

CLAS-ACT

Conformal Lightweight Antenna Structures for Aeronautical Communication Technologies

Overview/Description

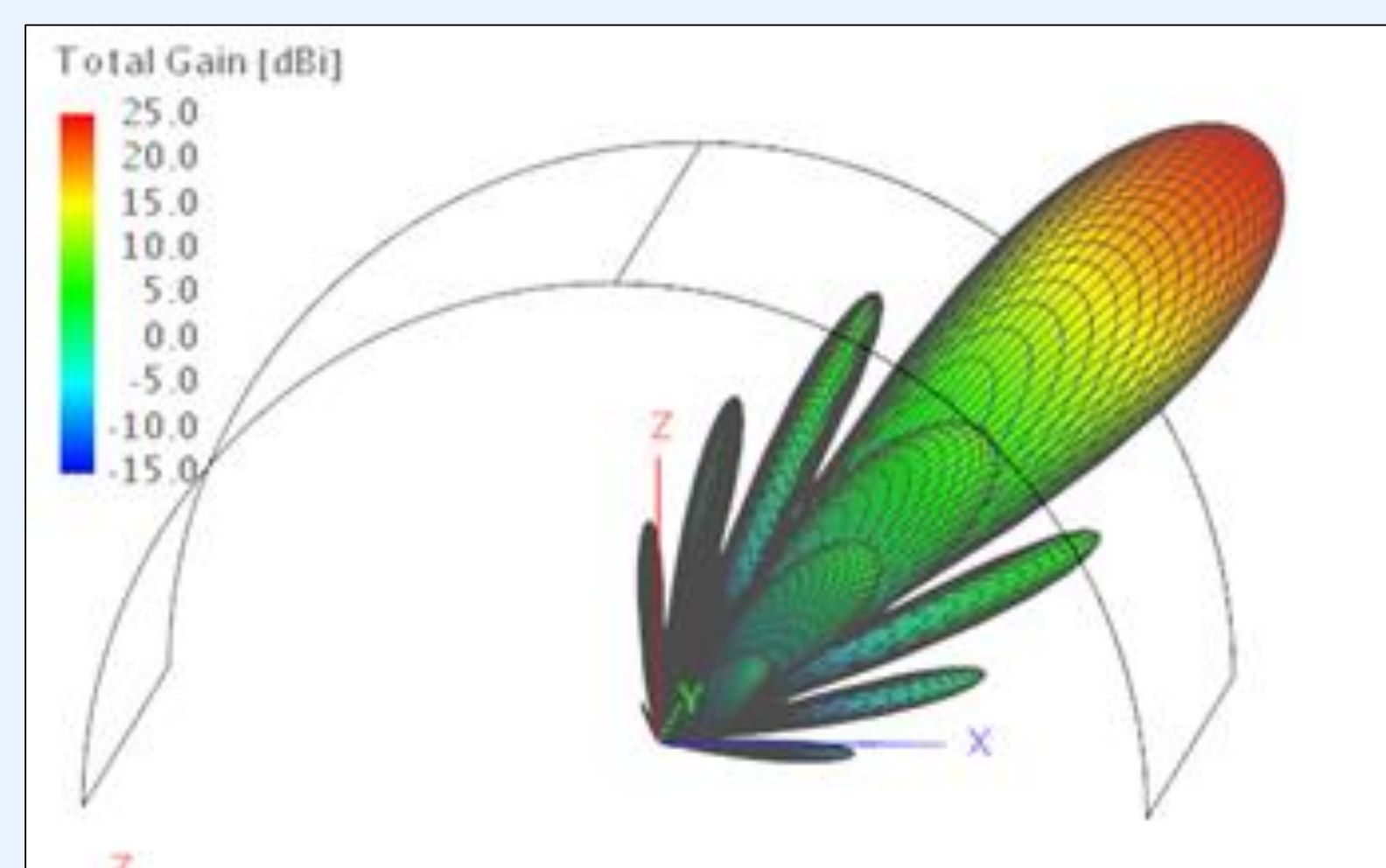
This project is to develop antennas which enable beyond line of sight (BLOS) command and control for UAVs. We will take advantage of newly assigned provisional Ku-band spectrum for UAVs and use unique antenna designs to avoid interference with ground systems. This will involve designing antennas with high isotropic effective radiated power (EIRP) and ultra-low sidelobes. The antennas will be made with polymer aerogel as a substrate to both reduce weight and improve performance, as demonstrated in an Aero Seedling. In addition, designing the antennas to be conformal to the aircraft fuselage will reduce drag.

