ARMD Transformative Aeronautics Concepts Program

CONVERGENT AERONAUTICS SOLUTIONS PROJECT

CLAS-ACT: Conformal, Lightweight Antennas for Aeronautical Communications Technology

CAS Showcase

November 13, 2019

UAS Need for BLOS* Coverage

UAS currently using BLOS

Global Hawk/Northrop Grumman

MQ9 Predator/General Atomics

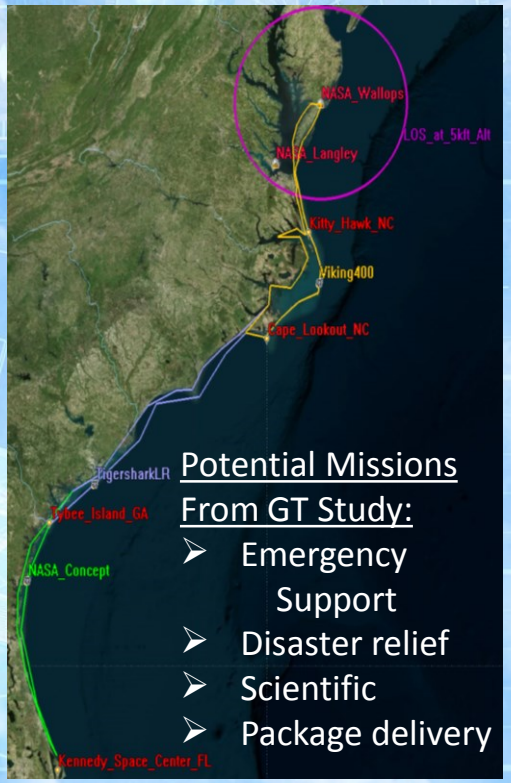
UAS to benefit from BLOS

L3 Viking 400

Navmar Tigershark XP

U.S. Navy/ NASA SIERRA

L3Harris HQ-90

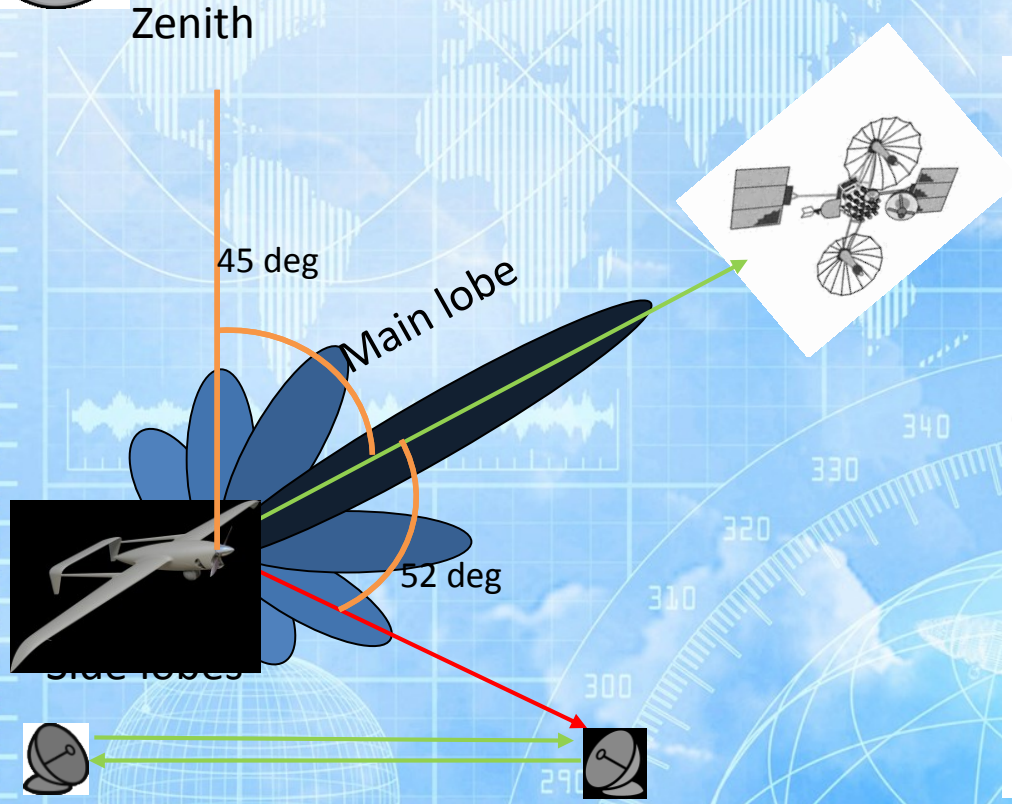


Potential Missions From GT Study:

