



**Air Force
Research Laboratory | AFRL**

Science and Technology for Tomorrow's Aerospace Force

OVERVIEW BRIEFING

**Mr. James L. Rudd
Deputy Director**



**AIR VEHICLES
DIRECTORATE**

AFRL/VA



OUTLINE

AIR VEHICLES DIRECTORATE

- **Mission**
- **Vision**
- **Integrating Concepts**
- **Organization**
- **Personnel**
- **Location**
- **Core Competencies**
- **Centers of Excellence**
- **Experimental Facilities**
- **Summary**



MISSION

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Develop and transition superior technology solutions that enable dominant military aerospace vehicles.





VISION

AIR VEHICLES DIRECTORATE



Strike UAV (ACC)



Sustain The Fleet (All)



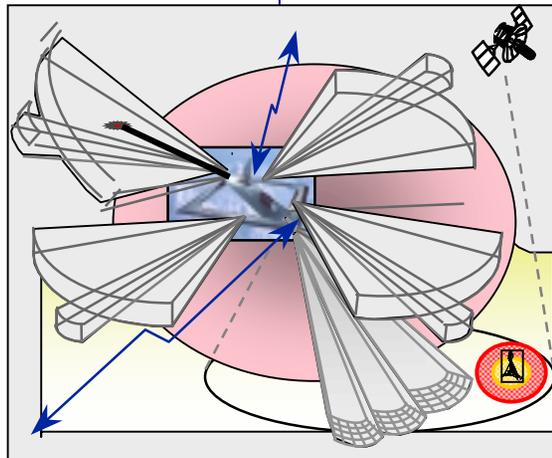
Directed Energy (ACC, AFSOC)



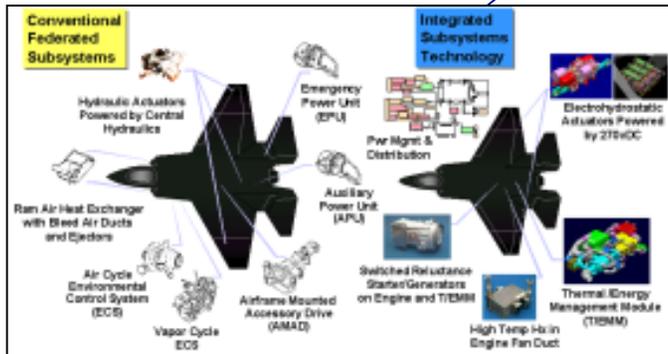
Future Strike Technology (ACC)



Space Operating Vehicle (AFSPC)



ISR Sensor Craft (ACC)



J/IST (ACC)



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S&T Focus: Integrating Concepts

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Sustainment:

Technology insertion to enable today's fleet to meet tomorrow's warfighter needs



Increased mission capable rates
Reduced operation and support costs

Unmanned Air Vehicles:

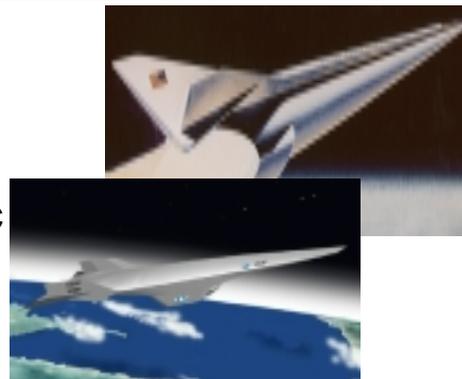
Technologies to enable routine operation of high payoff UAV alternatives across the full spectrum of warfare



Seamless manned / unmanned vehicle operation
Superior mission capability at reduced cost
Intelligent control of UAV swarms

Space Access & Future Strike Technology:

Affordable space access and quick reaction trans-atmospheric capability

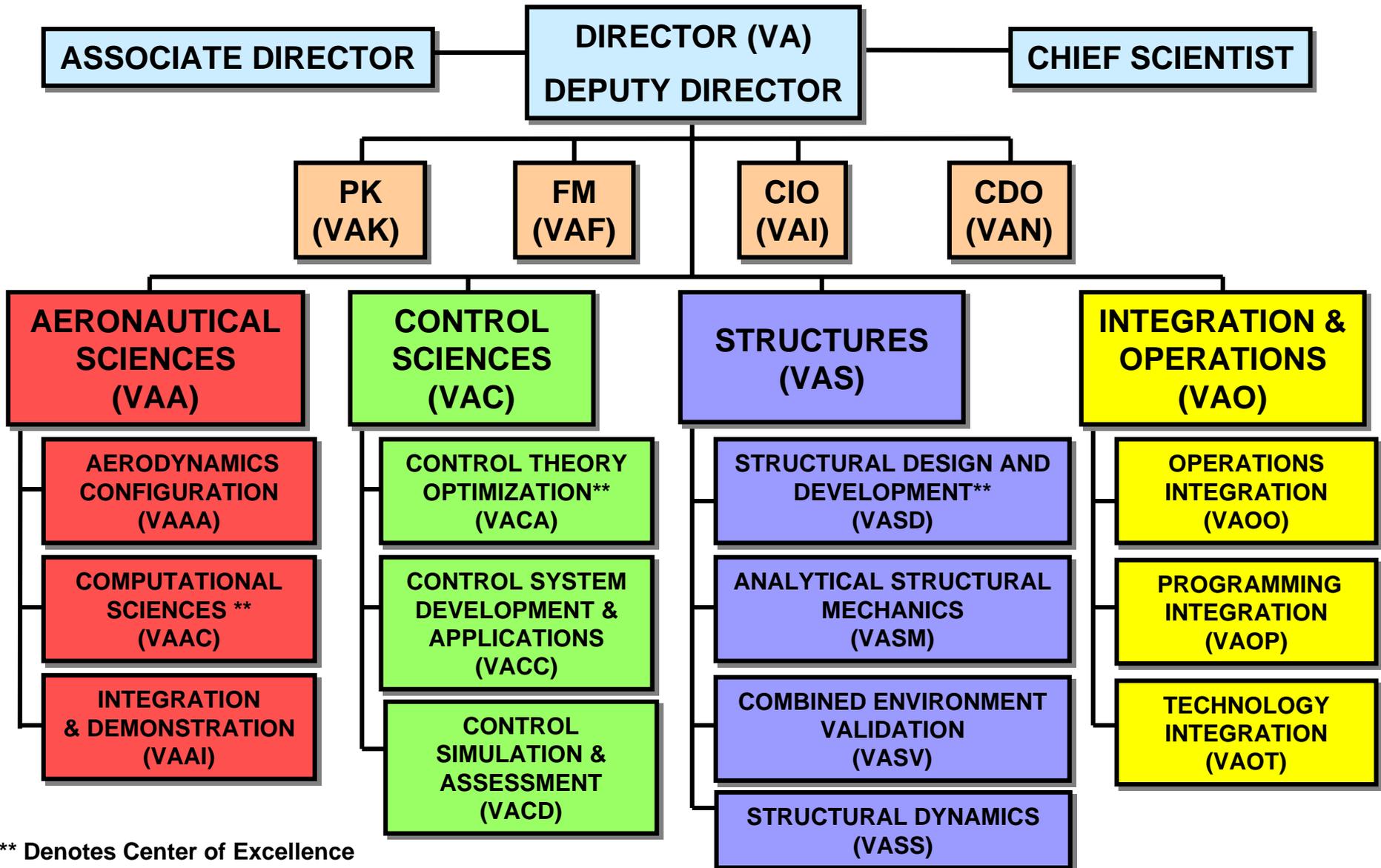


Aircraft like operation -- quick turnaround and flexible mission capability
Global engagement in less than 3 hours
Reduced cost for access to space



