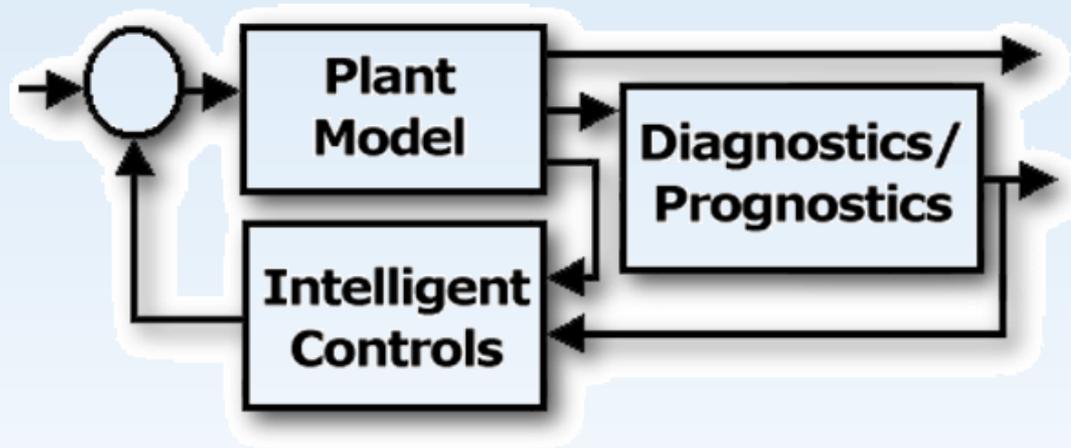


# Propulsion Control and Diagnostics Research under NASA Aeronautics Research Mission Programs



**3<sup>rd</sup> NASA GRC PCD Research Workshop**  
**Feb. 28 – Mar. 1, 2012, Cleveland, OH**

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<http://www.grc.nasa.gov/WWW/cdtb/>

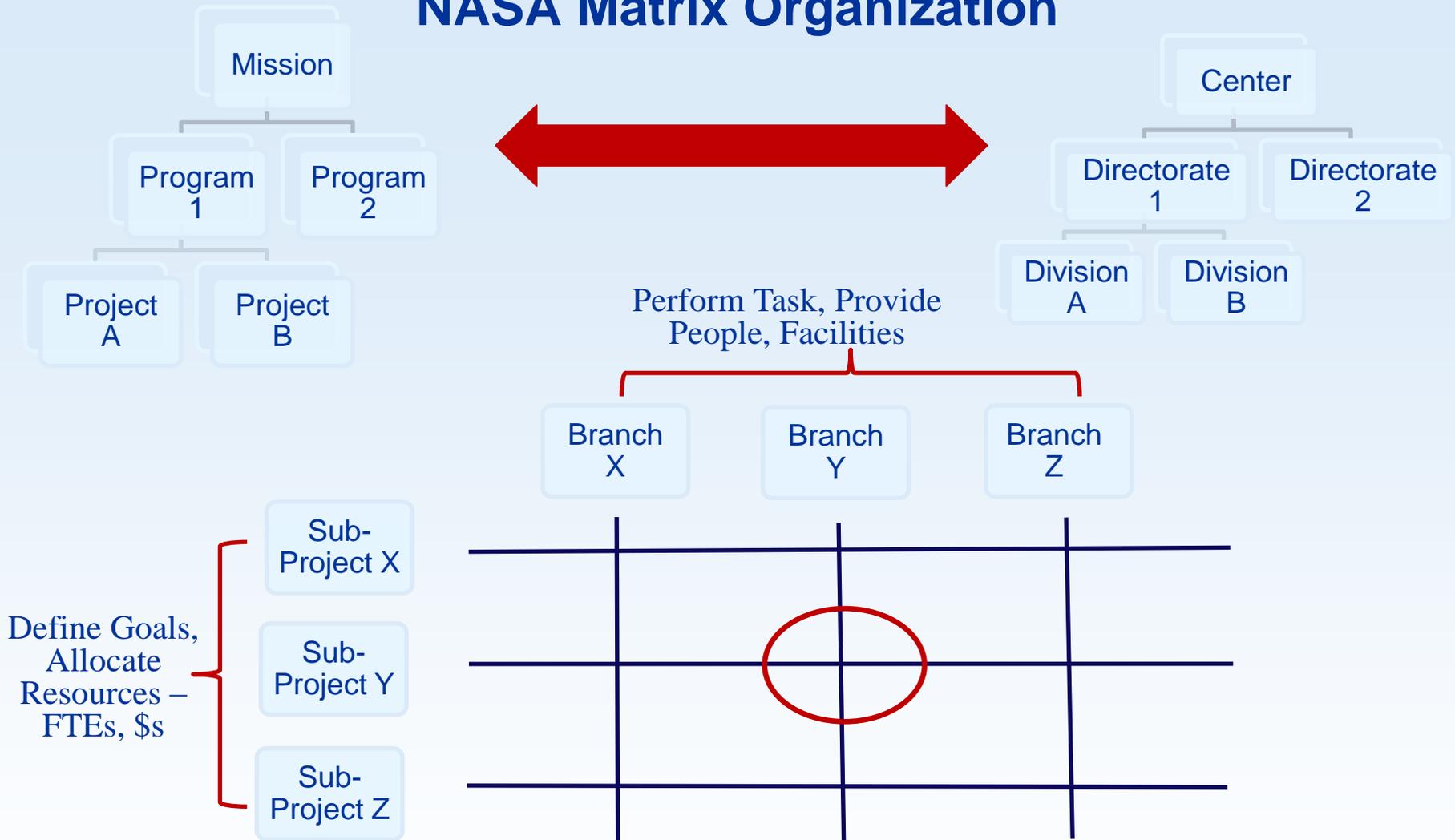
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at Lewis Field