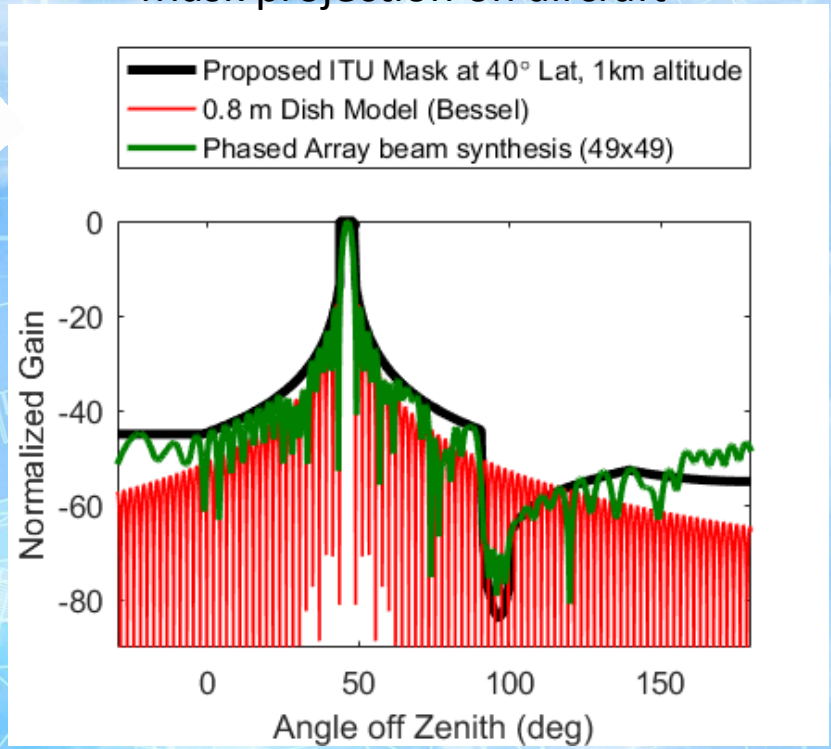
- Emergency Support
- Disaster relief
- Scientific
- Package delivery

Beyond Line of Sight (BLOS)

Problem with Wide Spread BLOS on UAS



Mask projection on aircraft



The ITU has identified an interference issue with the provisional UAS frequency allocation while using a standard antenna

Why phased arrays and why now

Traditional Reflector Antenna

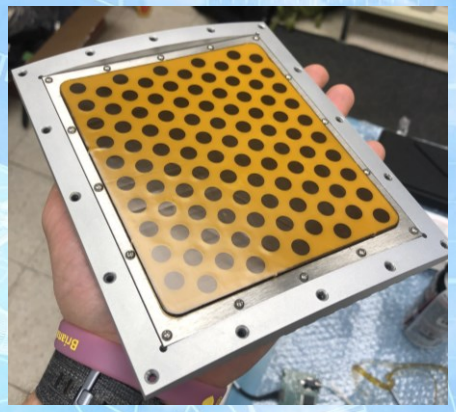
- *High performance*
- Large volume
- Heavy Mechanical gimbal
- Fixed Radiation Pattern

Traditional Phased Array

- *High performance*
- Large mass/volume (7.5 lbs)
- *Electronic steering*
- *Flexible Radiation Pattern*
- High cost, long lead (custom IC's)

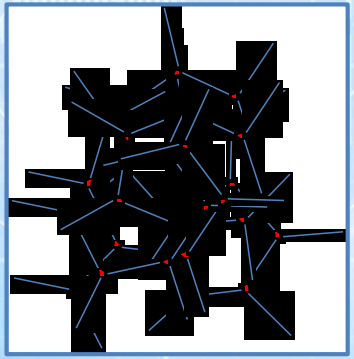
Phased Array with Silicon IC's

- *High performance*
- *Low mass/volume (1 lb)*
- *Electronic steering*
- *Flexible Radiation Pattern*
- *Lower cost, lead time (COTS IC's)*

