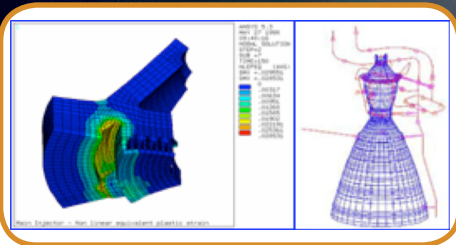


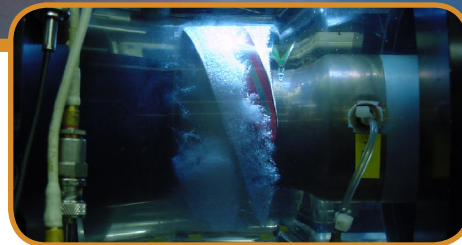


Marshall Space Flight Center Propulsion Structural, Thermal & Fluid Analysis

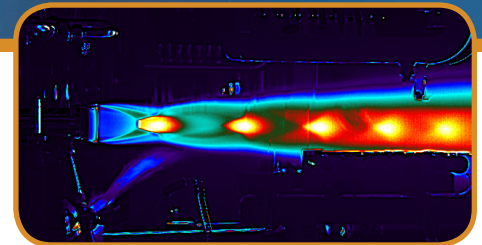
Engineering Solutions for Space Science and Exploration



Stress and Dynamics



Fluid Dynamics



Thermal

The Propulsion Structural, Thermal & Fluid Analysis Division (ER40)

provides technical expertise for propulsion systems by engaging through the entire life cycle. The division provides value added products that result in growing deep technical discipline lines needed at NASA, Other Government Agencies, Industry, and Universities. The division provides expertise in the areas of integrated analysis, problem resolution, testing, and data reduction for multiple propulsion systems (e.g. solids, liquids, nuclear, etc), components (turbomachinery, valves, line, ducts, combustion devices, etc.) and flight vehicles. To meet the challenging needs continually requested by our customers, team members are constantly developing new tools, techniques, test facilities/rigs, and relevant one-of-a-kind data to ensure safe and reliable space flight.

The Structural and Dynamics Analysis Branch (ER41) is responsible for all aspects of structural and dynamic analysis of propulsion hardware. The branch specializes in dynamics, strength, and life assessments of components under extreme operating environments of space vehicle propulsion systems. It also provides analysis support for design and development of non-propulsion hardware such as ground support equipment, pumps, and rotating machinery.

The Fluid Dynamics Branch (ER42) is responsible for all aspects of the discipline of fluid dynamics applied to propulsion or propulsion-induced loads and environments. This work begins with design trades and parametric studies, and continues through development, risk assessment, anomaly investigation and resolution, and failure investigations. Because of the skills in the branch, ER42 also works non-propulsion items such as telescopes and payload racks on an as needed basis. The branch is discipline-centric, and utilizes methods including system stability analysis, lump parameter modeling, finite element modeling, CFD, cold flow testing, and signal processing.

The Thermal Analysis Branch (ER43) is responsible for all thermal and thermal fluid aspects of propulsion systems and hardware. The branch specializes in assessing the thermal environments and conditions and mitigating issues resulting from these extreme operating environments, including large thermal transients that exist on space vehicle propulsion systems. Because of the skills in the branch, ER43 also works non-propulsion on an as needed basis (e.g. Infrared Thermography).

Capabilities

While each branch has numerous areas of expertise, the capabilities listed below highlight several key areas for which the branches are nationally and internationally recognized as being leaders in the field.

Structural and Dynamics Branch:

- > Structural Dynamics Analysis
 - Component dynamics, loads, and environments analysis
 - High-frequency dynamic response assessments
 - Fluid-structure interaction
- > Strength, Fatigue, and Fracture Analysis
 - Thermal-structural and nonlinear assessments
 - Analysis of high-temperature ablative nozzles
 - Analysis of viscoelastic solid propellant, liner, and insulation
- > Rotordynamic Analysis
 - Linear and nonlinear stability assessments of rotating machinery
 - Bearing and seal design, analysis, and testing
- > High speed Vibration Data Analysis
 - Analysis of high speed dynamic data from engine testing
 - Assessment and real-time monitoring of rotating machinery
 - Development and integration of high speed vibration data acquisition and health management systems
- > Vibroacoustic and Shock Analysis
 - Development of vibration, acoustic, and shock design and test criteria
 - Vibration and shock test support

Fluid Dynamics Branch:

- > Acoustics
 - Internal acoustics
 - Lift-off/separation environments (including acoustics, IOP, debris, hydrogen entrapment)
- > Multiphase Flows
 - Sound suppression
 - Cavitation dynamics
 - Slosh dynamics
- > Combustion Dynamics
 - Injection dynamics
 - Chamber acoustics
 - Combustion stability
- > Computational Fluid Dynamics
 - Algorithm development and validation
 - Loads and environment predictions (steady, unsteady, transient, multiphase, multispecies)

- > Cold Flow Testing
 - Air and waterflow testing for Turbines, pumps, nozzles, Feed-lines, etc. with dynamic data acquisition
- > Coupled System Dynamics
 - Coupled pump/MPS dynamics
 - Pogo
 - Thrust oscillations
- > Flow Dynamics
- > High-Speed Data Acquisition, Analysis, and Signal Processing
 - Data acquisition and analysis
 - Signal processing
 - Instrumentation calibration, set-up, and placement
- > System Identification
 - System damping
 - Dynamic characterization

Thermal Analysis Branch:

- > Thermal and thermal structural analysis
 - Complex integrated conjugate systems and component analysis
 - Testing/instrumentation support
- > Thermal fluid analysis including characterization of environments
 - Development and release of the industry and educational versions of the NASA software “General Fluid Systems Simulation Program (GFSSP)”
 - Joint analysis (thermal and joint pressurization)
 - Film cooling
- > Thermo-chemical analysis and testing
 - Composite ablative modeling including ply-lifting and pocketing phenomena
 - Iterative grid regeneration routines to account for “burn-back”
 - Thermal characterization of materials/environment including planning/performing tests
- > Infrared thermography—wide range of applications (e.g. additive manufacturing, engine testing, vehicle testing, components testing (e.g. tanks))
 - Highly accurate temperature profiles and data over a large temperature range
 - Vehicle tracking, debris tracking, and IRIG timing
 - Camera calibration, set-up, data acquisition, and post-processing
 - Custom data and image processing software including multi camera fusion

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

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Huntsville, AL 35812
www.nasa.gov/marshall

www.nasa.gov