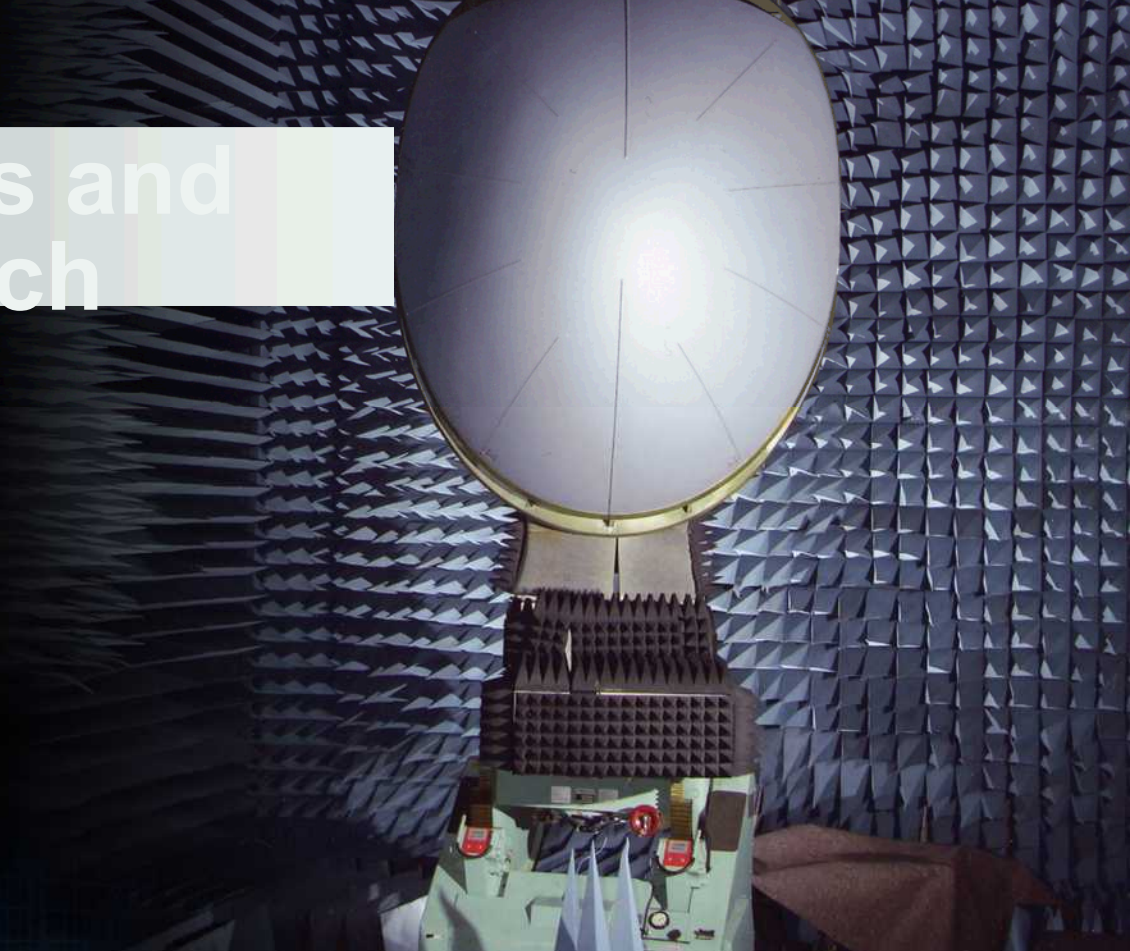


Electromagnetics and Sensors Branch

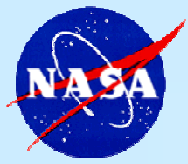
2013 Peer Review

August 26-29, 2013



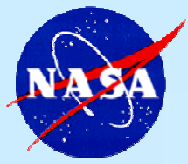
Erik Vedeler

Head, Electromagnetics and Sensors Branch



Location



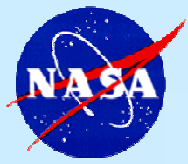


Measurement Sciences Lab

Electromagnetics and Sensors Branch



- Future Branch Location
- Design Contract Underway
- Construction Contract FY15



Workforce Allocation on Programs

Electromagnetics and Sensors Branch

■ Aeronautics

Aviation Safety Program

- Atmospheric Environment 15.7
- Vehicle System 1.8

Fundamental Aeronautics Program

- Advanced Aircraft 2.5
- Active Liner 0.5

■ Science and Exploration

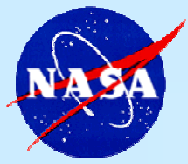
High Spectral Resolution Lidar (Science) 2

