



# Models, Simulation, and Software

Johnson Space Center (JSC) offers capabilities in developing high-fidelity, real-time, human-in-the-loop engineering simulations with math models, scene generation, and realistic control station mockups. Expertise is available in software development, including flight and ground systems, real-time, mission critical, embedded software, software integration, and hardware-in-the-loop testing. JSC also provides computer graphics and model development for engineering visualization as well as state-of-the-art facilities for testing advanced simulation environments, allowing integration of multiple models into a single simulation.

## Services Provided

- Software development, testing, and simulation
  - Flight and ground systems
  - Real-time, mission-critical, embedded software
  - Software integration and hardware-in-the-loop testing
  - Capability Maturity Model Integration (CMMI) certified software development organization
  - Advanced simulation environments allowing integration of software developed for many platforms
  - Integration of multiple models into a single simulation
  - Real-time analysis
- Simulation
  - Trick Generic Simulation Toolkit for rapid development of high-fidelity simulations
  - Design, development, and integration of high-fidelity, real-time, human-in-the-loop simulations
  - Six-degree-of-freedom simulations of single- and multiple-vehicle missions for various flight phases
  - User defined graphical user interfaces
- Models and Graphics
  - 3-D engineering visualization, modeling, and graphics custom software development
  - Animated Graphics for Engineering Analysis (AGEA)
- Dynamics systems testing
  - Physical emulation of spacecraft motion with motion platforms
  - Open and closed-loop testing of automated rendezvous and docking systems
  - Real-time, hardware-in-the-loop, human-in-the-loop testing



## Simulation

Human-in-the-Loop Simulation	<ul style="list-style-type: none"> <li>• Integrated engineering simulation with high-fidelity dynamics and pilot environment models designed for tasks that require crew in the loop.</li> <li>• Simulation of multiple free-flying vehicles with accurate six-degree-of-freedom equations of motion</li> </ul>
Guidance Navigation & Control (GN&C)	<ul style="list-style-type: none"> <li>• Build high-fidelity, six-degree-of-freedom simulations of single- and multiple-vehicle missions for various flight phases</li> <li>• Development of high-fidelity models and simulations used for integrated GN&amp;C design and analysis</li> <li>• High-fidelity visualization of real-time GN&amp;C operations</li> </ul>
Mechanical Interfaces	<ul style="list-style-type: none"> <li>• Open and closed-loop testing of automated rendezvous and docking systems</li> <li>• Closed-loop testing of mating interfaces, including contact forces</li> <li>• Physical emulation of spacecraft motion with motion platforms</li> </ul>
Communication Systems	<ul style="list-style-type: none"> <li>• Model and simulate the performance of both proposed and actual spacecraft communication systems, subsystems, components, and parts.</li> <li>• Services include radio frequency coverage, communication systems performance, signal analysis, frequency management, RF compatibility, and anomaly resolution</li> </ul>

## Models

3-D Engineering Visualization	<ul style="list-style-type: none"> <li>• Data visualization</li> <li>• Advanced concept visualization</li> </ul>	<ul style="list-style-type: none"> <li>• Proof-of-concept</li> <li>• Accident reconstruction</li> </ul>
3-D Modeling	<ul style="list-style-type: none"> <li>• Model reduction and correlation</li> <li>• Texture mapping</li> </ul>	<ul style="list-style-type: none"> <li>• Reflection mapping</li> <li>• Bump mapping</li> </ul>
3-D Graphics Custom Software Development	<ul style="list-style-type: none"> <li>• Develop custom algorithms for 3-D computer graphics</li> <li>• 2-D displays and controls</li> </ul>	<ul style="list-style-type: none"> <li>• Physics simulations</li> <li>• Lighting simulations</li> </ul>
Mockup Development	<ul style="list-style-type: none"> <li>• Develop low-to-medium fidelity, full-scale mockups of space vehicles and habitats to user specifications and coordinate testing at remote locations</li> <li>• Develop simulation control interfaces, including mockups of control panel hardware and crew interface and control software to fully evaluate the mockup and interface panel design and integration</li> </ul>	

## Software

Software Development and Evaluation	<ul style="list-style-type: none"> <li>• Flight and ground systems, real-time, mission-critical, embedded software, software integration, and hardware-in-the-loop testing</li> <li>• CMMI certified software development organization</li> </ul>
Software Testing and Simulation	<ul style="list-style-type: none"> <li>• Advanced simulation environments allowing integration of software developed for many different platforms</li> <li>• Integration of multiple models into a single simulation</li> </ul>
Vehicle Systems Management	<ul style="list-style-type: none"> <li>• Fault detection, isolation, and recovery software</li> <li>• Automation for human workload reduction, flight safety enhancement, and resource management</li> </ul>
Automation and Robotics	<ul style="list-style-type: none"> <li>• Hardware and software integration for human robotic systems</li> <li>• Teleoperations, autonomous system control, and automation for operations</li> </ul>

We have developed customer-friendly agreements to streamline business relationships and are eager to share our unique facilities and expertise with new customers. We invite your inquiries regarding application or adaptation of our capabilities to satisfy your special requirements. Briefings on general or specific subjects of mutual interest can be arranged at JSC or at your business site.

### Facility Testing Information

<http://jsceng.nasa.gov>

### Point of Contact

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