ORGANIZATION

AIR VEHICLES DIRECTORATE

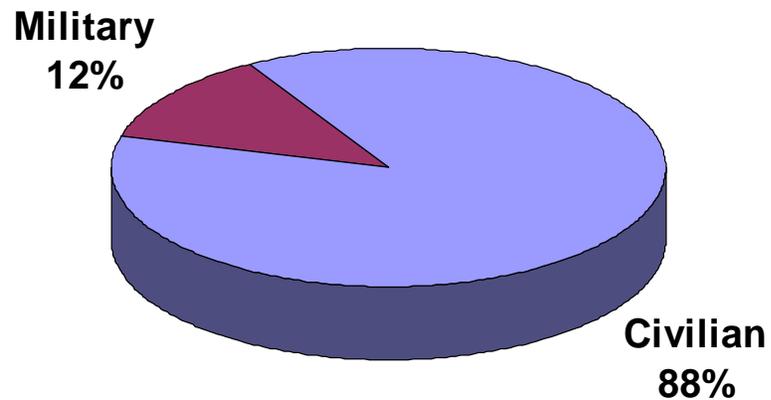




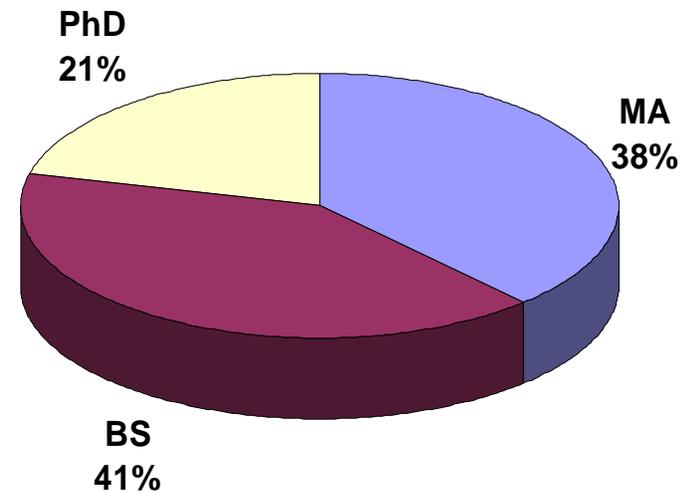
PERSONNEL

AIR VEHICLES DIRECTORATE

Government Personnel



Government S&E

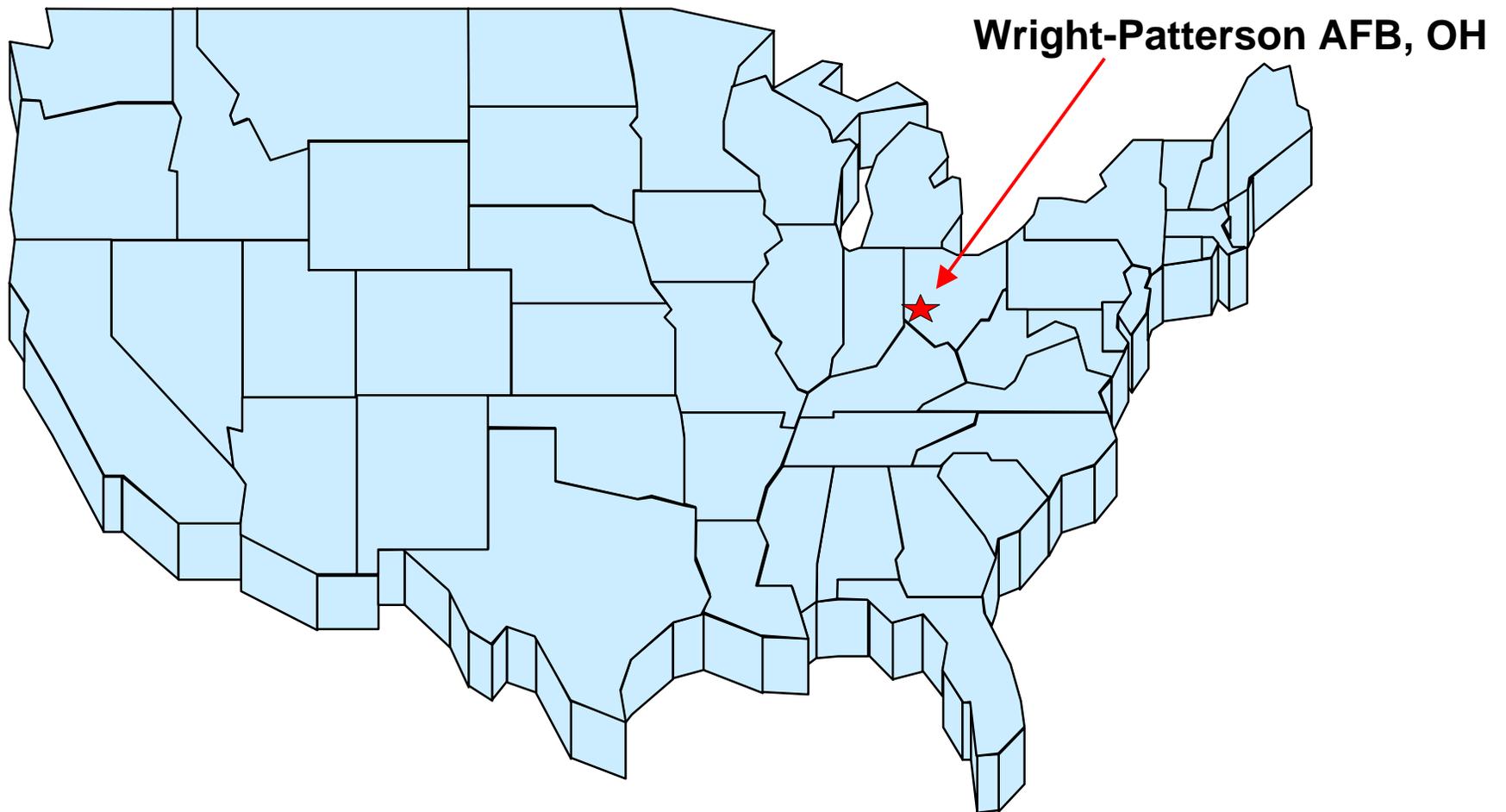


Government Personnel	324
IPA	3
On-site Contractors	140
Total	467



OPERATING LOCATION

AIR VEHICLES DIRECTORATE



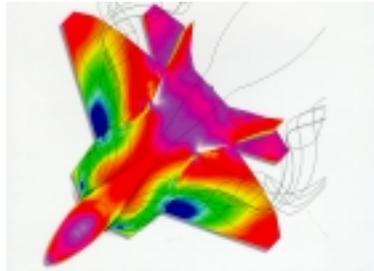


CORE COMPETENCIES

Sciences To Support Sustainment, UAVs and Space