Feasibility Assessment / Benefit if Feasible

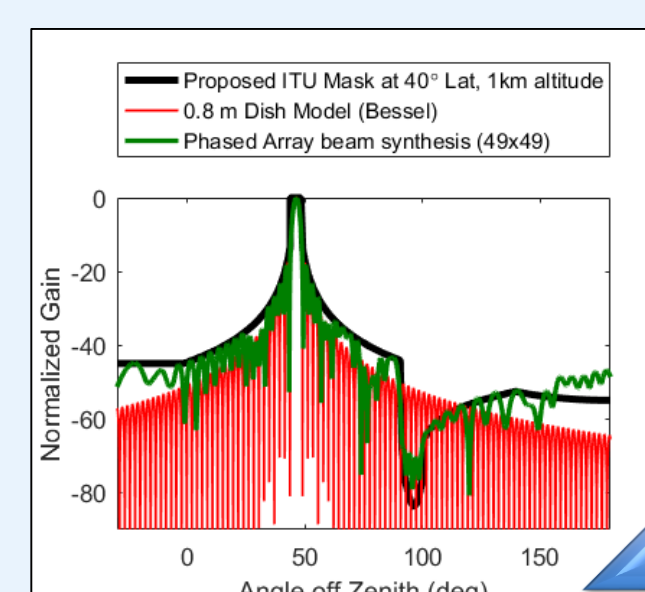
- Antenna performance and flight requirements/feasibility defined
- Demonstration of conformable aerogel (1 m bend radius in 1 cm thick substrate/no need to mold to net shape)
- Demonstration of high directivity antenna array and beam steering capabilities in lab environment/25-30 dB reduction exceeding acceptable level of interference in controlled environment
- Demonstration of 20 dB sidelobe reduction from standard parabolic dish antenna in flight test/meets requirements for reducing interference with fixed service ground stations

Partners

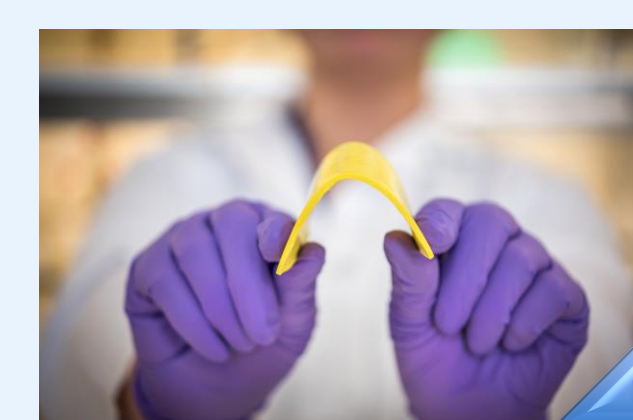
- LMN/GRC: (Aerogel synthesis and characterization) Mary Ann Meador (PI), Stephanie Vivod, Rocco Viggiano, Baochau Nguyen, Linda McCorkle, Jessica Cashman; Haiquan Guo, LCA/GRC: (ITU guru) Robert Kerczewski
- LCF/GRC: (Antenna design, fabrication and testing) James Downey (co-PI), Bryan Schoenholz, Marie Piasecki, Bushara Dosa, Peter Slater
- LaRC: (Design and trade-off studies on aero-dynamics, structural, mass saving, robustness) Scott Kenner, Anne Mackenzie, Mark Cagle, Ray Rhew, Jeremy Smith
- AFRC: (Integration, ground test and flight test of concept design on the Ikhana UAS) Andy Gutierrez, Patricia Martinez, Ricardo Arteaga, Kelly Snapp, Mark Buschbacher
- ARC: (Flight test simulations) Richard Alena, Aaron Cohen, Sasha Weston, Needa Lin