Lightweight Surface Manipulator (Exploration) 2

Metamaterials (IRAD) 2

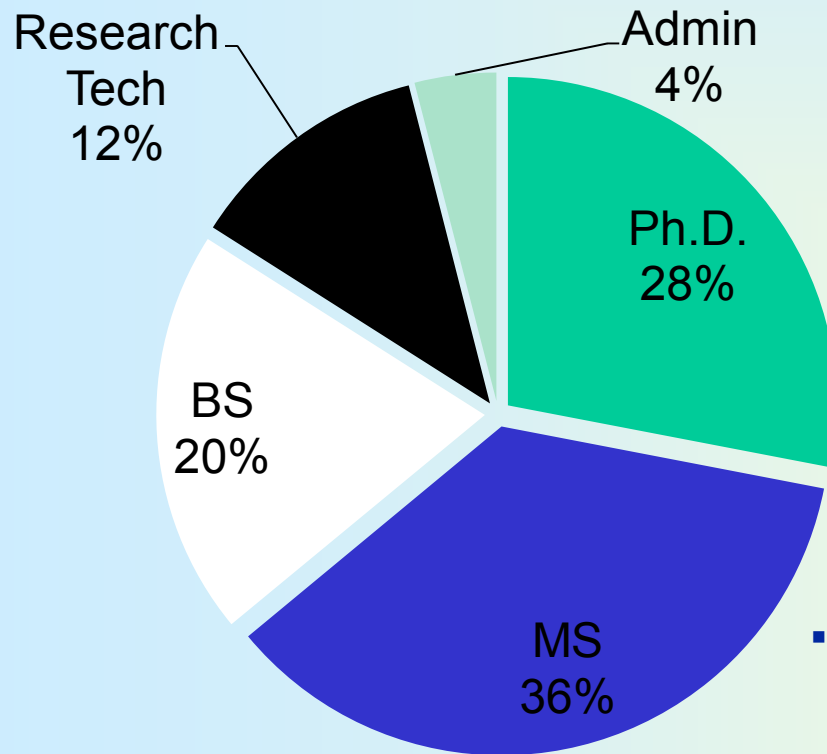
Complexity / Autonomy and Signals of Opportunity 0.5



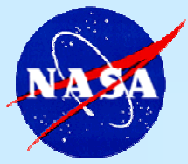


Branch People

- **25 Civil Servants**
- **6 full time and 1 part time on site contractors**



- **Since last Peer Review**
 - One Ph.D. completion
 - One Ph.D. New Civil Service Hire
- **Distinguished Research Associates**
 - Dr. Carl (Lin) Fales
 - Dr. Steve Katzberg (University of South Carolina)
 - Gale Wilson