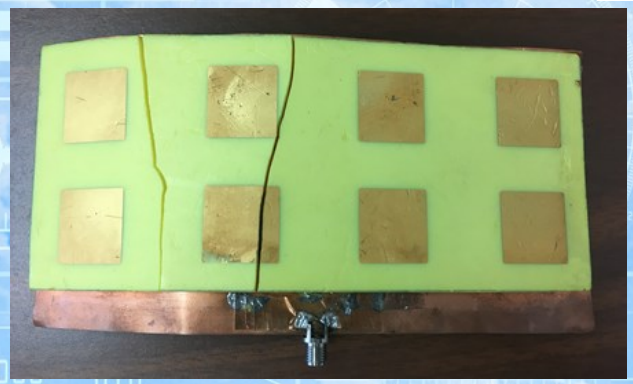


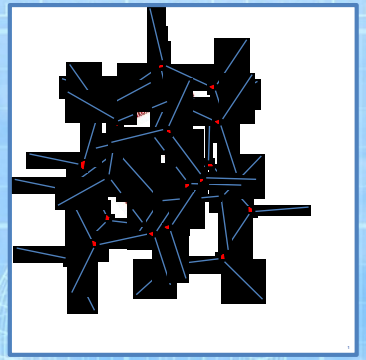
Phased Arrays enable pattern re-optimization and are now a viable low SWaP solution

Building from Existing Aerogel Antennas

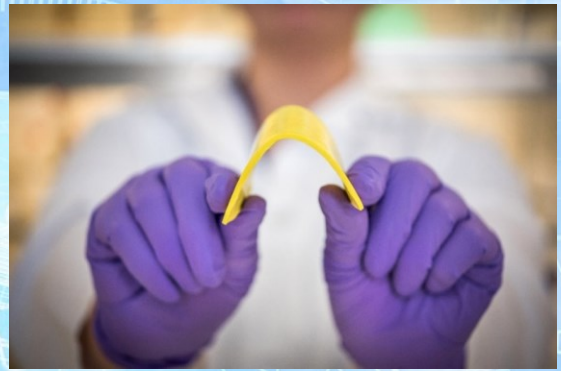


2015 Aerogel with rigid polymer backbone





New Aerogel with flexible polymer backbone



Aerogel is 77% lower in density vs conventional material

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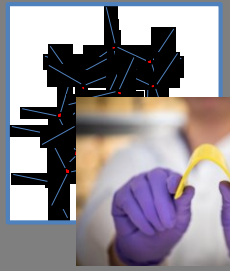

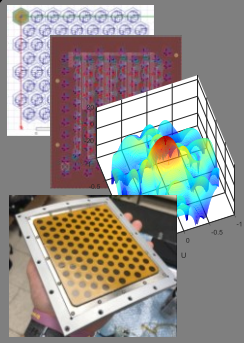

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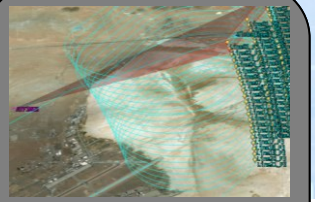

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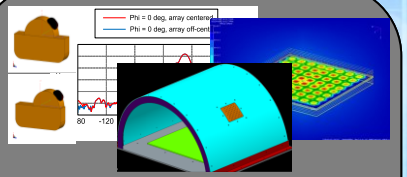

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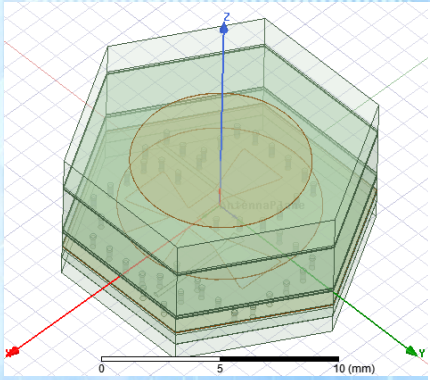
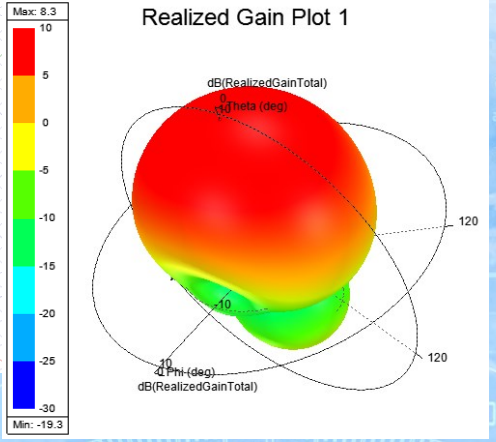
CLAS-ACT Team