# NASA Matrix Organization



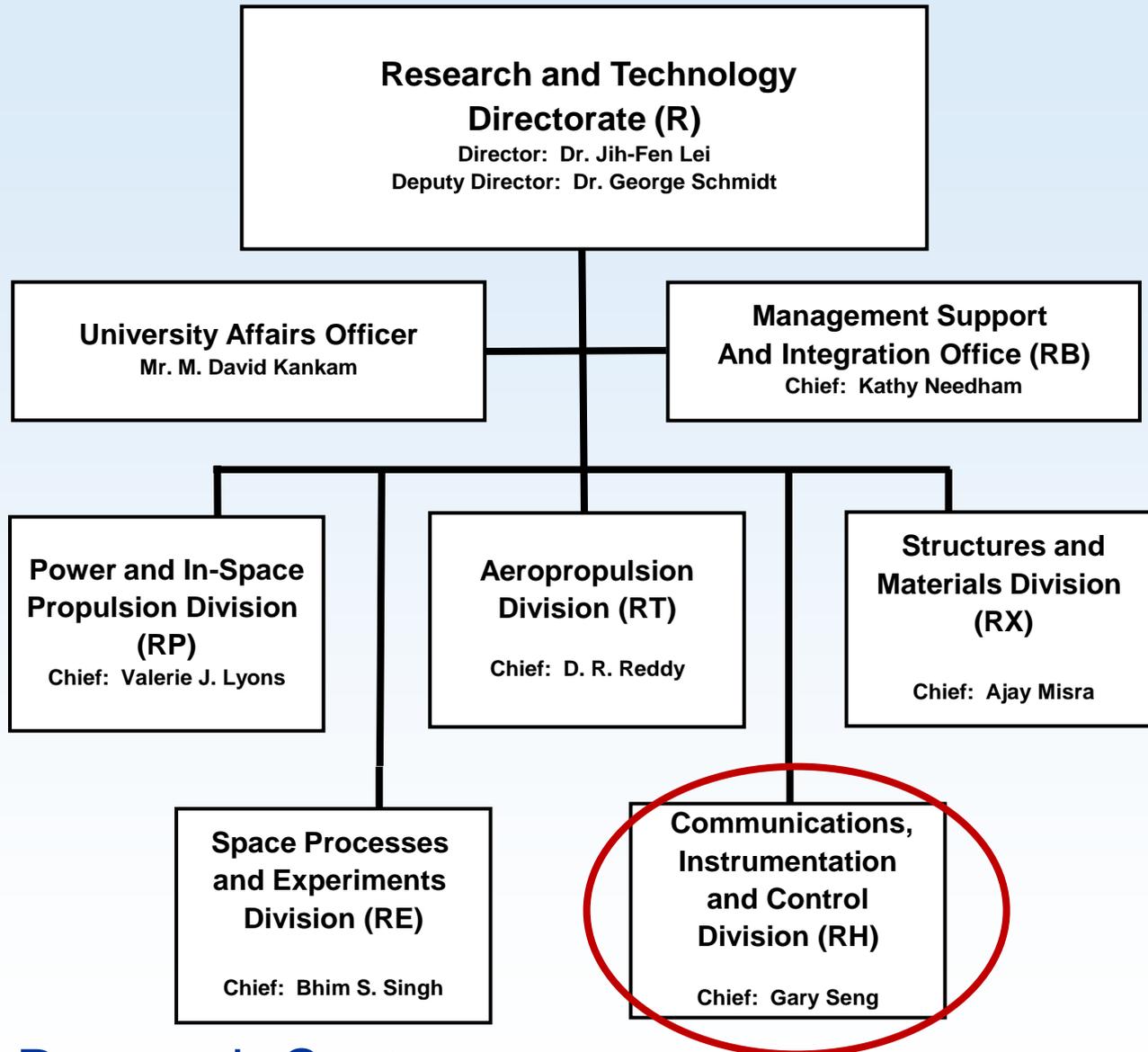
**We work with Project Management to identify and implement research and technology development tasks which are consistent with project objectives**