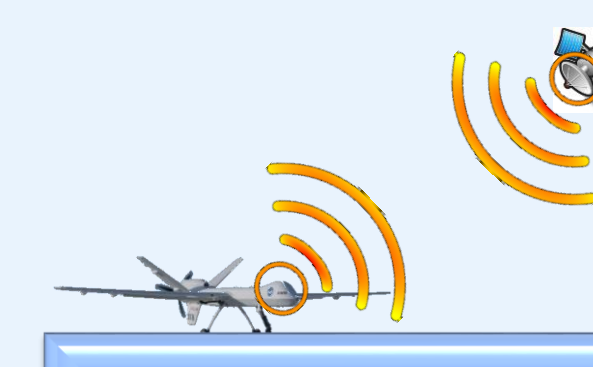
Simulated antenna gain pattern



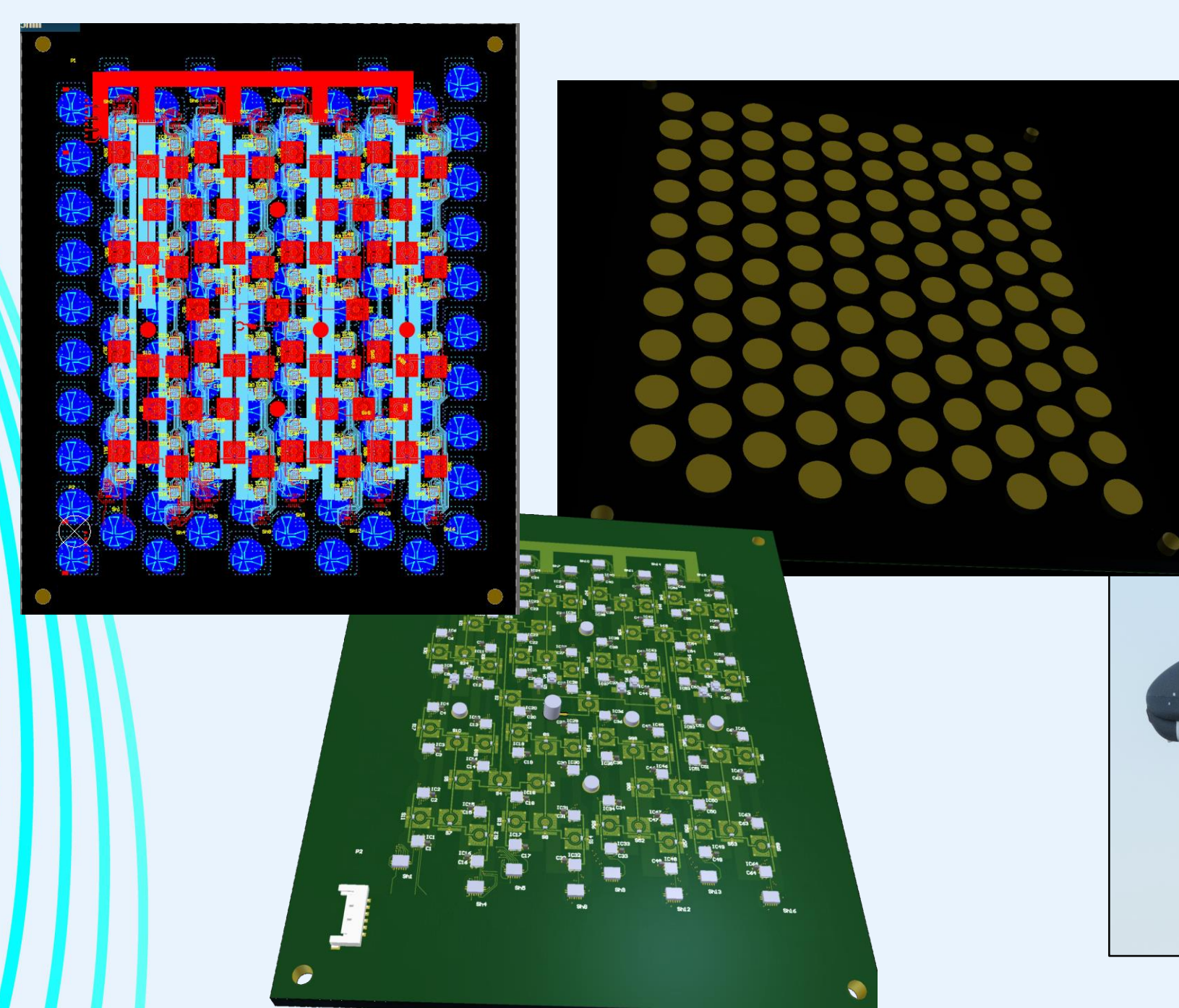
Challenge: Use phase array antenna beamforming to help mitigate ground station interference for ITU compliance