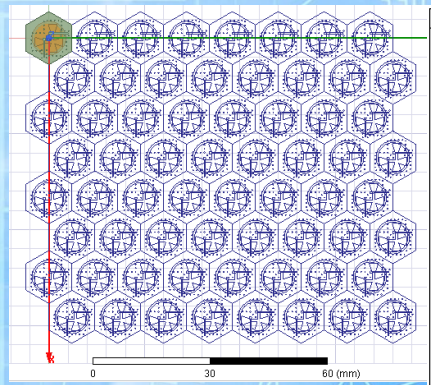
Antenna Design

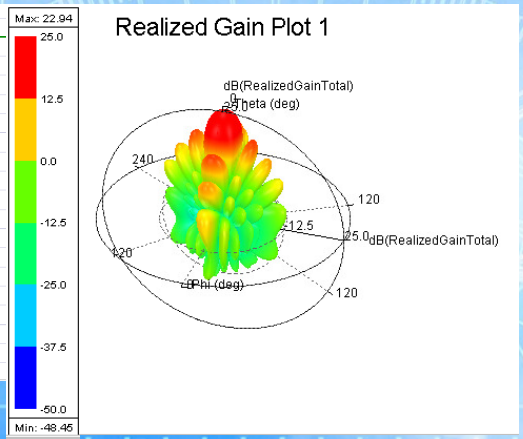
Standard PCB .056”

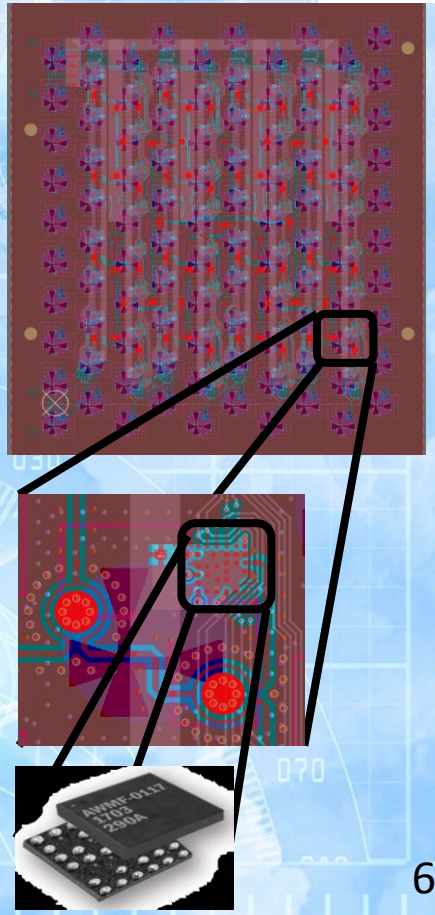
Aerogel Stack .147”



