



Airborne Systems Competency Overview

April 2004

NASA's Vision

To improve life here,
To extend life to there,
To find life beyond.

NASA's Mission

To understand and protect our home planet
To explore the Universe and search for life
To inspire the next generation of explorers
...as only NASA can.



Langley Mission

**In alliance with industry, other agencies, academia,
and the atmospheric research community,
in the areas of aerospace vehicles,
aerospace systems analysis and atmospheric science
we undertake innovative, high-payoff activities
beyond the risk limit or capability of commercial enterprises
and deliver validated technology, scientific knowledge
and an understanding of the Earth's atmosphere**



***Our success is measured by the extent
to which our research results improve the quality of life***

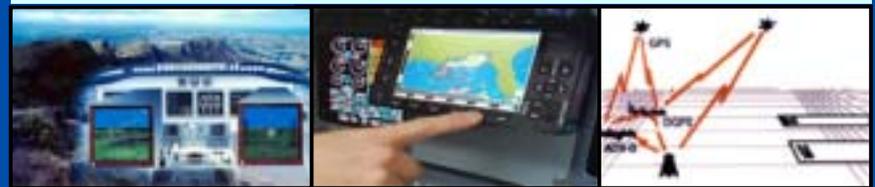
Areas of Expertise (AoE's)

Flight Dynamics, Guidance & Control



- Stability and Control Characteristics
- Control Concepts and Requirements
- Mathematical Modeling and System ID
- Guidance & Control Law Design

Crew Systems and Aviation Operations



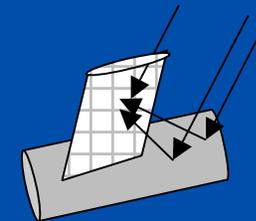
- Integrated Flight Deck Systems (terrain, traffic, WX)
- Aircraft Self-Separation and Distributed ATM
- Atmospheric Hazard Awareness and Avoidance
- Human-Centered Design

Reliable Digital Systems



- Design Integrity and Fault Tolerance
- Formal Methods
- Real-Time Upset

Electromagnetics



- Antennas and Sensors
- Radar Cross Section
- High Intensity Radiated Fields



Airborne Systems Competency

Director – P. Douglas Arbuckle
Deputy Director – Dr. Steven G. Reznick
Assistant Director – David A. Hinton
Assistant Director - Brenton W. Weathered

Crew Systems and Aviation Operations AOE

Projects & Advanced Concepts Branch
John H. Koelling (Head)

Aviation Operations & Evaluation Branch
Lisa O. Rippy (Head)

Crew Systems Branch
Cornelius J. O'Connor (Head)

Guidance and Control AOE

Dynamics & Control Branch
James G. Batterson (Head)

Guidance & Control Branch
Plesent W. Goode (Acting Head)

Flight Dynamics AOE

Vehicle Dynamics Branch
Daniel G. Murri (Head)

Reliable Digital Systems AOE

Assessment Technology Branch
Raymond S. Calloway (Head)

Systems Integration Branch
Plesent W. Goode (Head)

