National Aeronautics and
Space Administration

Flight Mechanics

Johnson Space Center (JSC) provides design and evaluation of mission concepts, vehicle flight performance capabilities and requirements, and preliminary guidance, navigation, and control (GN&C) requirements. This includes flight envelopes and trajectories for ascent, targeting and profiles for on-orbit rendezvous, interplanetary trajectories, and entry through landing designs. These efforts also include assessments of system requirements, such as those related to GN&C architecture, propulsion, thermal protection, aerodynamics, and decelerators. Launch and landing capability windows are defined, as well as guidance algorithms developed, to produce the desired trajectory performance. JSC provides end-to-end mission design and vehicle performance analysis for all current and advanced vehicle concepts for low Earth orbit, lunar, and planetary missions.

Services Provided

- End-to-end mission design
- Mission phase trajectories development
  - Ascent/on-orbit/rendezvous
  - Deorbit/entry/descent/landing
  - Aerocapture
  - Interplanetary
- Constraint envelopes and corridors
  - Launch windows
  - Landing opportunities
  - Entry corridors
  - Footprints
- Vehicle Performance
  - Vehicle capabilities and requirements
  - Flight performance definition
  - GN&C requirements and algorithms
  - Vehicle dynamics
  - Parachute systems design/performance
  - Entry demise/debris predictions
  - Flight performance visualization

End-to-End Mission Design

The Flight Mechanics Laboratory uses a high-performance Linux computing cluster and specially designed software tools in order to solve various flight mechanical disciplines.

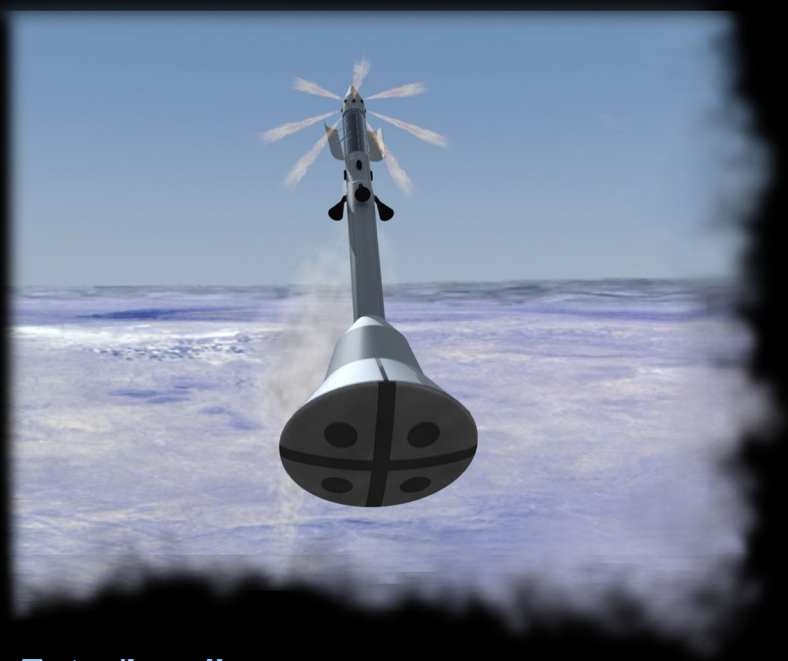
- Development of mission opportunities – departure windows, trip times, energy costs
- Flight phase development – ascent, orbit, deorbit, entry/landing
- Integration of all flight phases into a total mission architecture
- Build requirements for all flight, terrestrial, and planetary systems – definition of GN&C concepts
- Assessment of environmental model effects – gravity, atmosphere, planetary motion

Ascent

- Powered flight – high thrust ascent
- Design and development of flight profiles
- Guidance and control requirements and methods
- Performance assessments
- Aerodynamic stability and dynamics

On-Orbit

- Methods for orbital maneuvers – guidance and control requirements
- Aerocapture guidance and trajectory design
- Orbital rendezvous design
- Orbital lighting/communication/tracking
- Deorbit targeting and guidance
- Entry and aeroassist
- Rendezvous and proximity operations with guidance
- Performance assessments
  - Landing opportunities
  - Proximity opportunities



Entry/Landing

- Trajectory design – constraints
- Entry guidance and control design – requirements and methods
- Performance assessments – aerodynamic stability and dynamics
- Terminal area energy management
- Decelerators
  - Parachutes and parafoils
  - Design, test, and simulation
  - Parafoil GN&C
- Hazard avoidance and landing

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

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FS-2011-07-026-JSC