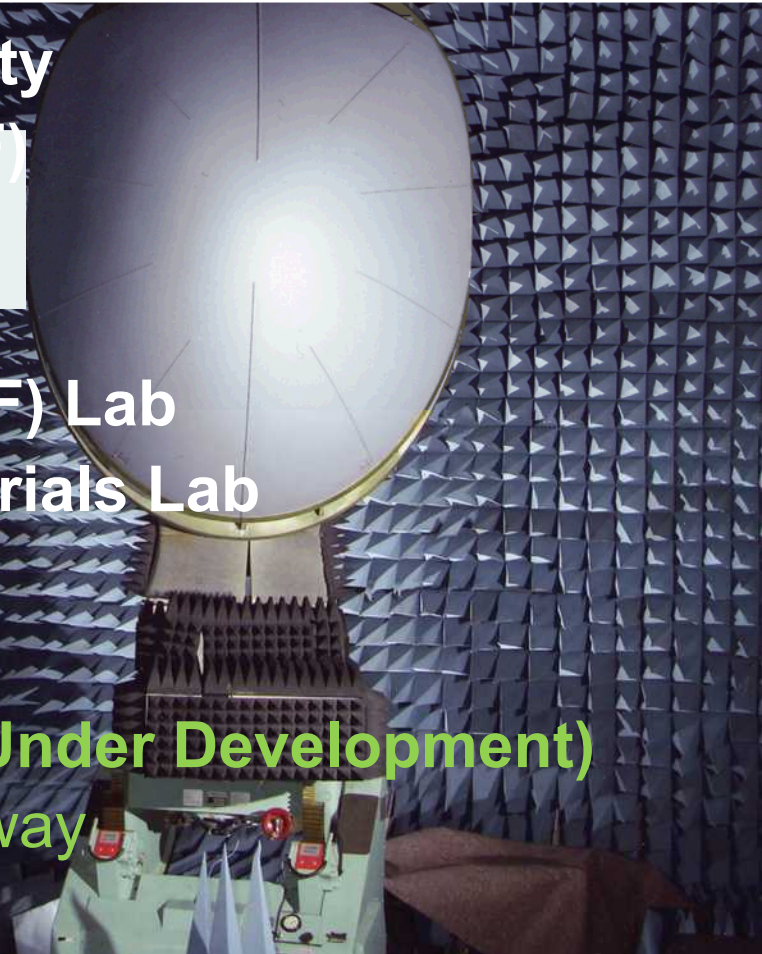
Students

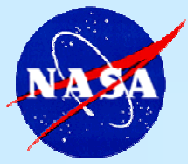
- **Duncan McGillivray – Microwave Metamaterials, University of Virginia Ph.D. Candidate**
- **Matt Schubert – Image Enhancement, Christopher Newport University**
- **Tim Dugan – Image Enhancement, Old Dominion University**
- **Shane Seaman – Optics / Materials Science, Virginia Tech**

- **Other Student Programs:**
 - Governor's School for Science and Technology
 - LARSS
 - Old Dominion University (SAA)
 - Pathways (Co-op)

Laboratory Facilities

- **Low Frequency Antenna Test Facility**
- **Compact Range Test Facility (CRTF)**
- **Smart Visual Awareness (SVA) Lab**
- **Laser Photonics Lab**
- **High Intensity Radiated Fields (HIRF) Lab**
- **Electromagnetic Properties of Materials Lab**
- **Mobile Sensors Van**
- **Experimental Test Range (ETR) (Under Development)**
 - Positioning System contract underway