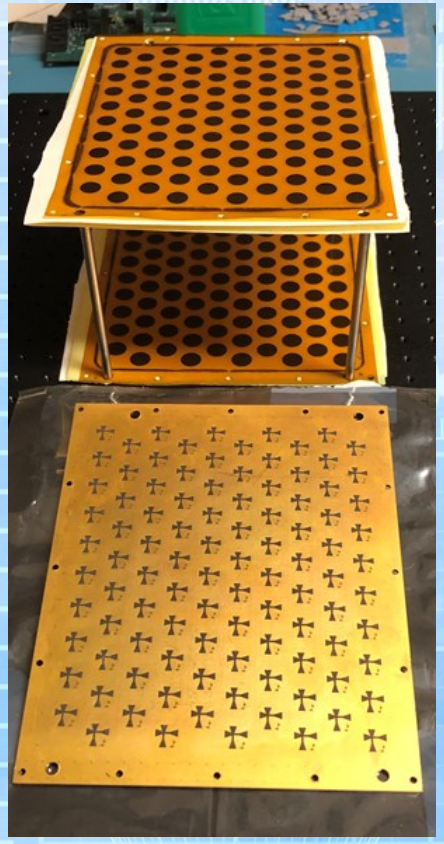


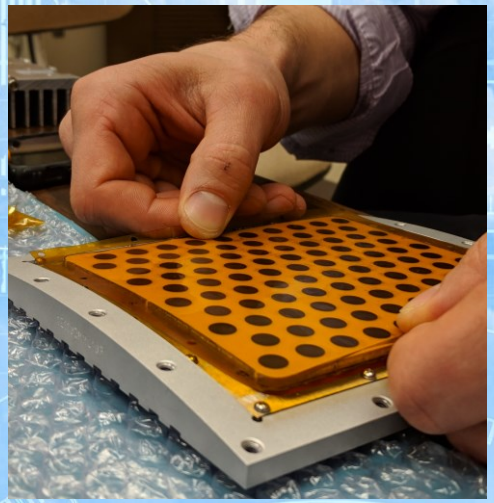


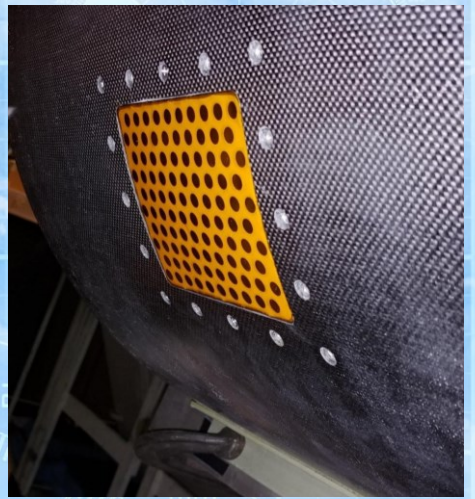




Fabrication Process

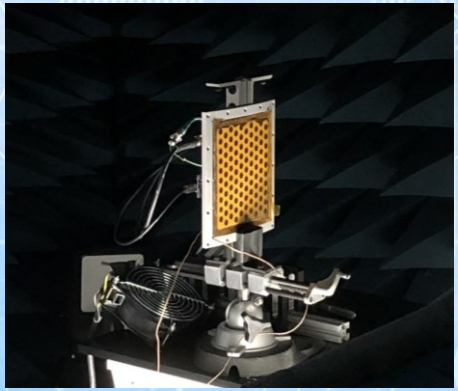




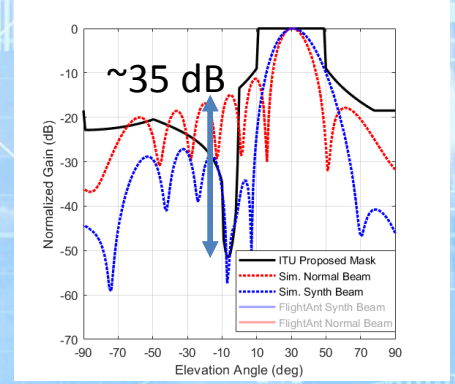


Interference Mitigation Lab Demonstration

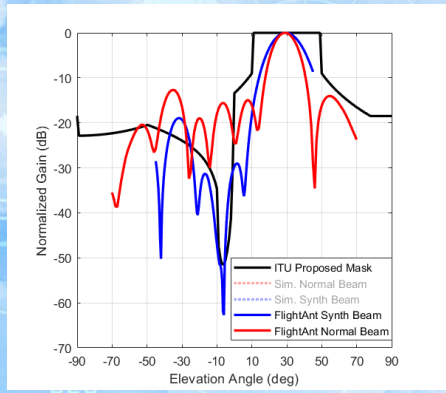
GRC Far-Field Antenna Range



Beam Synthesis Simulation

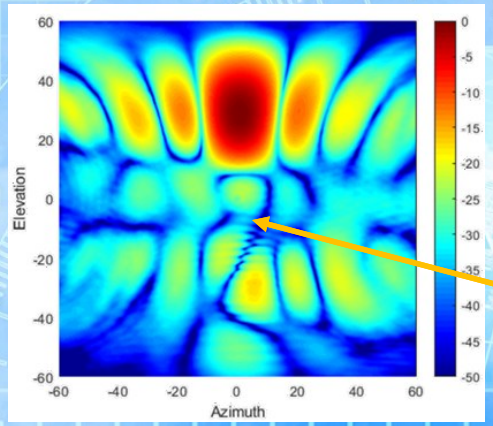