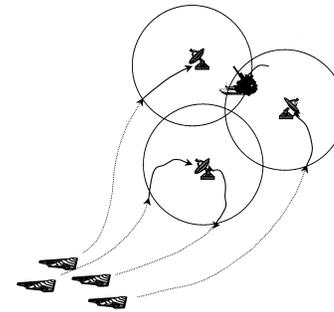
AIR VEHICLES DIRECTORATE

Aeronautical Sciences



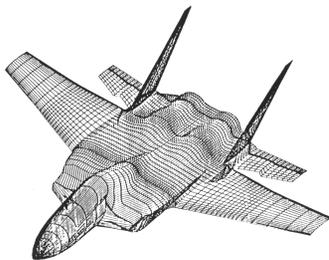
- Computational sciences (CFD & CEM)
- Aero configuration
- Plasma physics and aerodynamic relationships

Control Sciences



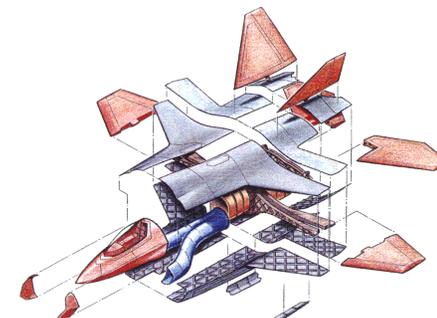
- Systems and control theory
- Distributed network feedback systems

Structures



- Combined environments (loads/thermal/acoustic)
- Computational/analytical certification
- Multifunctional affordable structures

