ENGINEERING AND TECHNOLOGY GROUP

The Engineering and Technology Group (ETG) is a nationally recognized space systems and technology resource. Containing approximately half of The Aerospace Corporation's technical talent, ETG consists of six specialty organizations equipped with state-of-the-art computing, testing, diagnostic, research, simulation, and laboratory facilities as well as unique databases that have evolved since the beginning of the space era.

Communication Technologies and Engineering Division

All spacecraft, launch vehicles, and ground systems rely upon successful communications. Main-mission communication satellites, wideband links, command and telemetry, and terrestrial networks along with their enabling technologies are the domain of the Communication Technologies and Engineering Division (CTED). The division addresses the field from architectures to implementation, working with corporate customers to ensure robust and resilient communications are available. To enable this, it maintains an impressive array of laboratories, software tools, and computing resources that are available to perform conceptual design; feasibility and trade studies; modeling and simulation; prototype construction; integration and test modeling; and anomaly investigation and resolution. The division continues to advance the state of the art through efforts in advanced antenna design, digital signal processing, millimeter wave technologies, optical communications, and the evolving regulatory processes employed to ensure customer access to RF spectrum. Division staff at all major corporate locations apply the fundamentals of communications to diverse areas, including GPS signals and receivers, geolocation, signal intelligence, and radar systems.

RF AND OPTICAL COMMUNICATION
› Payload implementation and assessment
› Telemetry and command
› Ground stations
› Antenna/ground systems
› Phased arrays
› Optical communications
› Traveling wave tube amplifiers, solid-state power amplifiers, low-noise amplifiers
› RF electronics and components
› Time and frequency standards
› End-to-end hardware performance assessment and subsystem measurement

COMMUNICATION AND NETWORK ARCHITECTURES
› Network systems design, analysis, and troubleshooting

› Network modeling and performance
› Signal processing design, development, and analysis
› Communication waveform development
› Wireless (terrestrial and space-based) communications and technology
› Spectrum management
› Flexible terminals
› Communications analysis and simulation
› Field collections and measurements
› Communication systems engineering

COMMUNICATION SYSTEMS AND AGILE PROCESSING
› Software defined radios
› GPS/GNSS user equipment and navigation payloads
› Algorithm implementations for

high-speed processing
› Machine learning for digital communication systems
› Cryptography
› Field measurements
› Signal Intelligence (SIGINT) and geolocation
› Hardware/CubeSat prototypes
› RF and microwave subsystems
› Jamming and scintillation mitigation and analysis

SATCOM DEVELOPMENT AND STRATEGY
› Concept development
› Commercial system assessment
› Enterprise strategies and roadmaps

Electronics and Sensors Division

The Electronics and Sensors Division (ESD) is a world-class engineering and scientific leader in electronics and remote sensing systems. Our staff span a broad range of disciplines, including radio frequency, infrared, visable and multispectral sensors; sensor data exploitation methods; analog and digital circuits; microelectronics, vehicle power systems; and space system electronic parts, materials, and processes. Our expertise, combined with our sophisticated laboratories, prototyping, modeling, and simulation capabilities, enables ESD to deliver innovative solutions to national space systems and civil customers.

ELECTRONICS

› Power system analysis (generation, management, and distribution)
› Electromagnetic effects measurement, analysis, and mitigation
› Electronics system integration
› Parts, materials, and processes evaluation
› Failure analysis
› Electronics measurement, modeling, and simulation
› Radiation effects modeling and analysis
› Microwave and RF circuits and systems

› Microelectronics and FPGA simulation and analysis
› Digital and analog electronics measurement, modeling, simulation, and prototyping

SENSOR SYSTEMS AND SIGNALS

› Rapid sensor prototyping
› Radio frequency, radar, and microwave sensor system design, analysis, and implementation
› Optics and electro-optical system architecting, design, and analysis

› Remote sensing data exploitation using machine learning, deep learning, and computer vision
› Image and signal detection, analysis, and processing (including sensor and remote sensing data analysis)

SENSORS

› Optical engineering and system modeling
› Electro-optical devices and focal plane arrays
› Radio frequency, radar, and microwave sensors
› Remote sensing phenomenology modeling

Information Systems and Cyber Division

The Information Systems and Cyber Division (ISCD) is the premier provider of current, state-of-the-art, and future secure information systems expertise for the space enterprise and beyond. ISCD staff couple the latest in information system technologies, such as cloud computing, artificial intelligence, cybersecurity, and augmented/virtual reality, with modern computer and software engineering methods to deliver responsive and timely engineering products of the highest quality to a variety of customers.

