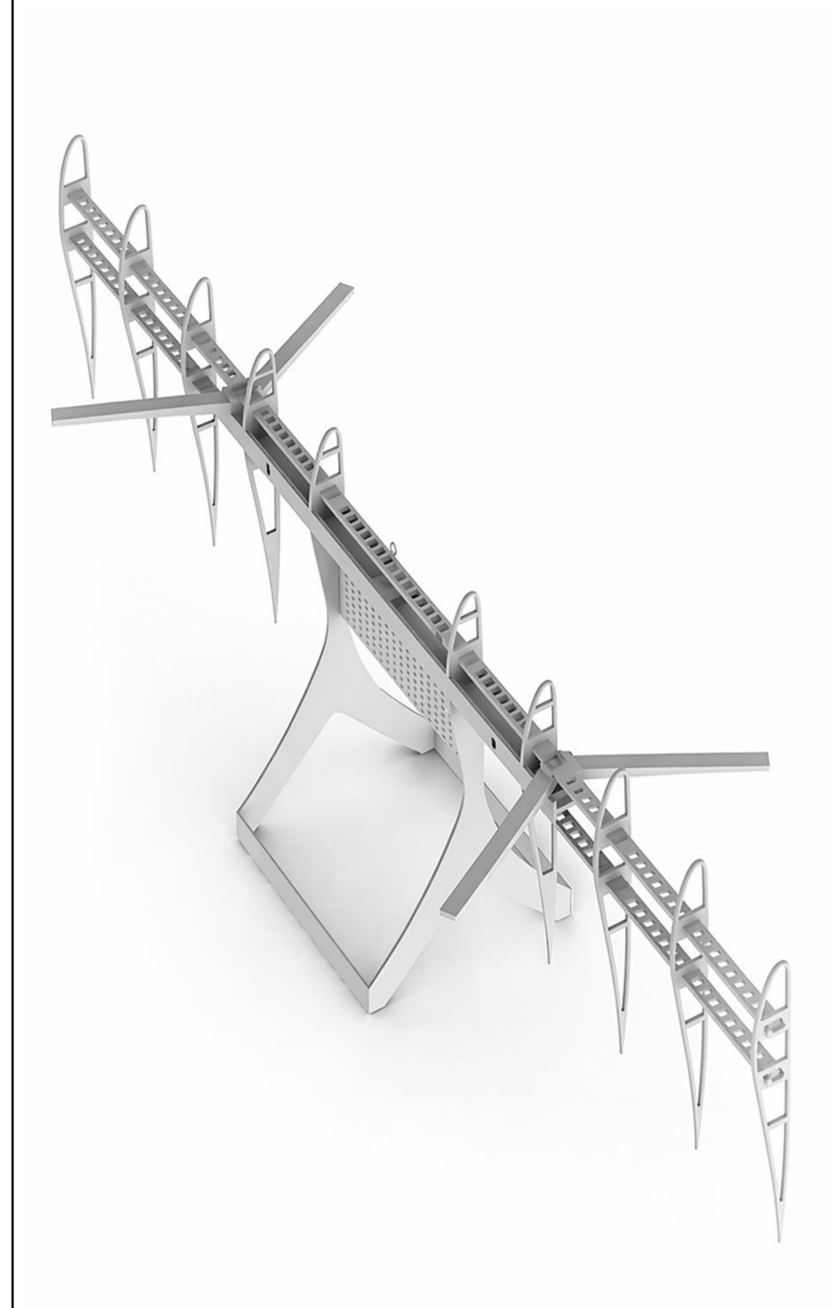
The *Aeronautical Regional Geospatial Observer System* (ARGOS) is an uncrewed aerial platform designed for multiple applications. The vehicle is a solar-powered flying wing with a payload capacity of 10 kg and 20U. The prototype is being iteratively developed to operate continuously at 20 km for months. The current version demonstrates vertical takeoff and landing (VTOL) in our laboratory and low-altitude horizontal maneuvers in the desert. An early objective is to fly an *Automated Radiation Measurements for Aerospace Safety* (ARMAS) dosimeter above the aircraft corridor. The platform will provide data for multiple aviation applications by flying ARMAS dosimeters, dual-frequency *Global Navigation Satellite System* (GNSS) receivers to quantify signal degradation due to scintillation, three-axis magnetometers to map the geomagnetic field over the ocean, and environmental sensors to measure ionospheric and stratospheric conditions. We introduce a novel multi-sensor approach to control the flexible structure required for high-altitude long-endurance (HALE) performance. We present recent aerodynamic analyses and simulations as well as hardware-in-the-loop (HITL) and flight test results using this approach. We invite collaboration with researchers seeking new measurements at altitude.