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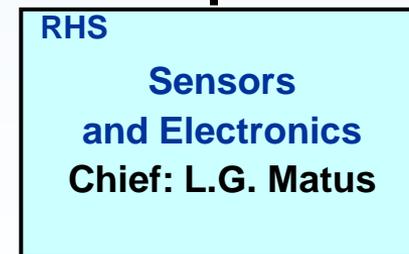
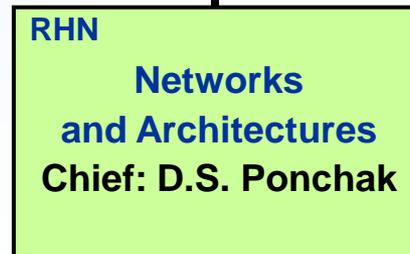
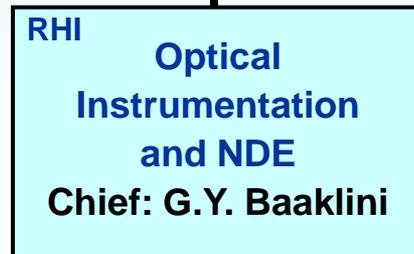
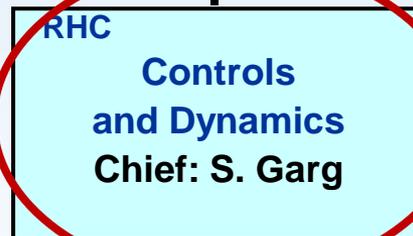
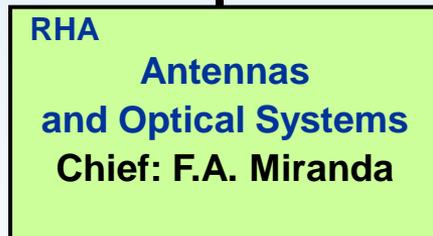
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# Code RH Division Organizational Structure



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# Controls & Dynamics Branch Overview

- Mission

- Research, develop and verify aerospace propulsion dynamic modeling, health management, control design and implementation technologies that provide advancements in performance, safety, environmental compatibility, reliability and durability
- Facilitate technology insertion into the mainstream aeropropulsion community

- Capabilities

- 22 engineers and scientists - most with advanced degrees and extensive experience in aeropropulsion controls related fields
- Extensive computer-aided control design and evaluation facilities including real-time and man-in-the-loop simulation facility
- Strong working relationship with controls technology groups in the aerospace propulsion industry, academia and other agencies

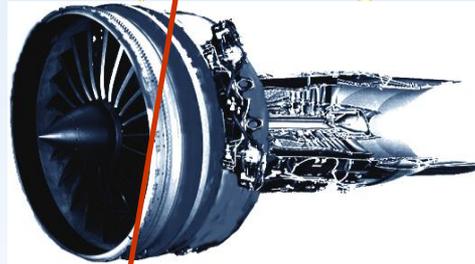


# Intelligent Propulsion Systems Control System perspective

**Multifold increase in propulsion system Affordability, Capability  
Environmental Compatibility, Performance, Reliability and Safety**

Active Control Technologies for enhanced performance and reliability, and reduced emissions

- active control of combustor, compressor, vibration etc.
- MEMS based control applications