INTEGRATED DATA & APPLICATIONS

› Software systems engineering and assurance
› Ground systems concepts design, engineering, and transitions
› Engineering software tool development
› Computer-aided design and rapid prototyping
› Orbit analysis and space environment applications
› Visualization and immersive technology
› Telemetry systems engineering/processing
› Utility and performance modeling and simulation
› Data platform architectures and analytics pipelines
› Cloud software development & migration
› Artificial intelligence and machine learning research
› Applied data science
› Machine learning engineering
› Operationally-relevant engineering solutions

CYBERSECURITY AND ADVANCED PLATFORM

› Space enterprise cybersecurity
› Space enterprise cyber operations, wargames, and strategy
› Enterprise and architecture cybersecurity engineering
› Program protection planning
› Software vulnerability analysis and reverse engineering
› Information assurance certification and accreditation
› Cybersecurity situational awareness
› Cybersecurity resiliency assessments and risk management
› Cybersecurity vulnerability and penetration testing
› Wireless and mobile cybersecurity

SOFTWARE ENGINEERING

› Software architecture evaluation and reconstruction
› Software systems acquisition
› Enterprise engineering and integration
› Software prototyping and integration
› Model-based software engineering
› Flight software and realtime embedded systems
› Software lifecycle standards, processes, and methodologies
› Software code analysis and assessment
› Software measurements and metrics
› Software process modeling and simulation
› System performance forecasting
› Agile and DevOps methodologies

Systems Engineering Division

The Systems Engineering Division (SED) is the corporate focal point for system-level modeling and analysis of the design, performance, and programmatic feasibility of national space systems. SED provides unmatched experience in systems engineering to the U.S. government and to numerous public and private agencies, universities, nonprofit organizations, consortia, and commercial companies involved in the advanced application of space technology. From systems architecture development to system analysis and optimization, astrodynamics, orbital debris, navigation, failure analysis, mission assurance, cost and schedule assessment, and economic market analysis, SED exploits an incredibly broad array of engineering and business disciplines against a diverse and dynamic portfolio of programs and national challenges.

SYSTEM ANALYSIS AND SIMULATION

› Space traffic management
› Mission architecture simulations
› System performance analysis and optimization
› Astrodynamics
› Constellation design
› Collision risk assessment
› Satellite navigation
› Orbit determination
› Geolocation performance analysis
› Orbital debris analysis
› Space security
› Threat and resiliency analysis

ARCHITECTURE AND DESIGN

› Concept Design Center
› Enterprise systems engineering
› Model-based systems engineering
› Space and launch system architecture development
› System-of-systems engineering

› Satellite and subsystem design evaluation
› System trades and analysis
› System performance analysis
› Small satellite design and analysis
› Launch system performance evaluation

ACQUISITION ANALYSIS AND PLANNING

› Acquisition Expertise
› Cost, Schedule, and Risk Analysis
› Data Centric Acquisition and Systems Engineering
› Economic and Market Analysis
› Agile Acquisition
› Decision Science and Analytics
› Industrial Base and Supply Chain Assessments

MISSION ASSURANCE

› Product and process assurance and manufacturing engineering
› Risk planning, assessment, and management
› Ground facilities infrastructure development and engineering
› Integration, test, operations, and test-like-you-fly assessments for space segment, mission systems, systems of systems and enterprise level
› Satellite constellation replenishment analysis
› Reliability engineering, failure modes, and effects analysis
› Statistical modeling and analysis
› Mission assurance planning, application and verification management

Physical Science Laboratories

Physical Sciences Laboratories (PSL) supports the effective and timely development and operation of national security systems through scientific research and the application of advanced technologies. PSL has more than 100 specialized laboratories used to test, analyze, and troubleshoot virtually every aspect of rocket and satellite system design, development, construction, deployment, and operation. The diverse expertise of the laboratories' technical staff allows PSL to stay abreast of new technological developments and program support issues associated with rapidly evolving space systems.