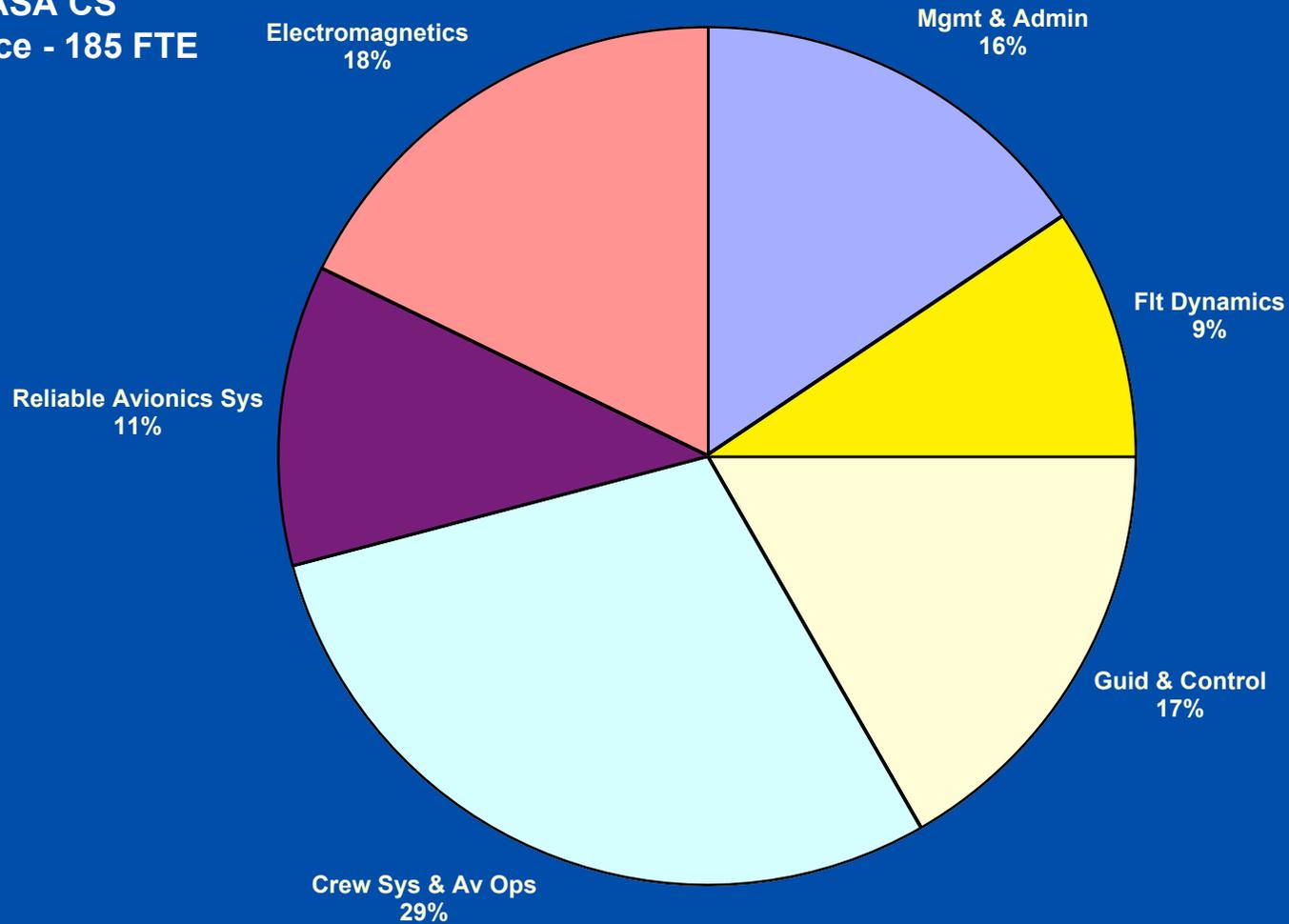
Electromagnetics AOE

Sensors Research Branch
Harry F. Benz (Head)

Electromagnetics Research Branch
Roland W. Lawrence (Head)