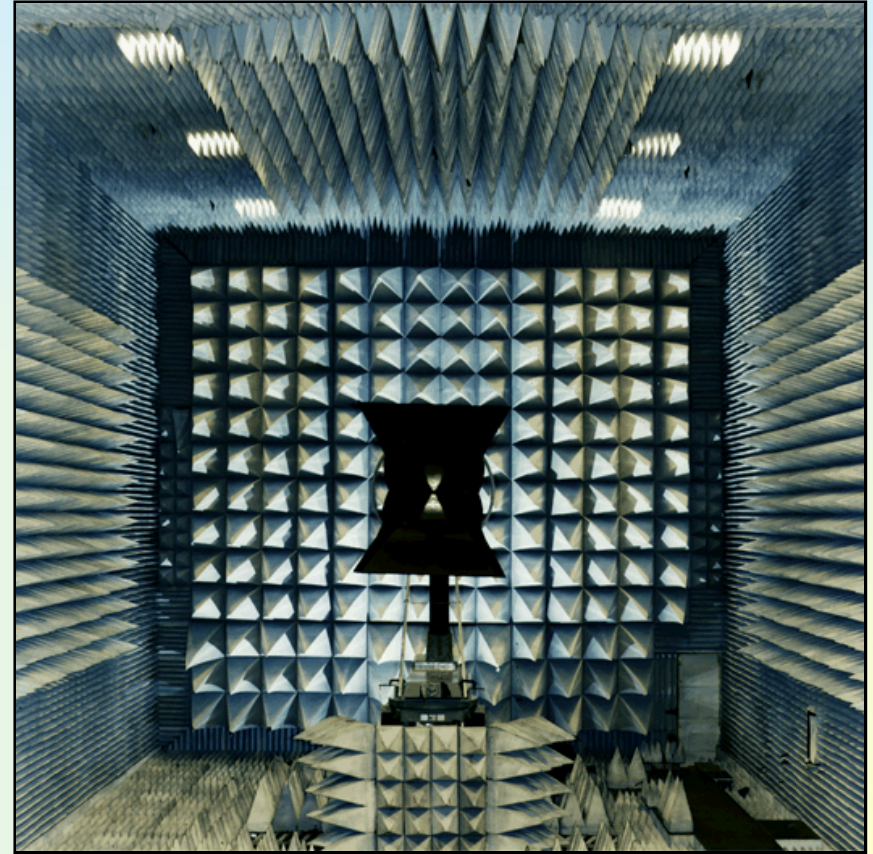


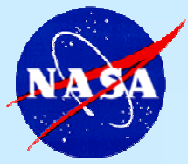


Low Frequency Antenna Test Facility

Electromagnetics and Sensors Branch

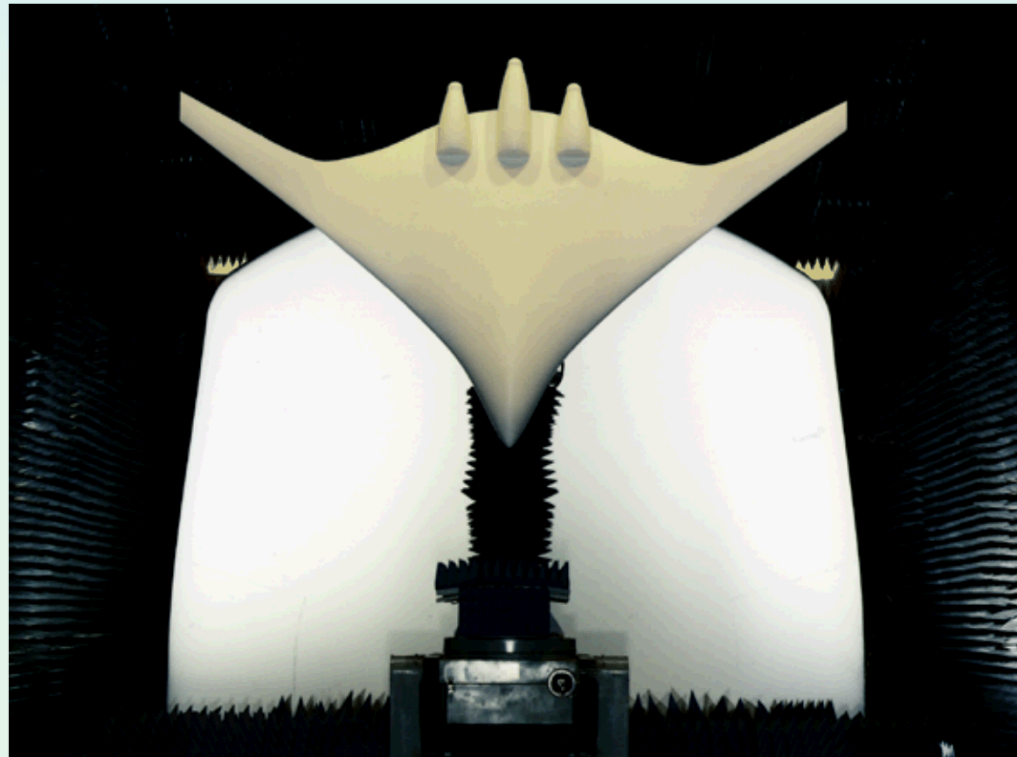
- Tapered far field anechoic range 30'x32'x105'
- Frequency: 200MHz – 18GHz and Ka Band (26.5GHz – 40GHz)
- Test zone: 6' - 12' diameter depending on frequency
- Model tower weight limit 500lbs
- Agilent Precision Network Analyzer 8362B
 - H11 option external remote mixer
 - High dynamic range up to >80dB
 - 014 front panel configurable