Integration



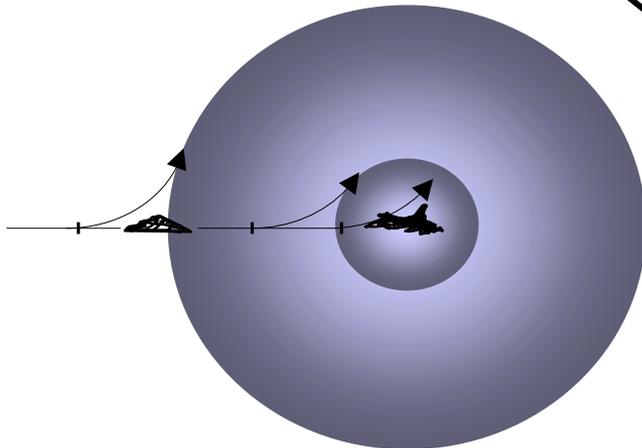
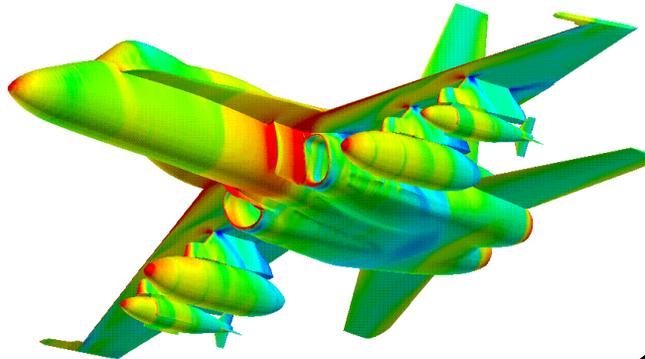
- Multi-disciplinary design and demonstration
- Modeling/simulation-based R&D (including virtual design space)



