National Aeronautics and Space Administration

Marshall Space Flight Center

Spacecraft and Vehicle Systems Department

Your one-stop-shop for end-to-end vehicle and systems design, analysis, test, and evaluation

Spacecraft and Vehicle Systems

Marshall Space Flight Center's Spacecraft and Vehicle Systems Department plans, performs, and directs the technical design, analysis, test, evaluation, verification, integration, and applied research and development of state-of-the-art spacecraft, habitats, rovers, robotics, and launch vehicle systems.

Structural Design and Analysis Division

As part of the Engineering Directorate, the team supports customers by providing structural expertise in design, analysis, and the definition of induced environments. Their key responsibility is to ensure the structural integrity of the primary and secondary structures, subsystems, and components of launch vehicles and spacecraft, including lander, transit, and habitation systems. Marshall has extensive experience in designing and analyzing launch vehicles, spacecraft, and other systems throughout all development and operational phases, including conducting forensic analysis for investigating anomalies and failures.

Structural Dynamics and Integration

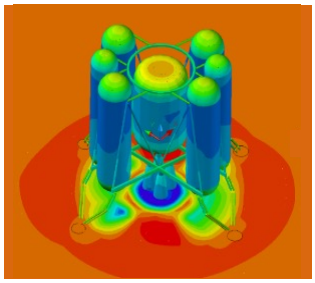
Assessing how payloads, spacecraft, and launch vehicles respond to various operational environments through:

- Vehicle/System Coupled Loads Analysis and Responses of the Vehicle
- Structural Dynamic Analysis including Vibration, Acoustics, and Shock
- Structural Discipline Integration of Vehicle and Sub-Elements

Structural Design, Development, and Analysis

This discipline incorporates all requirements, including specific customer needs and industry best practices, and necessary inputs (such as loads, environments, material properties, etc.) to create a fully functional structural design solution. The design solution is verified through:

- Vehicle/System Structural and Mechanical Design
- Structural Strength Analysis
- Multi-element Design Integration



Aerosciences (see Hypersonics flyer)

Provides launch vehicle ascent as well as stage re-entry aerodynamics and induced environments with:

- Aerodynamic, Aerothermodynamic, Aero-acoustic Analysis, and Venting
- Plume Induced Environments on Vehicles/Systems
- Rocket Plume-Surface Interaction (PSI)
- Blast and Debris Analysis

Thermal Analysis and Control

Responsible for the thermal management and protection of spacecraft, vehicles, payloads, and related hardware through all prescribed mission phases. The team provides analytical predictions to support both the thermal control and thermal protection system design processes, including:

- Thermal Environments Analysis and Characterization
- Lunar Surface/Terrain and Orbital Thermal Modeling
- Life Support System Analysis

Flight Mechanics and Analysis Division (see Flight Mechanics flyer)

Responsible for analysis, requirements definition, design, development, and verification of Guidance, Navigation, and Control (GN&C) and Integrated Systems Health Management (ISHM) and Automation systems as well as natural environments definition; this includes the GN&C, ISHM systems, and supporting subsystems for both launch vehicles and spacecraft. Responsibilities include design definition as well as advancement of supporting technologies.

Control Systems Design and Analysis

This discipline performs requirement derivation for vehicles and subsystems and develops models to analyze vehicle performance in addition to GN&C integration.

- Requirements Development
- Control System Development, Analysis, and Verification
- Prevention of Coupled Structure Propulsion Instability (POGO) and Slosh Modeling
- Precision Pointing

- Solar and Electrostatic Sails
- Rovers and Landers
- Artificial Intelligence/Machine Learning

Guidance and Trajectories

Develops, specifies, designs, models, and verifies guidance and navigation systems for space vehicles, from small satellites to heavy-lift launch vehicles.

- Visually Aided Guidance
- Multi-body Dynamics
- Descent trajectory design, optimization, attitude determination and control systems, and full-vehicle simulation including both 3-DOF and 6-DOF
- In-space orbit design, trajectory optimization, and mission analysis
- Extensive experience in solar sail and tether mission design and dynamics
- Unique Monte Carlo, multi-body 6-DOF dynamics analysis for critical events, from pad lift-off/tower clearance through all stage and component separations, and for deorbit, descent, and landing mission phases

Navigation Systems

- Surface/Relative Navigation
- Smartphone Video Guidance Sensor (SVGS) for Autonomous Surface Mobility
- Beacon Aided and Inertial Navigation

Integrated Systems Health Management and Automation

Provides for the understanding, design, and testing of the mission and fault management (M&FM) autonomous functionality of a vehicle or spacecraft.

- Vehicle timeline analysis
- Redundancy management, safing, caution and warning, and abort
- System functional design and analysis for autonomous operation
- M&FM design, test, and verification

Natural Environments

Define the natural environments for use in the design of launch vehicles, spacecraft, and landers, including surface payloads and habitats, to meet mission-specific performance requirements.

- Ionizing radiation, plasma, meteoroids, neutral thermosphere, thermal environment, solar activity, atmospheric wind dynamics, surface weather, lunar meteoroid ejecta flux, and lunar and planetary environments
- Meteoroid Environment Office has the responsibility to define the hazardous meteoroid environment throughout the solar system and assist in the protection of NASA assets and crew from the associated risk

System Engineering and Integration Division

Leads the integrated design, development, test/evaluation, certification, and sustainment of affordable, innovative spacecraft and vehicle system solutions for programs and projects of all sizes and types.

Technical Management

Provides crosscutting engineering capabilities required to meet the challenges of current and future projects.

- Systems Engineering Leadership (Lead Systems Engineers)
- Technical Performance Measures and Margin Management
- Operations/Supportability/ Sustaining Engineering and Integration

System Design, Definition, and Verification

Provides expert discipline systems engineers and applies systems engineering principles, both traditional and model-based, to help solve the complex engineering challenges of projects.

- Interface Development, Integration, and Management
- Complex Systems Integration
- Interface Verification
- Lead, Conduct, and Manage all aspects of Verification (Planning, Development, Execution)
- Requirements Management (development, tools, process, and approach)
- Ground Support Equipment Integration, Requirements and Verification

Systems Analysis

Provides supporting system analysis functions required throughout the project lifecycle.

- Leads and Performs System-Level Modeling and Analysis
- Mass Margin Management
- Human Factors/Human Integration Engineering
- Flight Imagery Planning, Processing, and Analysis

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