Advanced Health Management technologies for self diagnostic and prognostic propulsion system

- Life usage monitoring and prediction
- Data fusion from multiple sensors and model based information

Distributed, Fault-Tolerant Engine Control for enhanced reliability, reduced weight and optimal performance with system deterioration

- Smart sensors and actuators
- Robust, adaptive control

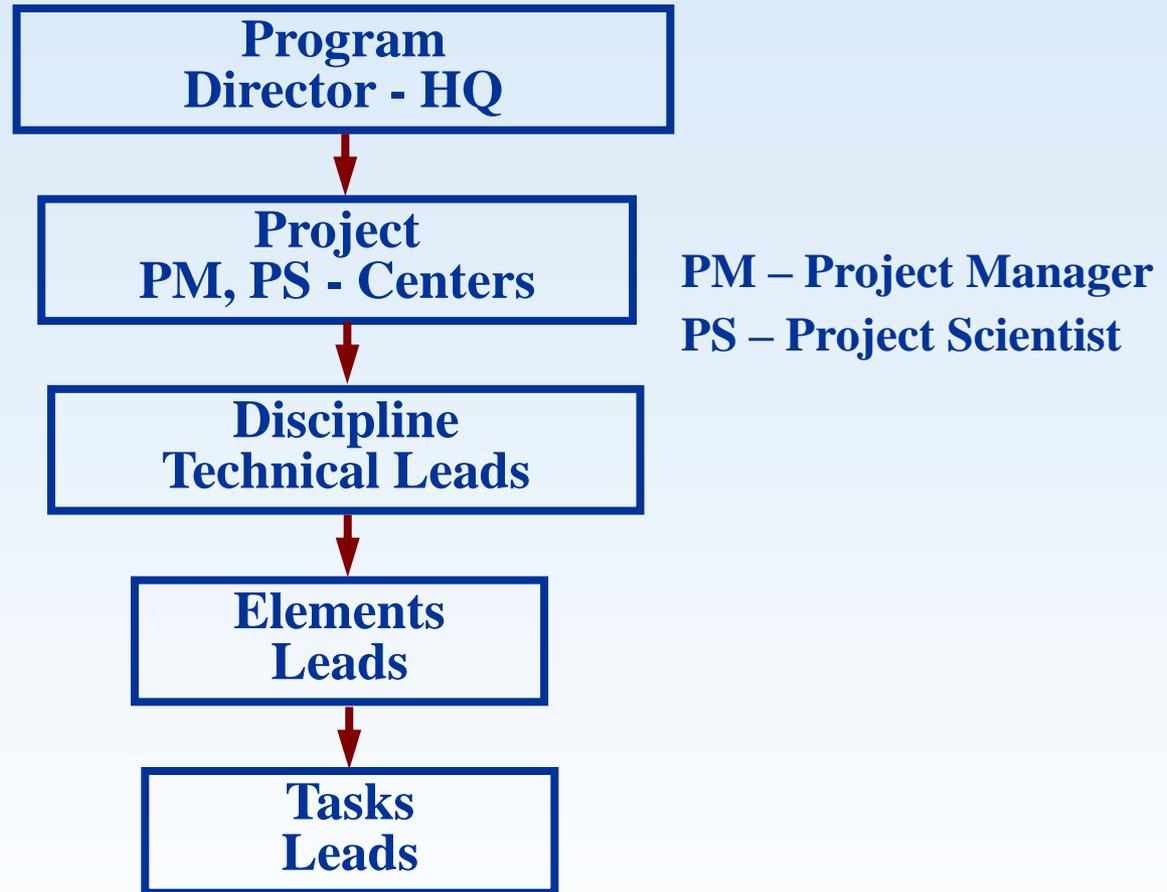
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# NASA ARMD Management Structure



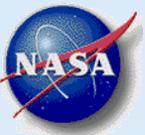
- **Each Center: ARC, DFRC, GRC, LaRC; has a center Point of Contact (PoC) who coordinates with Program Directors and Project Managers**
- **Line Management coordinates with Discipline Technical Leads**