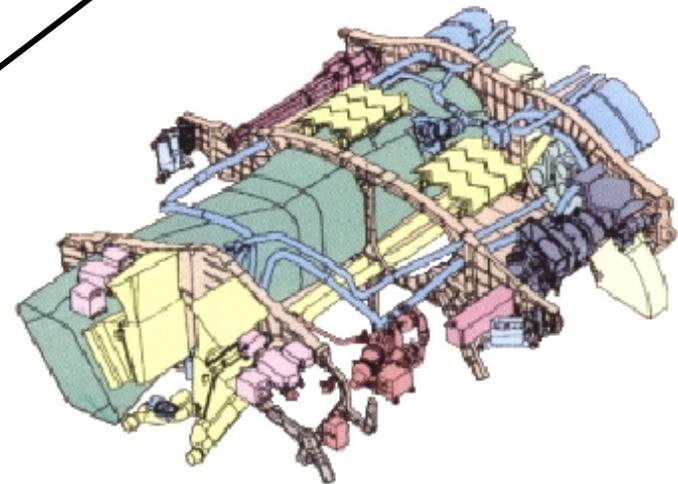
CENTERS OF EXCELLENCE

AIR VEHICLES DIRECTORATE

Computational Science



Control Science



Multi-Disciplinary Technologies



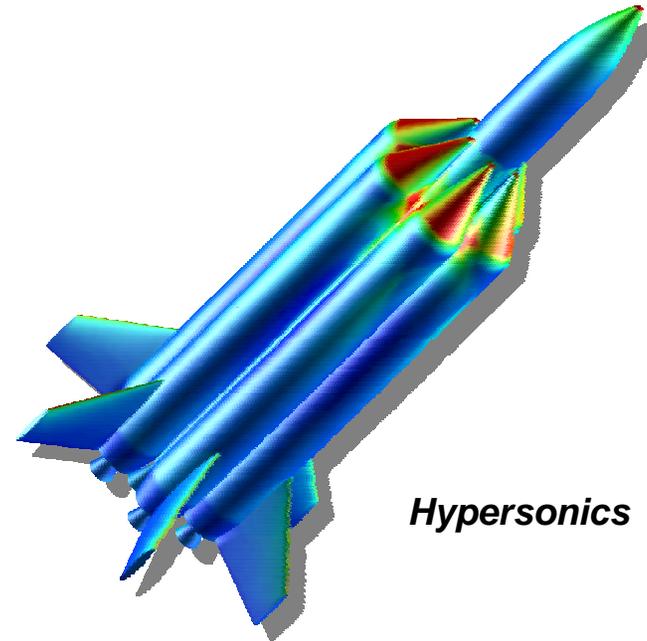
COMPUTATIONAL SCIENCES

Center of Excellence

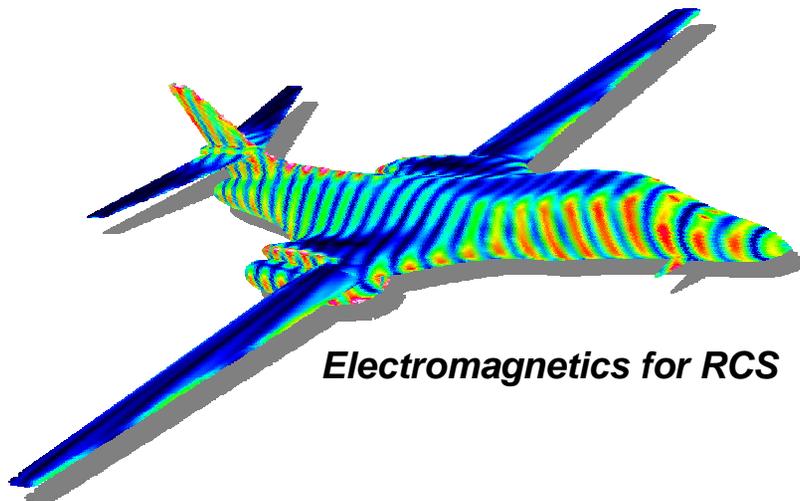
AIR VEHICLES DIRECTORATE

Objective

Develop and apply state-of-the-art multidisciplinary computational methods for design/analysis of air and space vehicles



Hypersonics



Electromagnetics for RCS

Areas of Expertise

- Computational Aerodynamics (CFD)
- Fluids/Structures Interactions (CFD/CSD)
- Aerodynamic Design Optimization
- Computational Magnetogasdynamics
- High-Performance Computing



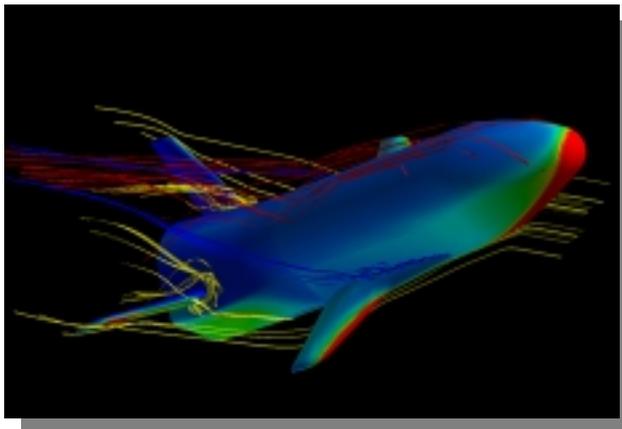
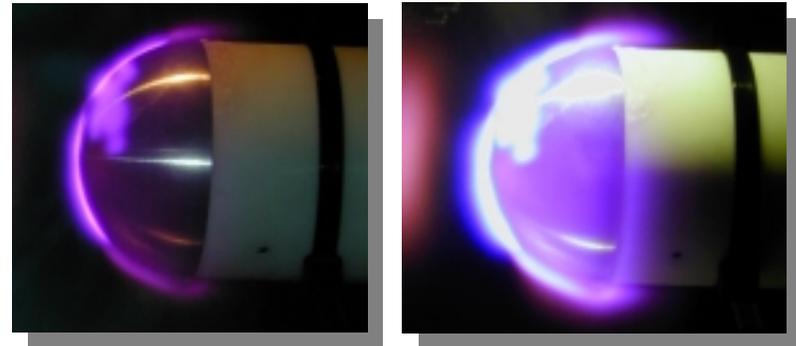
COMPUTATIONAL SCIENCES

Center of Excellence

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Plasma Flow Control Technology

- Development of Basic Theories
- Experimental Validation of Computational Methodologies