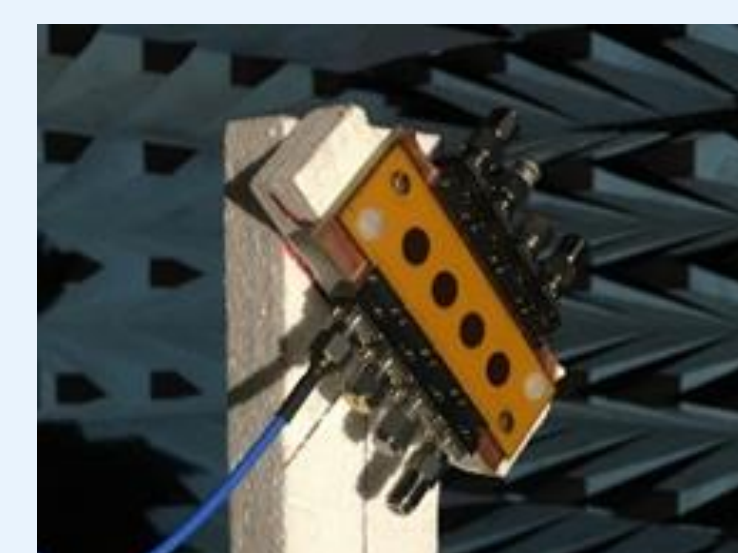
Challenge: Fabricate a tightly integrated antenna system using an ultra-lightweight flexible substrate



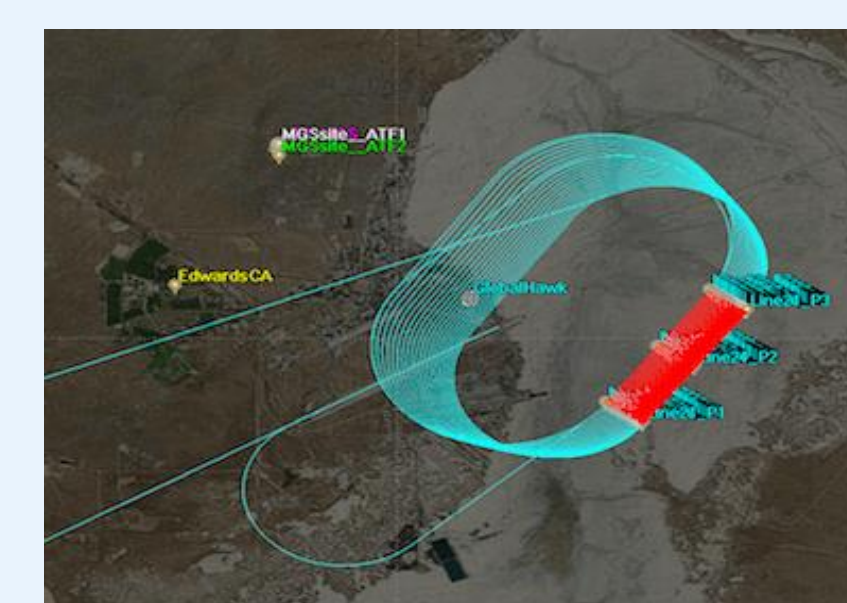
Goal: Advance technology for Ku-band phased array antenna using aerogel substrate to reduce SWaP (size weight and power) for UAV SatComm