ARGOS



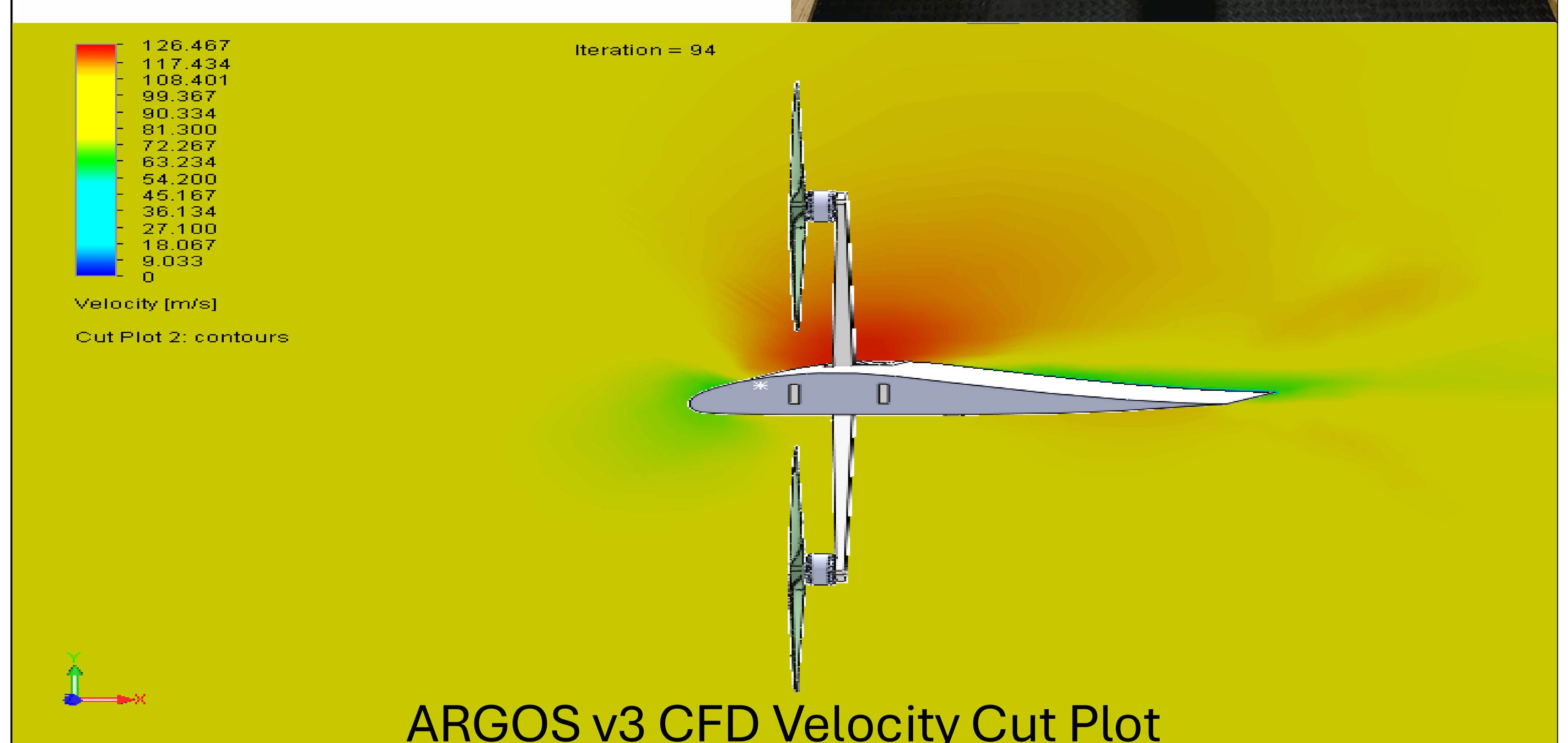
ARGOS v3 CAD design at 20 km altitude

Flying Wing Structure & Analysis

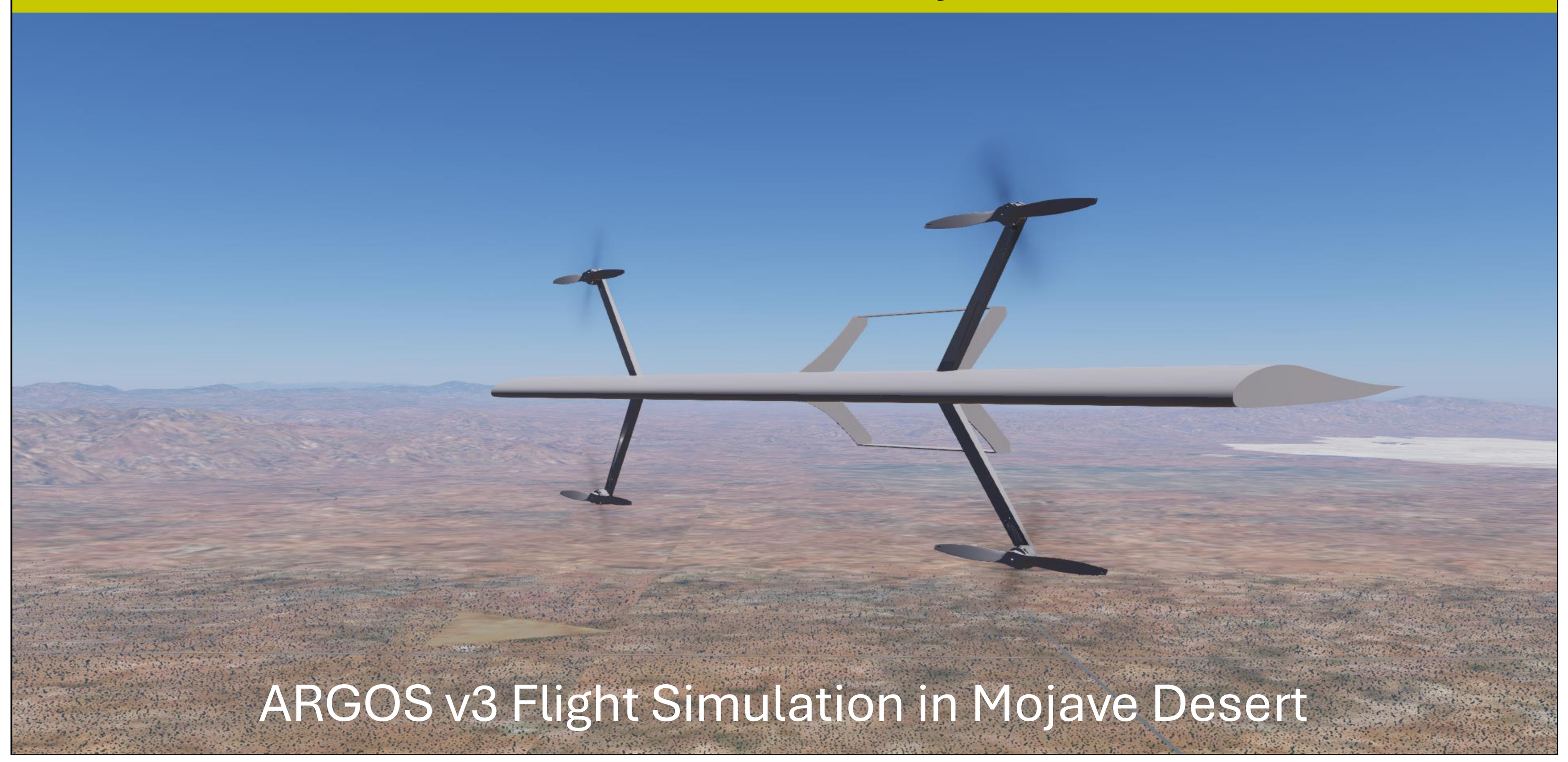


ARGOS v3 CAD Primary Structure

ARGOS v3 Wood Mockup



ARGOS v3 CFD Velocity Cut Plot



ARGOS v3 Flight Simulation in Mojave Desert

Avionics

ARGOS v3 is a wood mockup that has been fully assembled and integrated. Its main purpose is to develop a sophisticated dynamics and control capability for VTOL and horizontal flight under disturbances. The highly flexible airframe—required for VTOL and HALE performance—introduces significant challenges in structural integrity and coupled flight dynamics, making stability and control inherently difficult.

The airframe flexibility requires multiple optical and inertial sensors to accurately characterize the vehicle state at distributed locations. The current baseline configuration consists of five IMUs, six rangefinders, and an optical flow camera. We are developing a custom extended Kalman filter (EKF) that incorporates all sensor data to provide precise attitude and position estimation at multiple locations along the airframe, accounting for structural deformation.

Indoor flight testing is conducted in our Compton laboratory. In Spring 2026, flight testing will transition to the Mojave Desert to demonstrate Technology Readiness Level (TRL) 5 system functionality, including controlled ascent and landing.

Payloads

ARGOS v4 is being concurrently designed based on lessons learned from v3 and will support early-stage (low TRL) instruments through validation testing in the lower troposphere (up to ~5 km). These low-altitude, short-endurance flights will extend data collection for science-driven operations and enable repeated measurements where instruments can be tested and validated. As ARGOS matures and HALE flights become possible, the platform will enable collection of atmospheric, ionospheric, radiation, and environmental in situ data at stratospheric altitudes up to 20 km, along with remotely sensed data. ARGOS will provide observations in a region that is difficult to access with conventional aircraft and sparsely sampled by satellite observations.

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