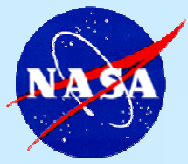




Compact Range Test Facility

- Electromagnetic scattering and antenna performance measurements
- Frequency: 500MHz – 40GHz
- Pulsed CW radar
- Anechoic chamber dimension 30'h x 28'w x 65'l
- Test zone: 4'h x 8'w x 8'l
- Model weight limit 500lbs





Visual Information Processing Lab

- Optical and IR enhanced imaging
 - Patented Retinex software
 - Multi sensor fusion
 - Generic Visual Pattern Recognition
-
- Real time DSP processing for flight deck vision
 - Low cost GA applications

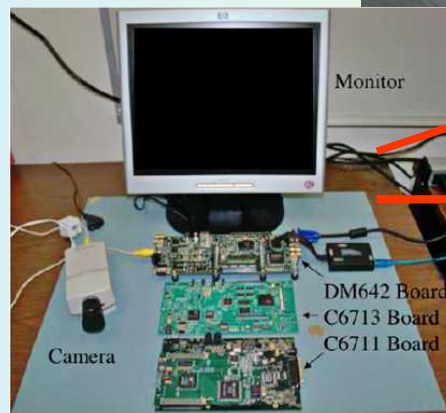


Original

Processed

Contact: Andrew Moore
757-864-6556
andrew.j.moore@nasa.gov

<http://dragon.larc.nasa.gov>



Monitor

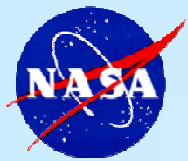
Camera

DM642 Board

C6713 Board

C6711 Board





Laser Photonics Lab

- Advanced Photonics and Lidar fabrication and testing
- High Spectral Resolution Laser (HSRL) development
- Aerosol / atmospheric particle density detection
- 4 full sized optical tables
- 1 nW – 10's W Power (μJ – J)
- Absolute wavelength down to 0.01 pM
- Linewidth to 10kHz
- Modulation bandwidth up to 20GHz
- 532nm – 2000nm lasers
- Component and Instrument testing



High Intensity Radiated Fields (HIRF) Laboratory

- 3 EM Reverberation Chambers
- 80MHz – 40GHz
- 4kW peak power 10KHz – 400MHz
- 1.5 - 2kW peak power 400MHz – 18GHz
 - Field Uniformity of +/- 2 dB
 - 120 dB shielding
- Lightning and Impulse generators
- TEM cells

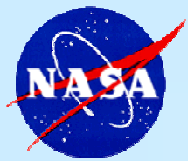
Chamber A

<u>Chmbr</u>	<u>Length (ft.)</u>	<u>Width (ft.)</u>	<u>Height (ft.)</u>	<u>Lowest Usable Frequency (MHz)</u>
A	47	23	9.5	80
B	23	13	9.5	150
C	9	7	9.5	250

Contact: Sandra Koppen

757-864-6209

sandra.v.koppen@nasa.gov



Electromagnetic Properties of Materials Lab (EPML)

Electromagnetics and Sensors Branch

- 2 Agilent PNA Network Analyzers
- 1 – 18GHz waveguide sample holder coverage
- Free space measurements for large samples
- Some UHF capability
- Ka 26.5 – 40 GHz and W band 75 – 90 GHz upconversion
- Specialized advanced techniques for thin films

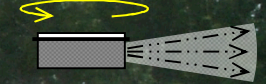


ESB Mobile R&D Laboratory

Meets All FAA Requirements to Operate on Airport Surfaces
(Taxiing Aircraft)

Advanced
Research
Radar

FLIR/CCD



Fiberglass Body Creates Low RCS - Approximates Small Aircraft

GPS

ADS-B

TCAS

Mini-ASR

Mini-WX
Station



Climate Control
(temp & humidity)

Aircraft Data Buses (ARINC 429)

High Speed / High Capacity Data Acquisition, Processing, & Storage

© DC/60/400 Hz
2x 100A

Image
Enhance
& Fusion

Head Up/Down
Displays

UHF/VHF
Comm

Electronic
Taxi Maps



Avionics Hardware/Software Research & Development

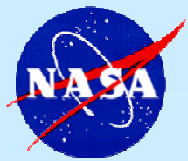
All Aspects – Sensors/DataAcq/Displays

Severe WX/Turbulence/WindShear & Air/Gnd-Traffic Surveillance & LoVis Ops (Air/Surf)