Far Field Range Cut

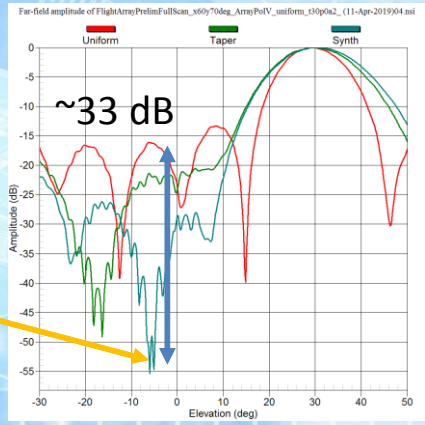


GRC Near-Field Antenna Range

Near-Field Range Pattern



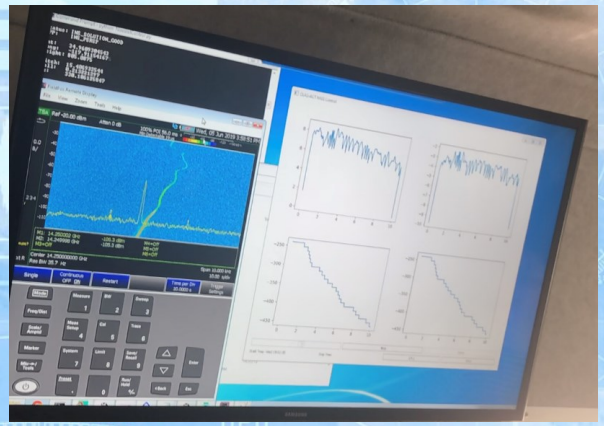
Near-Field Range Cut

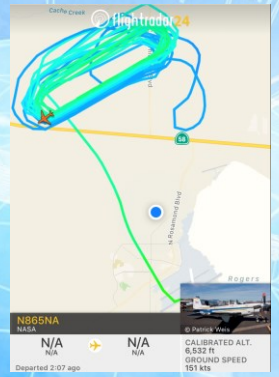


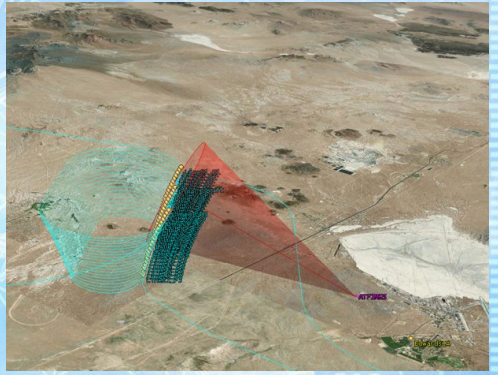
Antenna Hanger Testing

The Portable Laser Guided Robotic Metrology system (PLGRM) can be deployed in an aircraft hanger for pre flight characterization