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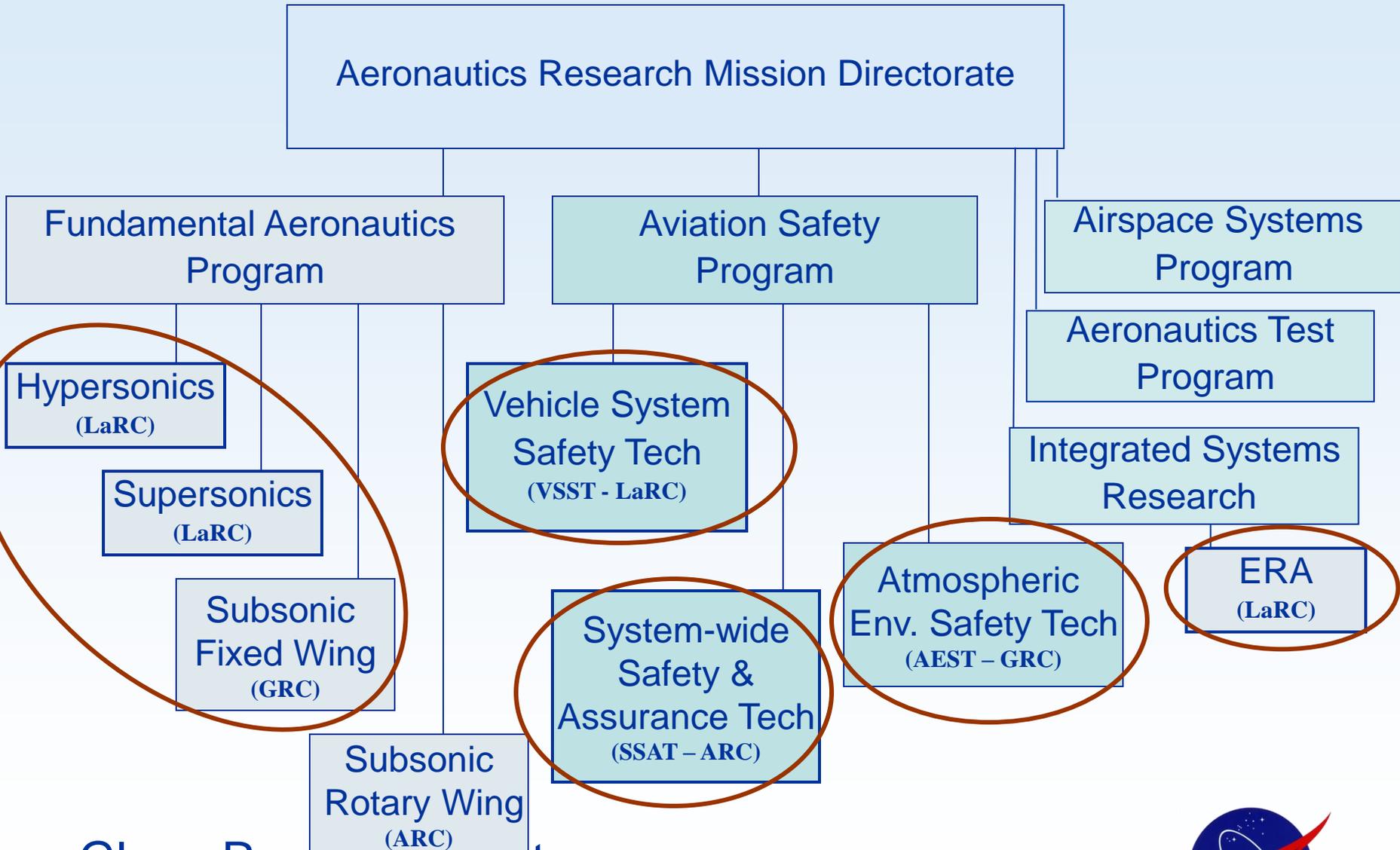
Fig. 4.3.2-1 from NPD 1000

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# NASA Aeronautics Program Structure