Contact: Steve Harrah

757-864-1805

steven.harrah-1@nasa.gov



Computational Electromagnetics

Microwave / RF Applications:

Analysis and Design synthesis of Antennas

Input impedance and Radiation Patterns

Radar Cross Section Prediction

Finite Element (FEM)

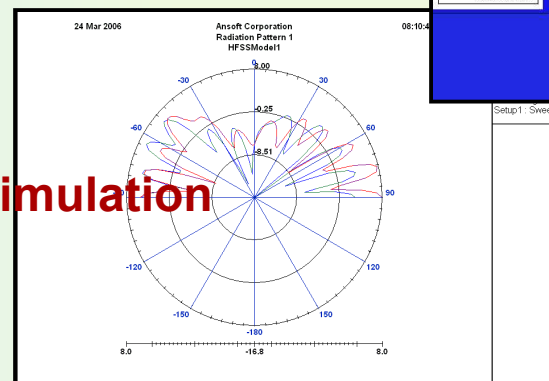
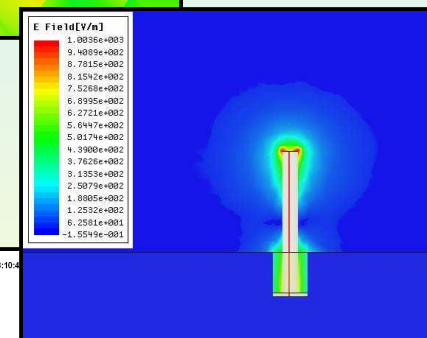
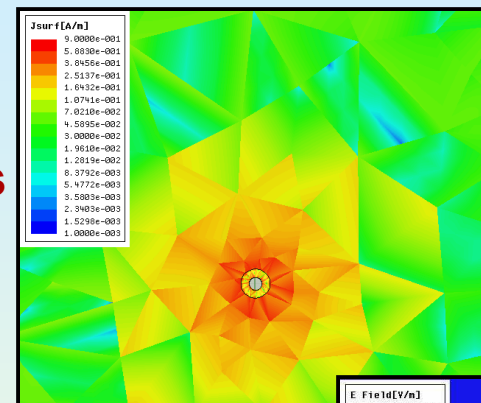
Microwave Devices and Materials

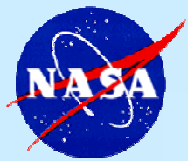
Method of Moments (MoM) and Hybrid techniques

Lidar Applications:

Atmospheric Propagation and Optics Simulation

Controller / Electronics Design





Computational Electromagnetics

Commercial Off the Shelf Codes:

Microwave Studio (CST)

Finite Difference Time Domain (FDTD)

HFSS (Ansoft)

Finite Element (FEM)

FEKO (EMSS)

Method of Moments (MoM) and Hybrid techniques

LabView (general sensors simulation and control)

MatLab (general sensors simulation)

COMSOL (finite element physics simulation)

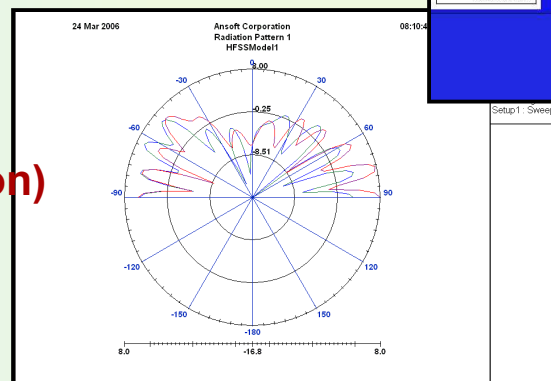
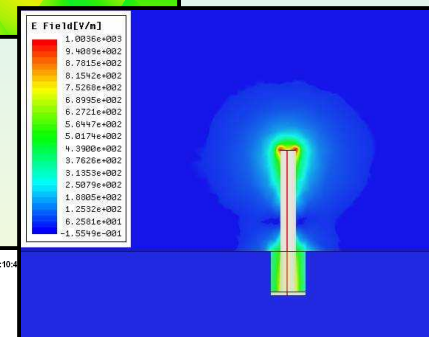
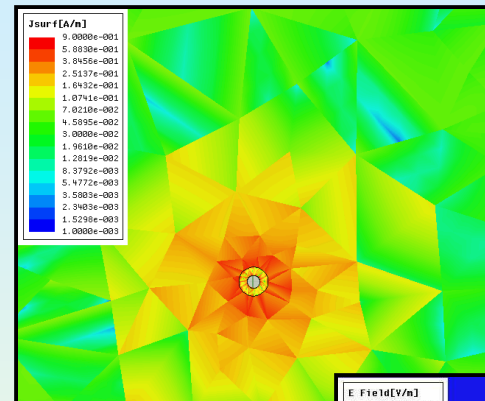
Zemax (optics simulation)

