AEROSPACE

Credit: Kennedy Space Center

VEHICLE SYSTEMS

The Vehicle Systems Division (VSD) provides engineering solutions to the nation's vehicle system challenges when and where they are needed. Our work spans innovative research and development; technical evaluations during the acquisition process; conceptual and detailed design, assembly, integration and testing; and operational support to launch and space vehicles. Comprised of highly trained mechanical and aerospace engineers, VSD provides national expertise in the fields of vehicle engineering; guidance navigation and controls; electromechanical devices; embedded systems; flight mechanics; fluid mechanics; thermal systems; propulsion; mechanisms; structures; structural dynamics; and dynamic environments.

Small Satellite Prototyping and Integration

Rapidly integrating new technologies will be essential to the future of space, and we are constantly exploring capabilities. We create CubeSats and small satellite prototypes, along with hardware-in-the-loop simulations to test internally, developed sensors and payloads with commercially available satellite buses and airborne platforms. Prototyping leads to both new systems and enhanced knowledge to support assembly, integration, and test for critical national systems produced elsewhere. Our engineers apply their skills to a variety of satellite development programs, working from initial design through final integrated testing.

Thermal Control

The vacuum of space is one of engineering's most challenging thermal environments. Our thermal control engineering group performs design, analysis, and assessment for spacecraft and payloads, including Aerospace's own technology demonstration missions. Our key strength is in understanding and applying lessons learned from the wide variety of programs we cover, and then helping to shape industry thermal engineering standards by sharing best practices. We are known for keen expertise and deep understanding that enables us to develop solutions to the thermal stage of broadly multidisciplinary engineering problems, unusually precise or poorly defined thermal problems, and difficult thermal design/test/analysis conditions. Our thermal engineers specialize in systems engineering, design and analysis, or thermal control technologies, such as heat pipes, cryocoolers, thermal materials, and new thermal management concepts.

Lines of Research

- Guidance, navigation, and control
- Space vehicle performance
- Structural mechanics
- Autonomy and vehicle engineering

Example Research Areas and Projects

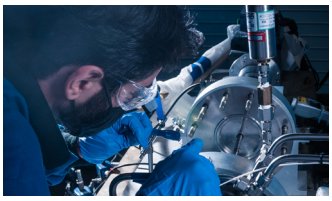
- Laser communications
- Engineering data analysis and trending
- Autonomous vehicles
- Advanced control and estimation techniques
- Space maneuvering
- Cooperative robotics
- Additive manufacturing Analysis and application
- Pointing and navigation sensors
- Hypersonic vehicles
- Booster propulsion technology

End-to-End Performance Simulation

An essential function of VSD is the expert development of multidiscipline models and simulations to analyze end-to-end spacecraft and payload performance, coupled with ground system processing to enhance final data products. We employ talented engineers with deep technical knowledge in spacecraft subsystems, including controls, propulsion, structures, thermal, and communications, along with solid general engineering skills to develop analyses focused on the interactions of engineering disciplines. In addition to mechanical and aerospace engineering skills, our analysts are experts in algorithm development for modeling real-world systems, with an interest in creating flexible simulation environments.

Autonomous Control Systems

Our employees are interested in all aspects of how to control systems. This includes understanding the essential hardware elements, such as gyroscopes, accelerometers, IMUs, star trackers, reaction wheels, fast steering mirrors, CMGs, thrusters, motors, encoders, inductosyns, and GPS receivers. It also includes the skills needed to develop analytical simulations and laboratory validations to understand performance factors. Current challenges relate to extending capabilities to monitor health, coordinating in formations, applying artificial intelligence, and using advanced sensor fusion. Critical skills include neural networks, deep learning, and cross-domain expertise relevant to the development of embedded systems and the associated software/hardware-in-the-loop simulations.

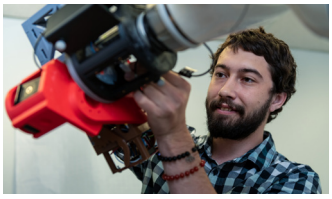


Trajectory Design and Optimization

Our trajectory design group provides mission analysis and optimization support for spacecraft, launch vehicles, reentry vehicles, and ballistic missiles in the near-Earth, cislunar, and interplanetary domains. This support spans the entire system lifecycle, including conceptual design; technology assessment; prelaunch analysis; launch operations; on-orbit maneuvering; and end-of-life disposal. Many vehicle propulsion technologies can be considered, including chemical propulsion, electric propulsion, hybrid chemical-electric, and hypersonic glide vehicles. Each vehicle type requires its own specific set of simulation techniques and optimization strategies.

Vibroacoustic Analysis

Our vehicle shock and vibration group provides expertise in dynamic environments for a variety of programs in the defense and civil sectors. We specialize in test support and hardware issue disposition, standards development, design criteria, time and frequency domain signal processing, and vibroacoustic analysis. Analysis efforts involve generation of acoustic, aerodynamic, and mechanical forcing functions; modeling via FEA, SEA, BEA, semiempirical methods, hand calculations, and computational scripts; and calculation of structural responses. We interface with multiple disciplines, including structures, propulsion, fluid mechanics, and mechanisms. Support ranges from long-lead projects to rapid requests requiring quick engineering judgment and hardware intuition.



The Aerospace Corporation

The Aerospace Corporation is a national nonprofit corporation that operates a federally funded research and development center and has more than 4,500 employees. With major locations in El Segundo, California; Albuquerque, New Mexico; Colorado Springs, Colorado; and the Washington, D.C. region, Aerospace addresses complex problems across the space enterprise and other areas of national and international significance through agility, innovation, and objective technical leadership. For more information, visit www.aerospace.org.

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