Antenna design



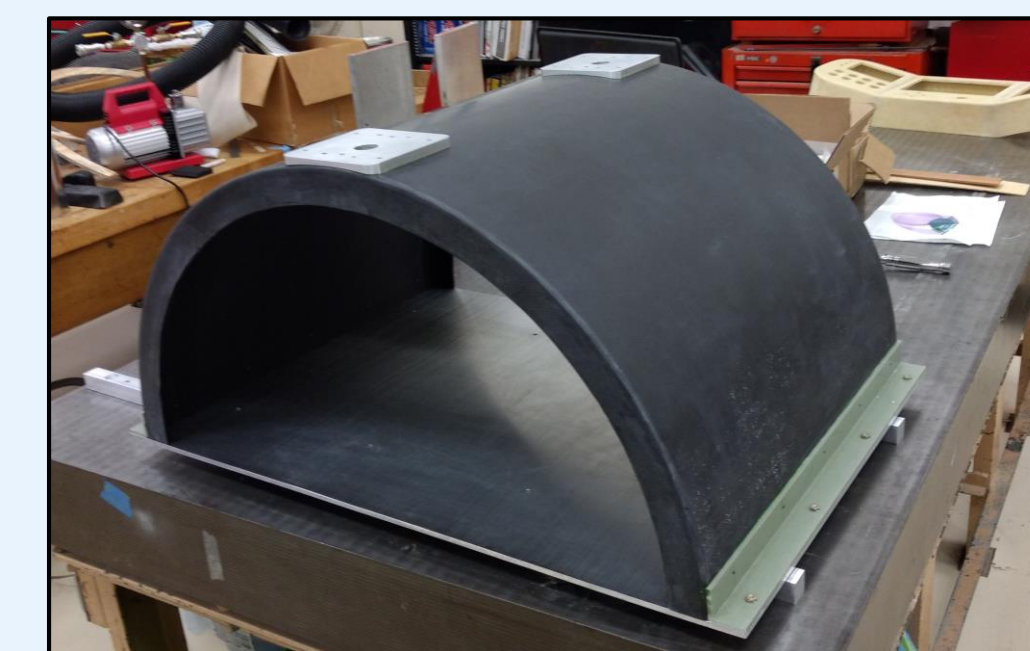
4 element test antenna



Notional flight path



Antenna will be mounted under radome in the Global Hawk on composite support structure (simulated fuselage)



Status

- Polyimide aerogels with higher bendability at 2-3 mm thickness demonstrated; down-selected formulation for antenna
- Antenna Element/Subarray designed and simulated
- Fabricated single element antenna with aerogel and conventional substrate
- Far/near field scanner designed and utilized for hangar test of antennas on Ikhana
- Models built to simulate performance of full size array on curved surface
- Flight simulation of aircraft to ground interference
- Antenna support structure fabricated; control systems to enable flight test designed
- Multilayer sandwich fabrication of full subarray prototype antenna near completion

Next steps

- Fabrication and testing of antennas with high EIRP and ultra-low sidelobes in hangar on Global Hawk and in range
- Flight test to demonstrate 20 dB reduction in antenna sidelobes
- Transition to follow-on project