ELECTRONICS AND PHOTONICS

› Microelectronics device performance, reliability, and anomaly resolution
› Radiation-hard microelectronics
› Micro and nano analysis
› Spacecraft and launch vehicle batteries and fundamental electrochemistry
› Solar cells and arrays
› Laser technology and optical communications
› Laser remote sensing and on-orbit sensor calibration
› Atomic clocks and other applications of atomic physics
› Optoelectronic material and device physics
› Optical signal processing, compressive sensing
› Integrated and RF photonics design and fabrication

SPACE MATERIALS

› Space use of metals, composites, and polymers
› Advanced material characterization
› Tribology and bearing mechanics
› Electrical and chemical propulsion science
› Nondestructive evaluation of materials
› Contamination
› Space environmental effects
› Optical thin films
› Advanced Manufacturing

SPACE SCIENCE APPLICATIONS

› Calibration and validation of on-orbit sensors
› Single-event effects testing
› Atmospheric and ionospheric effects
› Space environment measurements and modeling
› Space weather
› IR and UV target and background signatures
› Environmental modeling and chemistry
› Hyperspectral sensor design and fabrication
› Hyperspectral data applications and algorithms

Vehicle Systems Division

The Vehicle Systems Division (VSD) provides engineering solutions to the nation's vehicle system challenges when and where they are needed. VSD's 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. Composed primarily of highly trained mechanical and aerospace engineers, VSD provides national expertise in the fields of vehicle engineering, guidance navigation and control, electromechanical devices, embedded systems, flight mechanics, fluid mechanics, propulsion, thermal systems, mechanisms, structures, structural dynamics, and dynamic environments.

GUIDANCE AND CONTROL

› Attitude determination and control
› Payload line-of-sight pointing and estimation
› Jitter, line-of-sight stability and vibration isolation
› Control system fault management and safe mode evaluation
› Inertial sensors (gyros, star trackers)
› Servomechanism analysis and design
› Precision pointing systems
› Hardware testing
› Flight software systems
› Embedded system applications
› Hardware-in-the-Loop, Software-in-the-Loop simulation
› Collaborative robotics
› Flight control and guidance performance
› Navigation and GPS applications
› Interceptor and conventional strike capability assessment

VEHICLE PERFORMANCE

› Aerodynamics and CFD applications
› Aerodynamics, hypersonics, and CFD applications
› Launch and reentry vehicle thermal analysis
› Fluid systems and component analysis
› Orbital and reentry debris studies
› Liquid propulsion
› Satellite propulsion
› Solid propulsion
› Engine technology
› Spacecraft thermal design
› Thermal systems engineering
› Thermal control technology
› Mission design (trajectories)
› Flight trajectory design and optimization
› Engineering visualization

STRUCTURAL MECHANICS

› Shock, vibration, and acoustic testing
› Electronic component structural analysis
› Spacecraft and launch vehicle dynamics
› Mode survey testing and time series data analysis
› Independent coupled loads analysis
› Flexible system separation analysis and testing
› Space and launch vehicle structural analysis
› Structural integrity assessment and testing
› Thermostructural technologies
› Advanced structural technologies and materials
› Mechanical systems, mechanisms, and bearings
› Ordnance device analysis and applications
› Separation and deployment analysis and testing

VEHICLE ENGINEERING

› Interface requirements (hardware-to-hardware and hardware-to-software)
› Payload integration and support
› Assembly, integration, and test
› Small Satellite Simulation and Integration
› Integrated Advanced Autonomy
› System to Architecture Scale Simulation Framework
› Anomaly investigation and mitigation
› Mass properties
› Vehicle simulation
› Geolocation
› End-to-end system analysis
› Fault management and vehicle safing

The Aerospace Corporation

The Aerospace Corporation is a national nonprofit corporation that operates a federally funded research and development center and has more than 4,600 employees. With major locations in Chantilly, Virginia; El Segundo, California; Albuquerque, New Mexico; and Colorado Springs, Colorado, 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.

AEROSPACE