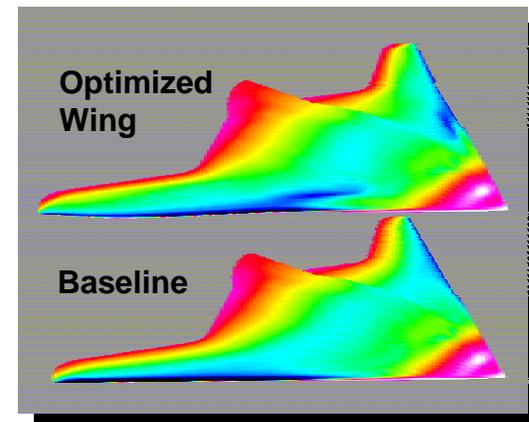


Modeling and Simulation

- Multidisciplinary Aeroelastic Predictions
- Computational Magnetogasdynamics for Hypersonics, Electromagnetics, Plasmas

Innovative Configuration Development

- Aerodynamic Design Optimization of UAVs
- Rapid CFD Analysis of Design Concepts
- Small Munitions Loads/Trajectory Analysis





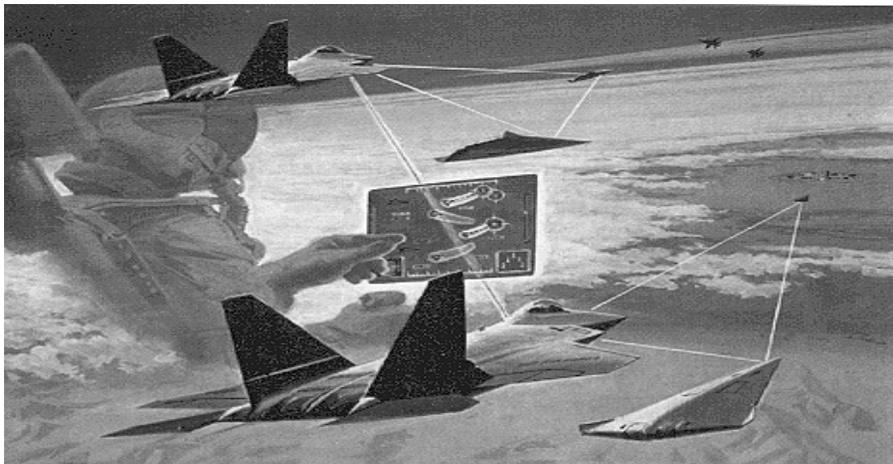
CONTROL SCIENCE

Center of Excellence

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Objective

Extend state-of-the-art control theory for application to military air and space vehicles



Areas of Expertise

- Multivariable Control Theory
- Adaptive Control Theory
- Flight Dynamics and Control
- Optimization Theory
- Robust Control Theory
- System Identification

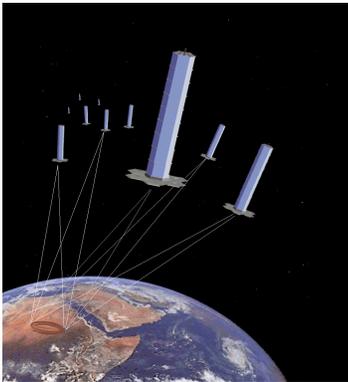
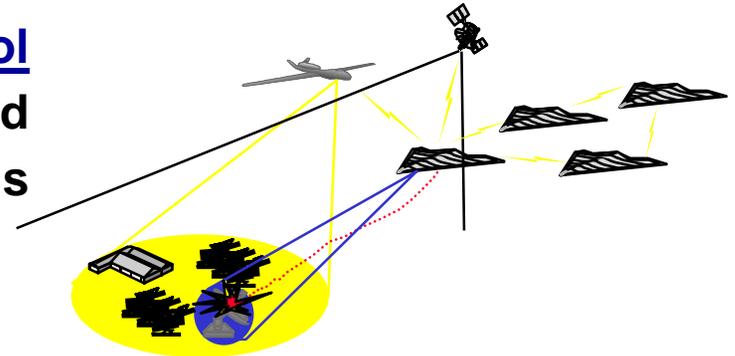


CONTROL SCIENCE Center of Excellence

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Unmanned Air Vehicle Control

Develop planning, guidance, and control for UAV cooperative operations



Microsatellite Formation Control

Develop formation control, maintenance, and reconfiguration of satellite clusters

Hypersonic Vehicle Control

Develop guidance and control algorithms addressing unique hypersonic challenges and optimizing performance



