National Aeronautics and Space Administration

Marshall Space Flight Center
Spacecraft & Vehicle Systems

Engineering Solutions for Space Science and Exploration

Marshall's Spacecraft and Vehicle Systems Department

For over 50 years, the Marshall Space Flight Center has developed the expertise and capabilities to successfully execute the integrated design, development, test, and evaluation of NASA launch vehicles, and spacecraft and science programs. Marshall's Spacecraft and Vehicle Systems Department (EV) has been a major technical and engineering arm to develop these vehicles and programs in the areas of Systems Engineering & Integration (SE&I), flight mechanics and analysis, and structural design and analysis. EV has performed advanced research and development for future spacecraft and launch vehicle systems, and has established technical partnerships and collaborations with other NASA centers, the Department of Defense, the Department of Energy, industry, technical professional societies, and academia in order to enhance technical competencies and advanced technologies for future spacecraft and vehicle systems.

EV applies engineering expertise to the design and development of NASA's Space Launch System (SLS) heavy-lift launch vehicle. This expertise includes structures and dynamics design, including vibroacoutics and strength analysis; as well as flight mechanics analysis for generating and analyzing the flight system design, and for creating and coding the guidance, navigation and controls algorithms for inclusion into flight software. EV also provides the SE&I skills for the vehicle system design and for Program decision-making. Specific SE&I skill areas are program planning, requirements flow-down, interfaces, test integration, designing for human integrations and risk analysis.

The Spacecraft and Vehicle Systems Department has also provided sustaining engineering support to the Space Shuttle, International Space Station, and other ongoing systems. For example, the EV support of the Space Shuttle program included use of the Image Analysis Facility to provide engineering photographic analysis for assessment of the orbiter's thermal protection system prior to reentry and for debris anomaly resolution. In addition, the Natural Environments group supported the day-of -launch I-Load Updates, provided the mean bulk propellant temperature forecast prior to each Shuttle launch, and performed radiation assessments of Shuttle avionics systems. Members in the department also co-chaired several propulsion SE&I panels including panels for Aerodynamics, Thermal, and Loads disciplines.

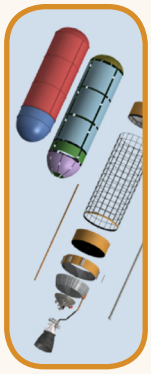
EV provides design and analysis support to numerous Science and Mission Systems projects, including the Environmental Control & Life Support System (ECLSS), the Microgravity Science Research Rack, and the Node elements for the International Space Station. The department also developed and maintains the Chandra Radiation Model used to plan operations of the Chandra X-Ray Observatory. EV has supported the Lunar Pre-Cursor Robotic Program, the FastSat spacecraft project, and various studies for other spacecraft candidate missions.

The Spacecraft and Vehicle Systems Department develops state-of-the-art technologies that have revolutionized the way engineers can display and visualize engineering data. The Collaborative Engineer and Design Analysis Room (CEDAR) allows engineers to experience 3-dimensional projections of their Computer-Aided Design (CAD) models and allows users to "fly through" a virtual design. In addition, the Virtual Environments Laboratory allows for virtual analysis of human factors by providing real-time, human motion tracking through an optical body tracking system and Bluetooth Cybergloves—a head-mounted display system allowing the individual to interact with a virtual environment. The department continues to explore and advance technologies or future aerospace applications.

Capabilities

Systems Engineering and Integration

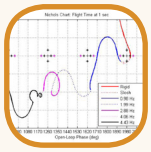
> Launch vehicle and spacecraft design and integration, including requirements, verification, and interfaces.



> Integrated system analysis and attributes, including design and analysis cycles, mass properties, discrete event simulation, supportability, sensitivity trades, model validation, verification and accreditation, and human factors.

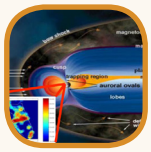
> System test and flight evaluation, including image analysis, planning for development, assembly, test, production, and acceptance.

> Systems engineering planning including plans and processes, risk management and analysis, and knowledge management.



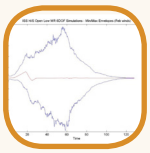
Flight Mechanics and Analysis

> Control system design and analysis including control structure interaction, vibration isolation, pogo stabilization, and precision pointing.

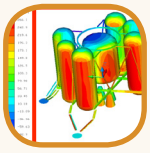


> Guidance, navigation, and mission analysis, including orbital mechanics, guidance laws, trajectory design/analysis, navigation systems, and vehicle end-to-end mission simulation.

> Integrated systems health management, including instrumentation and sensor technologies research and development, and computer architectures.



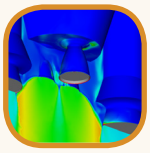
> Natural environments, including environment definition, upper air wind monitoring, spacecraft charging analysis, ionizing radiation effects, and meteoroid environments.



Structural Design and Analysis

> Structural dynamics, loads, and strengths, including fracture mechanics and vibroacoustic environments.

> Structural and mechanical design including pyrotechnic and parachute design, meteoroid-orbital debris and launch vehicle ascent debris impact assessments, and assembly engineering design.



> Aerosciences, including base heating plume radiation, recirculation, and impingement; and ascent and reentry for aerodynamics, aerodynamic heating, compartment venting, and acoustics.

> Thermal design, analysis, and control, including computer modeling, test support, and space and orbital thermal environments.

Key Benefits

> Deploys and depends on a diverse and dynamic group of people and talents to create high-quality, innovative services and products to meet the goals of existing and potential stakeholders.

> Provides a wide array of aerospace engineering discipline expertise, tools, methodologies and processes supporting every phase of the product life cycle to help solve the toughest spaceflight challenges.

> Delivers inventive, tangible technical solutions in a collaborative environment with the one goal of achieving successful outcomes in all efforts ranging from support for small, unique projects to cornerstone contributions for major launch vehicle development programs.

For more information, please visit www.nasa.gov/centers/marshall/about/business.html

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