Flight Testing

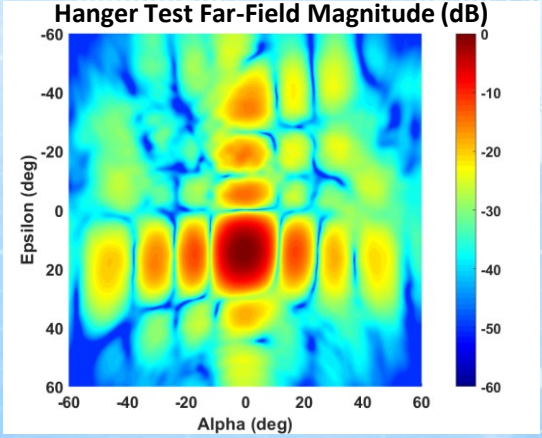


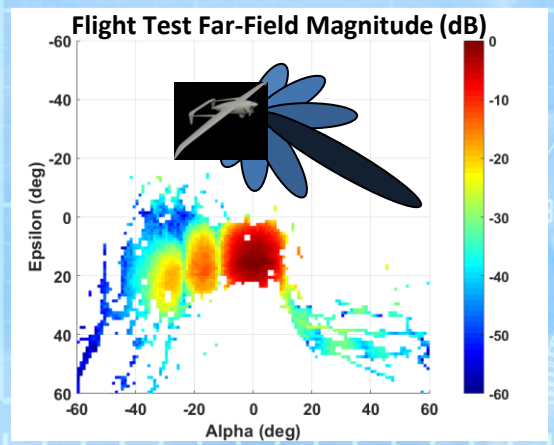




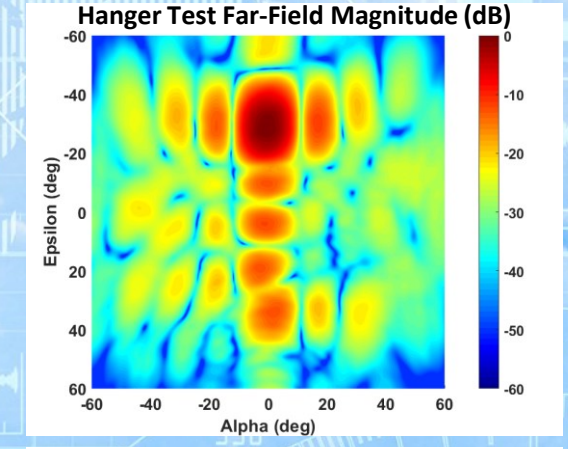
Hanger/Flight Testing Results

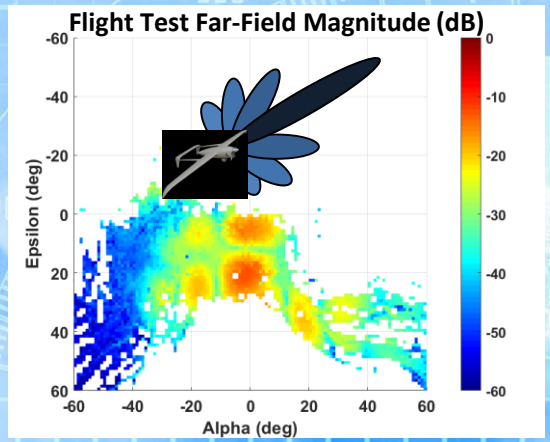
Main beam steered down



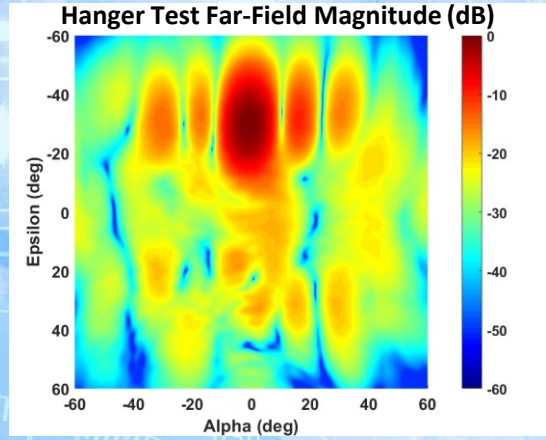


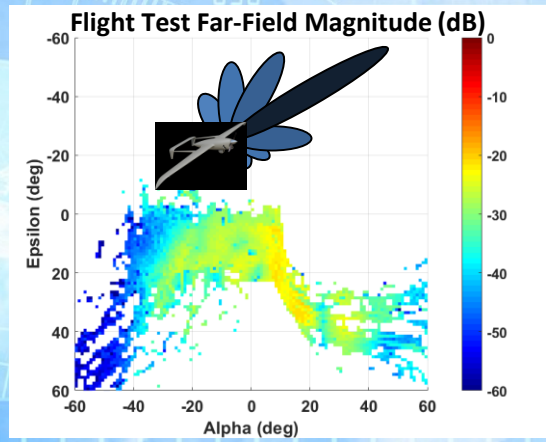
Main beam steered up



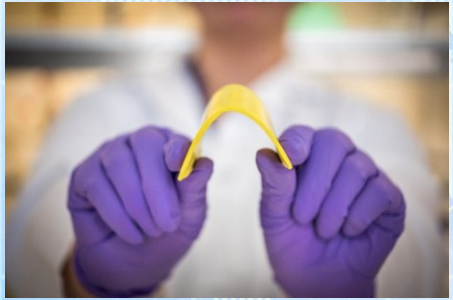


Beam Synthesis steered up



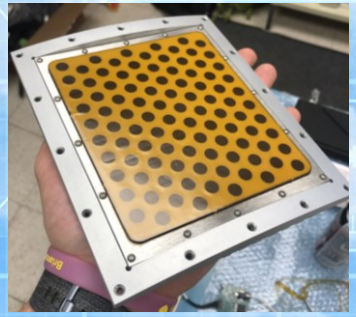


Activity Summary



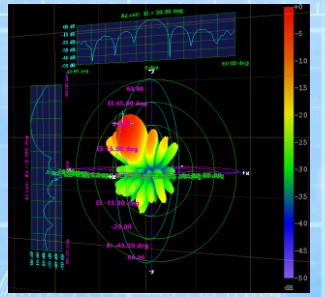
Developed new flexible aerogel material

New COTS silicon RF IC's



Developed a low profile Ku-band phased array antenna

- Reduced mass
- Increased RF performance
- Reduced manufacturing challenges



Demonstrated interference mitigation in antenna ranges

Developed in situ antenna characterization system