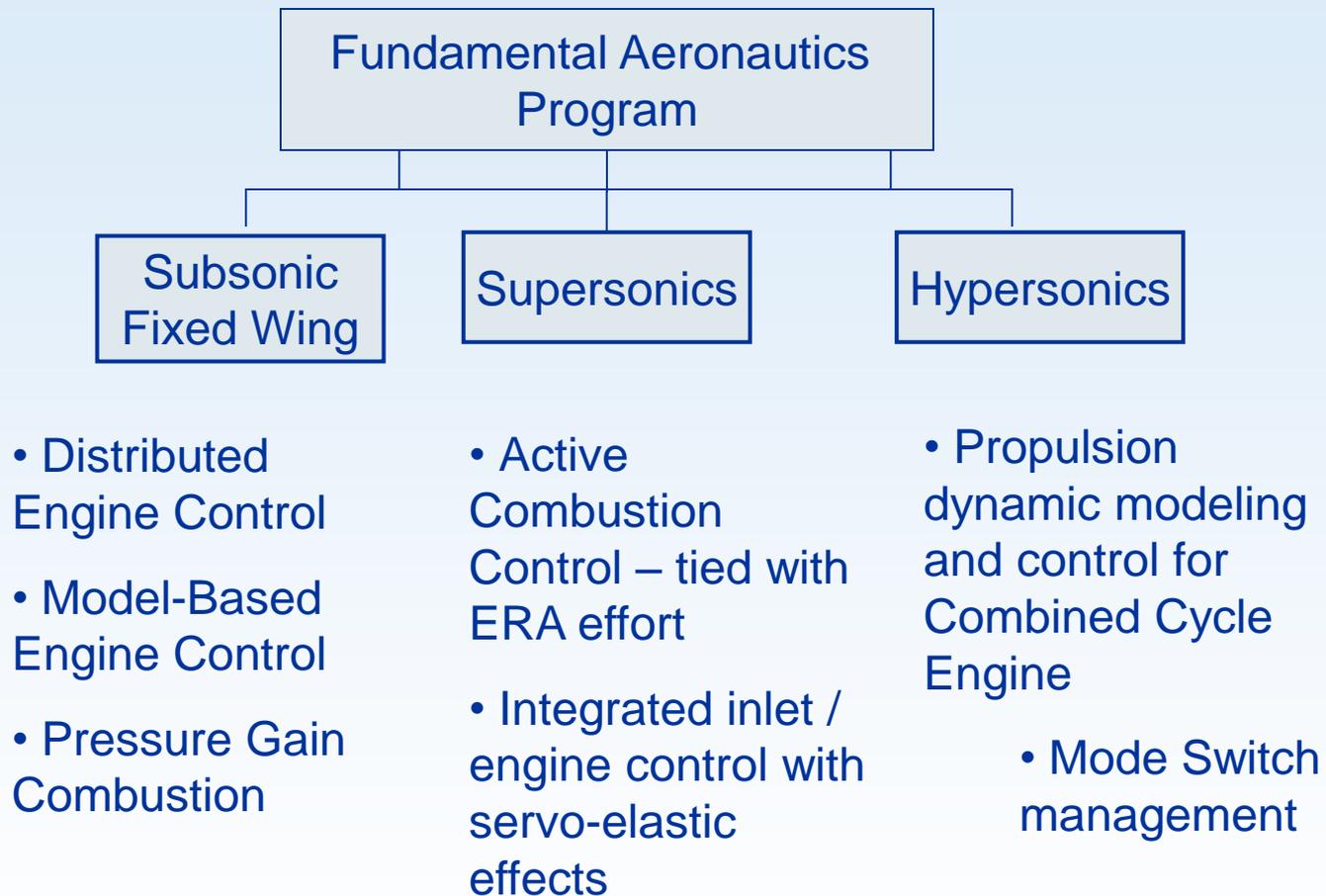


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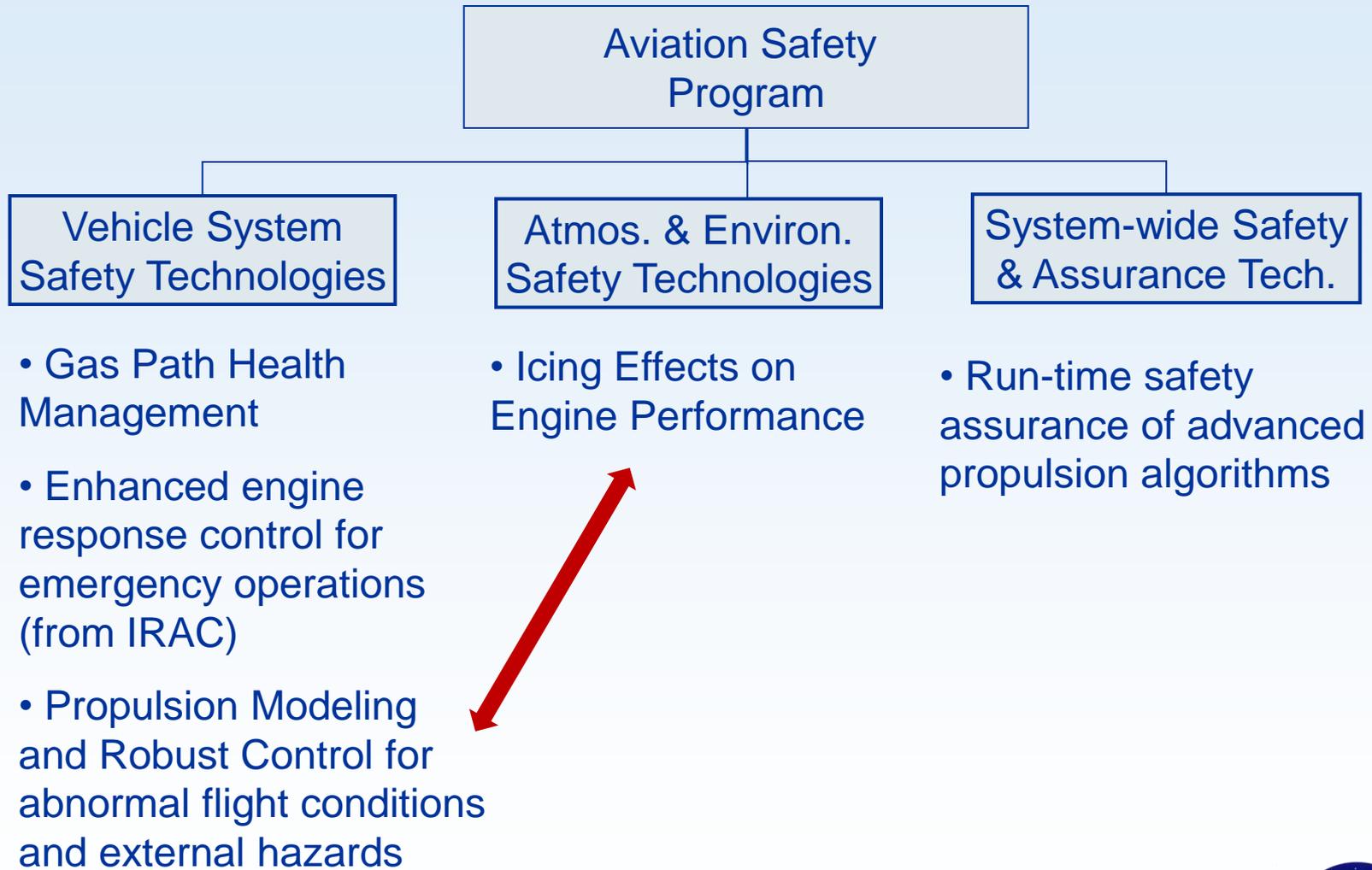
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# Propulsion Control for Fundamental Aeronautics



# Propulsion Control and Diagnostics for Aviation Safety



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# Propulsion Control and Diagnostics Support for Exploration Systems

Human Exploration and Operations Mission Directorate

Crew Vehicle and Launch System

Space Launch System

Upper Stage

Mission and Fault Management

J2-X

TVC

## Sensor Data Qualification System

- Provide a validated analytical redundancy-based methodology for on-board data qualification of sensors with application to various Upper Stage subsystems

- **Sensor Selection Study for J-2X Engine**

- Support development of J-2X Real-time Model and use of the model for application of Systematic Sensor Selection Strategy to J-2X

- **Fault Detection Isolation and Response for US Thrust Vector Control**

- Support development of integrated upper stage functional fault analysis model for fault testability and diagnostics

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# Collaboration Opportunities

- NRA (NASA Research Announcements)
  - Open to industry and universities
  - Very focused on specific topics
  - Announced by Projects on a periodic basis

<http://www.aeronautics.nasa.gov/nra.htm>
- SBIR (Small Business Innovative Research)
  - Open to small businesses
  - Very broad areas of call. Topics determined by Programs/Projects

<http://sbir.gsfc.nasa.gov/SBIR/SBIR.html>
- Space Act Agreement – no direct NASA funding
  - Open to industry/universities/govt. agencies
  - Ideal for collaboration on mutual areas of interest without exchange of funds or with inflow of funds to NASA efforts
  - Opportunity for industry to leverage NASA investment in projects
- Student and Faculty Programs

<http://www.nasa.gov/centers/glenn/education/index.html>