FY04 AirSC Workforce by Areas of Expertise

Total NASA CS
workforce - 185 FTE

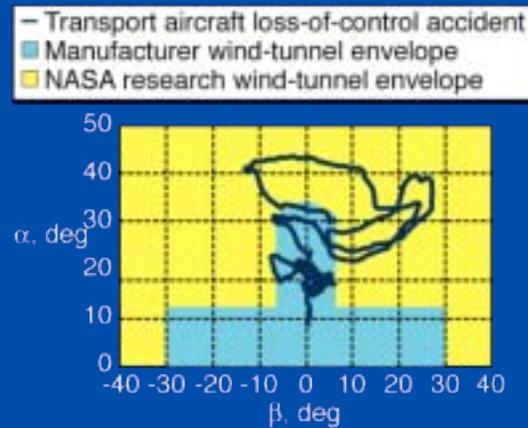


<u>AST's</u>	
PhD	19%
MS	46%
BS	21%



Flight Dynamics AoE

Out of Control Flight Characteristics & Prediction



Planetary Exploration Vehicle Dynamics



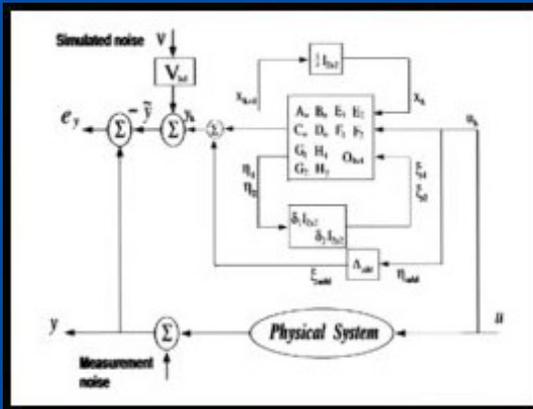
- Static and Dynamic Stability & Control
- Dynamic Modeling and Testing