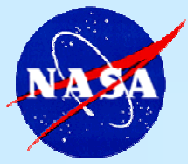
ModTran (atmospheric propagation simulation)

In-house codes:

Various MoM, FEM & high frequency and hybrid codes

Contact: Anne Mackenzie, Robin Cravey and Ivan Clark





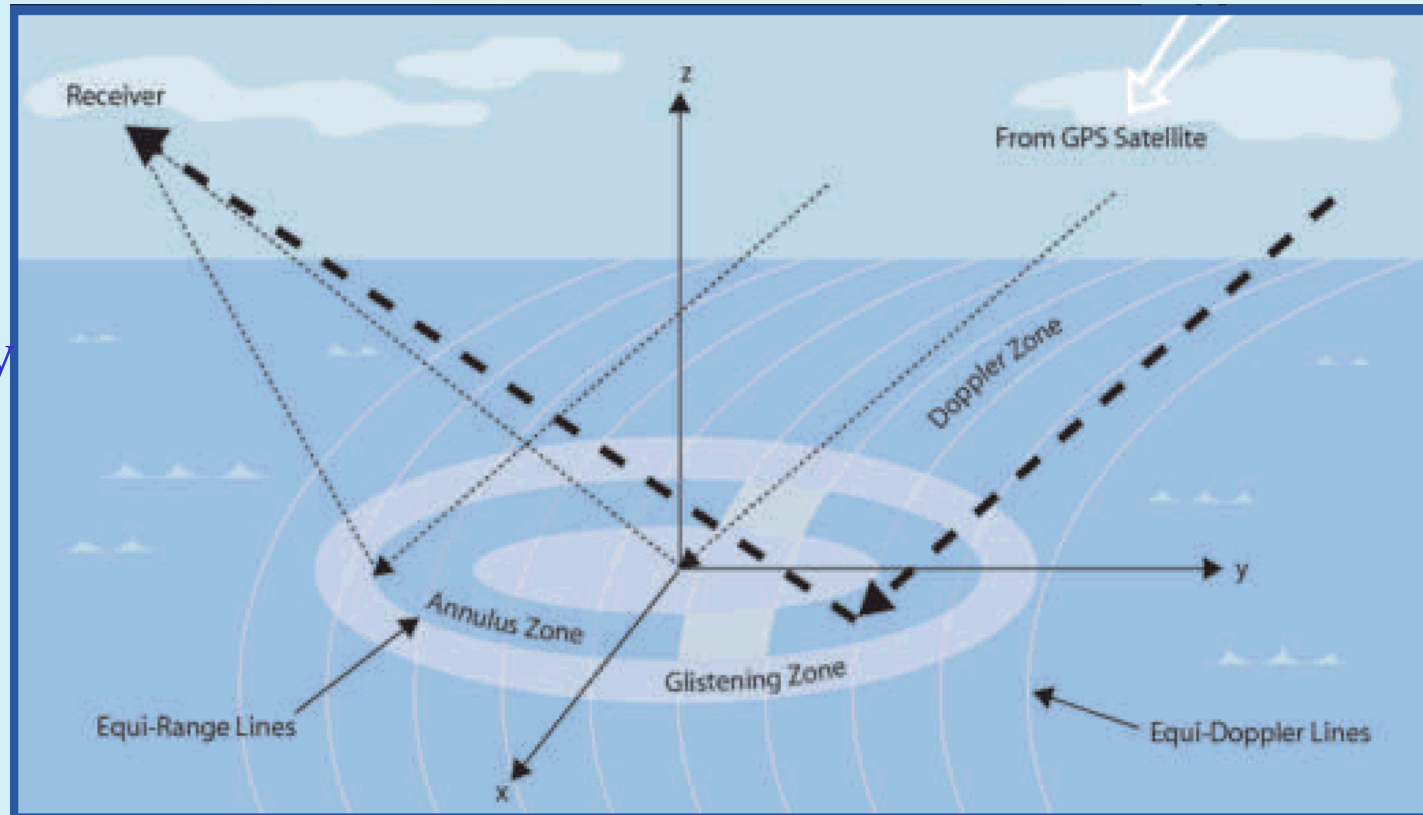
Signals of Opportunity

Utilization of human engineered
radio signals for earth surface
state research

Source Examples: GPS,
Direct Broadcast Satellite,

Research
Examples:

- Ocean surface
winds and salinity
- Soil moisture
- Soil chemistry





Publications

Information since the last ESB Peer Review in 2009

- Peer Reviewed Journal Articles

- 11
- # Citations: 261

- Conference Presentations

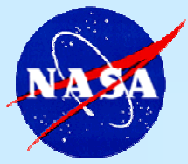
- 64
- # Citations: 42

- NASA Technical Memos

- 6
- # Citations: 28

- 2012 HJE Reid Award for Best Paper at Langley Research Center

“Airborne High Spectral Resolution Lidar for Profiling Aerosol Optical Properties”
Anthony Cook, Terry Mack et.al.



Publications cont.

Information since the last ESB Peer Review in 2009

- **Ph.D. Dissertation:**

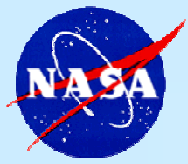
Daniels, T. S., (May, 2012), “The Analysis of An Imaging Passive Infrared Fourier Transform Spectrometer For Airborne Detection of Wake Vortices”, Ph. D. Dissertation, Hampton University, Advisor: Dr. William Smith.

- **Technical Committee Memberships**

Radio Technical Committee of America (RTCA) - Special Committee SC-206