Micro Adaptive Flow Control

Develop reduced-order modeling techniques for micro adaptive flow control law development



MULTI-DISCIPLINARY TECHNOLOGIES

Center of Excellence

AIR VEHICLES DIRECTORATE

Objective

Lead the development of innovative multidisciplinary design and analysis technologies, methodologies and processes that enable revolutionary aerospace vehicle capabilities for the warfighter



Areas of Expertise

- Multidisciplinary Methods for Design and Analysis
- Design Processes
- Uncertainty in Nonlinear Interactions
- Innovative A/V Concepts
- Aeroelasticity
- Reduced Order Modeling
- Cost Modeling
- Optimization



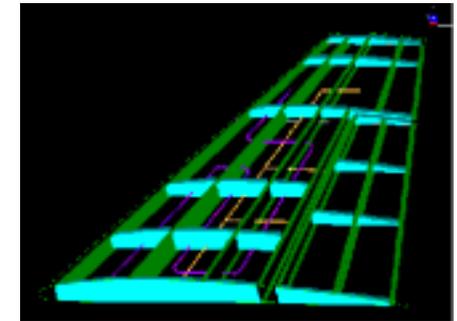
MULTI-DISCIPLINARY TECHNOLOGIES

Center of Excellence

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Design Modeling

Develop and apply advanced multidisciplinary technologies for UAV and space access vehicles

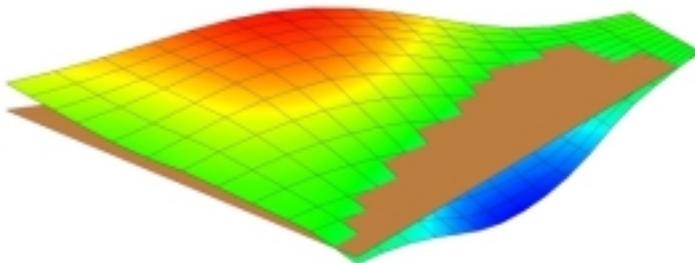
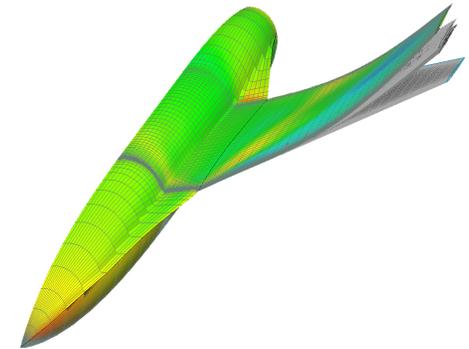


ASCI (Aero/Structure/Control Interaction)

Interdisciplinary integration to provide major advancement in air vehicle design capability

Nonlinear Analysis of Flexible Vehicles

Reduced Order Modeling of high fidelity aeroelastic equation sets and sensitivity analysis including nonlinear physics



Adaptive Wing Technologies

Integrate smart material based and conventional actuators into UAVs for improving aerodynamic performance



EXPERIMENTAL FACILITIES

AIR VEHICLES DIRECTORATE

- **Modeling and Simulation Facility**
 - Applies engineering and mission level flight simulation in support of technology integration, assessment, demonstration, and transition
 - Conducts exploratory and advanced development for control integration technologies





EXPERIMENTAL FACILITIES

AIR VEHICLES DIRECTORATE

- **Combined Environment Acoustic Chamber**
 - **Simulates severe aeroacoustic and engine environments**
 - **Only facility capable of achieving 173dB and 2500°F on a 9'x4' specimen**





SUMMARY

AIR VEHICLES DIRECTORATE

- **S&T Focus Provided by Integrating Concepts**
 - Sustainment
 - Unmanned Air Vehicles
 - Space Access & Future Strike Technology
- **Technologies Developed Through Core Competencies**
 - Aeronautical Sciences
 - Control Sciences
 - Structures
 - Integration
- **Centers of Excellence Exist Within Core Competencies**
 - Computational Science
 - Control Science
 - Multi-Disciplinary Technologies
- **POC: Rick Rolfes**
AFRL/VAOO
richard.rolfes@wpafb.af.mil
(937)255-3418 or DSN 785-3418