CONVERGENT AERONAUTICS SOLUTIONS PROJECT

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

CAS Showcase
November 13, 2019
UAS Need for BLOS* Coverage

**Potential Missions**

- Emergency Support
- Disaster relief
- Scientific
- Package delivery

**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

*Beyond Line of Sight (BLOS)*

---

**Potential Missions From GT Study:**

- Emergency Support
- Disaster relief
- Scientific
- Package delivery
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
CLAS-ACT Team

Mary Ann Meador
Baochau Nguyen
Stephanie Vivod
Haiquan Guo
Jessica Cashman
Rocco Viggiano

James Downey
Bryan Schoenholz
Marie Piasecki
Bushara Dosa
Peter Slater
Seth Waldstein
Dan Oldham
Dale Force

Rick Alena
Sasha Weston
Needa Lin

Andy Gutierrez
Patricia Ortiz
Ricardo Arteaga
Kelly Snapp
Thomas Matthews
Mirela Isic
Debra Randall

Scott Kenner
Ray Rhew
Mark Cagle
Jeremy Smith
Anne Mackenzie

Scott Howe
Marc Nicholson
Greg Strombo
Ben Pearsen
Dale Hogg
Antenna Design

- Standard PCB .056"
- Aerogel Stack .147"
Fabrication Process
Interference Mitigation Lab Demonstration

GRC Far-Field Antenna Range

GRC Near-Field Antenna Range

Beam Synthesis Simulation

~35 dB

Far Field Range Cut

Near-Field Range Pattern

~33 dB

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 a low profile Ku-band phased array antenna
- New COTS silicon RF IC's
- Developed in situ antenna characterization system
- Integrated low profile antenna onto T-34C

- Reduced mass
- Increased RF performance
- Reduced manufacturing challenges

- Developed new flexible aerogel material
- Demonstrated interference mitigation in antenna ranges

Concept to Flight in 2.5 Years
UAM’s BIG problem: Interference

Interference mitigation enables reliable and secure communication.

UAM will Increase Users
- More Users = More Interference

Interference Lowers Reliability and Security
- Denial of service
- Increased Latency
- Spoofing
Performance on various structures

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