SAE AE-2 Lightning Committee

American Meteorological Society (AMS) - Committee on Aviation, Range and Aerospace Meteorology (ARAM)



Patents

Information since the last ESB Peer Review in 2009

•Patents Awarded

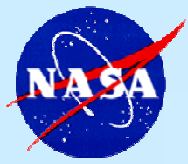
- Smart Image Enhancement Process (methods) #8,111,943 Dan Jobson; Glenn Woodell; Zia ur-Rahman;
- Method of Adjusting Acoustic Impedances for Impedance-Tunable Acoustic Segments #8,111,832
Kennie Jones et.al.
- Antenna with Dielectric Having Geometries #8,508,413 Ken Dudley; Holly Elliott; Robin Cravey; et.al.

•NASA Inventors Award Board

- Tailorable Dielectric Material with Complex Permittivity Characteristics #LAR-17427-1 Ken Dudley;
Holly Elliott; et.al.

•Patents Pending / Invention Disclosures

- Visual Alphabet (methods) LAR-18244-1 Dan Jobson; Glenn Woodell; Zia ur-Rahman;
- A Multifunctional Lightning Protection and Detection System for Aerospace Vehicles LAR-18037-1
Ken Dudley; George Szatkowski; Sandra Koppen; Truong Nguyen; Jay Ely; Chuantong Wang; John Mielnik; et. al.



Awards

- R&D 100 Award “*Oscars of Innovation*”
 - 2009 SansEC Sensor for fluid level Chuantong Wang et.al.
- Space Act Award (2012)
 - Smart Image Enhancement Process #8,111,943 Dan Jobson; Glenn Woodell; Zia ur-Rahman;
- NASA Honor Awards and Medals
 - Exceptional Engineering Achievement Tony Cook 2011
 - Toyota Unintended Acceleration Assessment Team Omar Torres et.al. 2011