- Flying and Handling Qualities
- Advanced Control Concepts



Guidance & Control AoE

Robust Theory



Dynamic Aeroelasticity

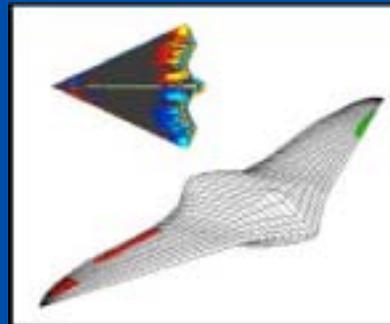


Multidisciplinary Modeling & Analysis

Frequency/Time Dependency



Multidisciplinary Integration



Guidance & Control Theory

Transatmospheric Flight



Controls Allocation/ Reconfiguration



Control Law Design

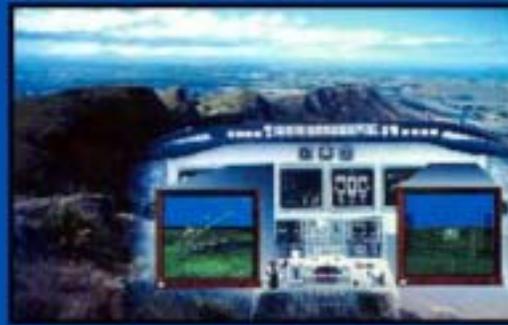


Crew Systems & Aviation Operations AoE

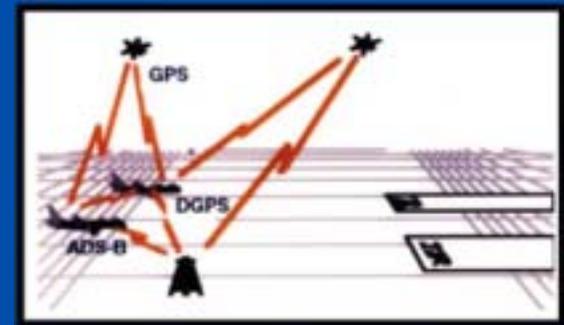
States of Awareness Assessment



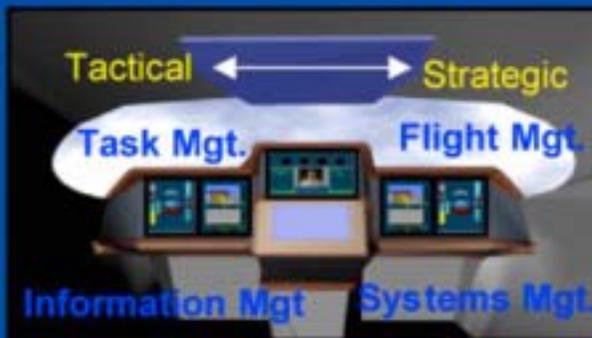
Synthetic Vision



Aircraft Self-Separation



Human-Centered Design



Weather Awareness & Avoidance



Strategic Route Planning



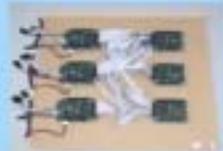
Reliable Digital Systems AoE

Design Integrity

Software Verification



Protocol Verification



Algorithm Verification



Design and Assessment



Laboratory Test Methods for HIRF, Lightning, & Neutrons



Prototype Development



Vehicle Health Management

Airframe Structure & Flight Systems



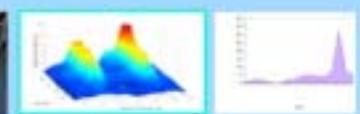
Prototype Development & Integration



Modeling, Estimation, & Dynamic Detection



Intelligent Real-Time Diagnostics & Prognostics



Software Certification



NASA/FAA Partnership



- *Software Verification Tools*
- *Object Oriented Technology in Aviation (OOTiA) Project*

Terrain Data Base Integrity Monitoring

Image Processing Methods



Signal Processing Methods

Compare range to leading edge during scans



Structurally Integrated Avionics

Structural Skin is Dielectric Substrate



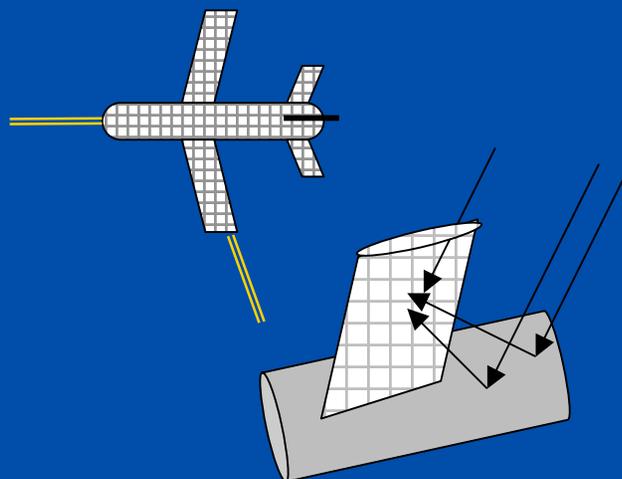
Flexible Multilayer Circuits/Thin Film Electronics



Molecular Electronics



Electromagnetics AoE



- Antennas
- Scattering
- Radar Cross Section (RCS)
- High Intensity Radiated Fields
- Material EM Characteristics

- Antennas Performance
- Scattering Models
- HIRF Analysis
- Hazardous Weather Algorithms
- Enhanced Vision
- Image Enhancement
- Remote Sensing
- Radar Simulation

- Airborne Sensors
 - Doppler Radar
 - LIDAR
 - Infrared Camera
- Spaceborne Sensors
 - Radiometers



Current Growth Areas

- **Flight Dynamics and Guidance & Control AoE's**
 - Multidisciplinary-oriented modeling/control methods and test techniques for nonlinear dynamics, including emerging approaches (neural nets, genetic algorithms, distributed systems)
- **Crew Systems & Aviation Operations AoE**
 - All areas except for Psychophysiological measurements research
- **Reliable Digital Systems AoE**
 - Technologies for developing/verifying highly reliable digital and/or hybrid systems, including software
 - Inexpensive, high performance “avionics-on-chips” components and systems (multidisciplinary with SMC/SEC)
- **Electromagnetics AoE**
 - Electromagnetic Interference and Lightning Effects prediction and measurement methods



Programs or Program Areas by AoE

Flight Dynamics, Guidance & Control



- Aviation Safety & Security
- Vehicle Systems
- Planetary Exploration, Space Access

Crew Systems and Aviation Operations



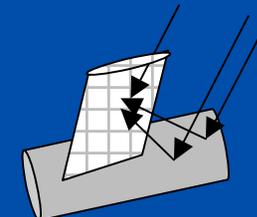
- Aviation Safety & Security
- Airspace Systems
- Vehicle Systems

Reliable Digital Systems



- Aviation Safety & Security, Airspace Systems
- Vehicle Systems
- Planetary Exploration, Space Access

Electromagnetics



- Aviation Safety & Security
- Vehicle Systems (including AAP)
- Planetary Exploration, Atmospheric Sensing