Integrated low profile antenna onto T-34C

Concept to Flight in 2.5 Years

UAM's BIG problem: Interference

UAM will Increase Users

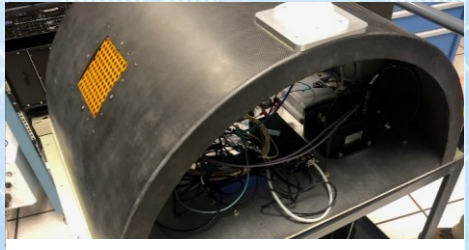
- More Users = More Interference

Interference Lowers Reliability and Security

- Denial of service
- Increased Latency
- Spoofing

Interference mitigation **enables** reliable and secure communication

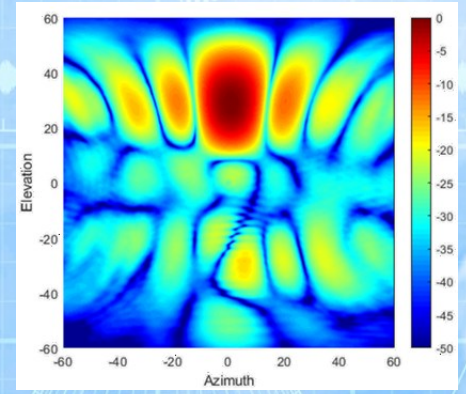
Performance on various structures

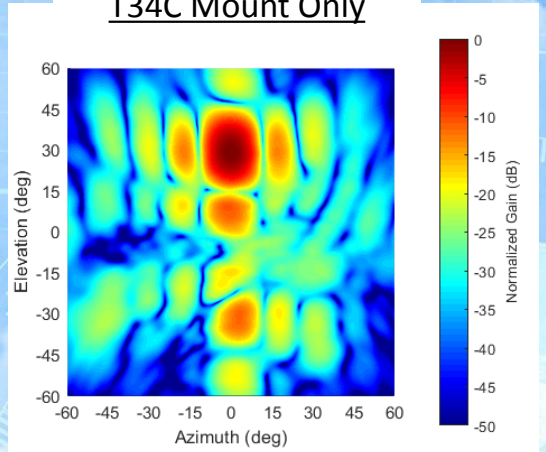


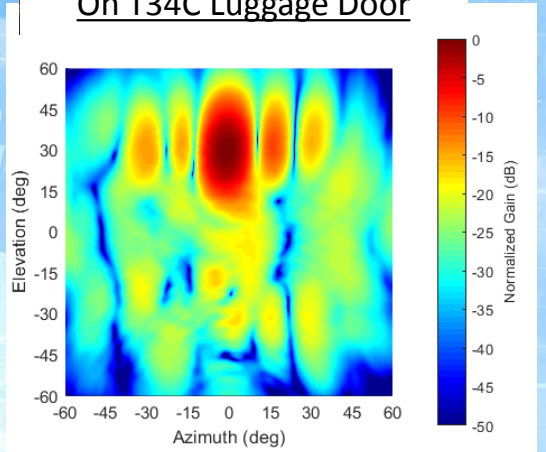
Global Hawk/Ikhana

T34C Mount Only

On T34C Luggage Door







Low SWaP Phased Array antennas can enable BLOS operation of small UAS. This technology can be used to re optimized antenna performance for interference mitigation on a variety of current and future vehicles

Questions?