E99

ISS Attitude and Pointing Visualization

Actual photograph from STS-134 Soyuz Fly-around

Preflight generated image of STS-134 Soyuz Fly-around

How do you explain how your oriented and what your looking at?

The key to solving these problems is to understand what is your spacecraft's attitude and how is it pointing.

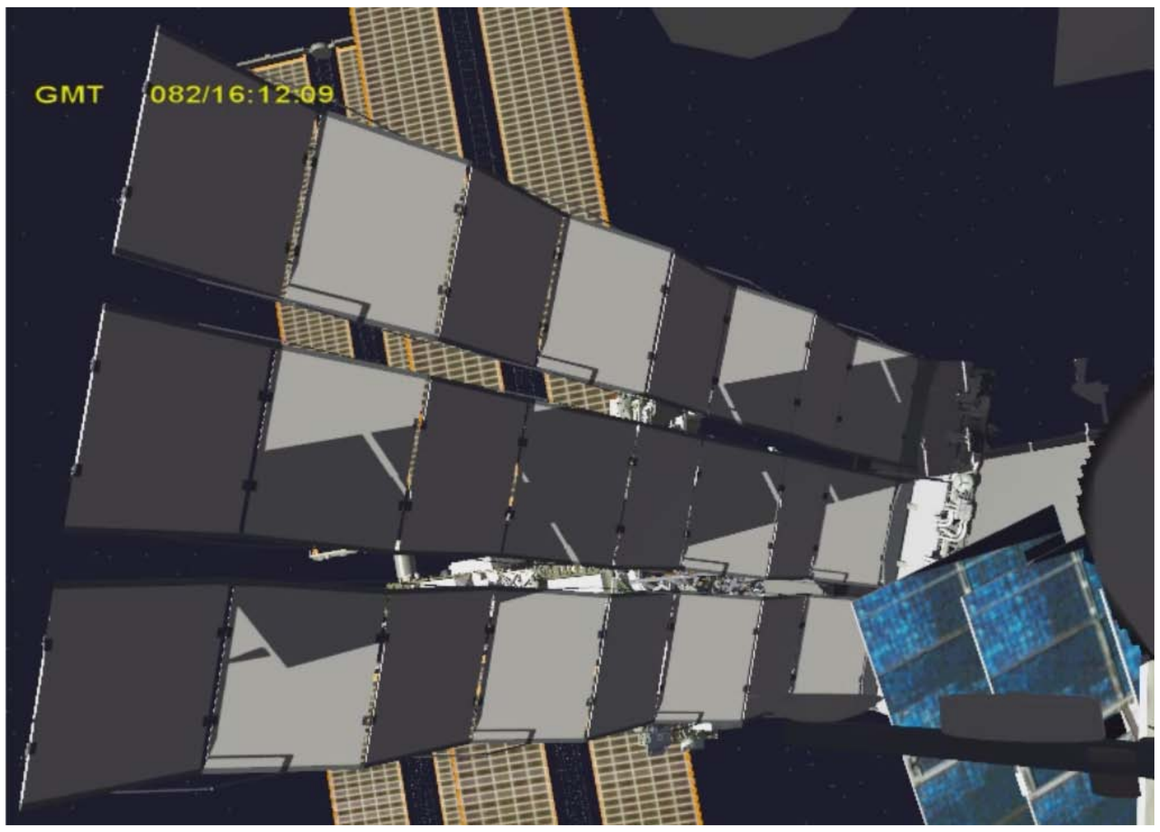
Attitude: How are you orientated in space? (ex. Yaw, Pitch, Roll)
Pointing: What your looking at? (ex. Orbiter star tracker looking at ISS on day of rendezvous)

Through the combination of JSC Engineering's EDGE 3-D Visual platform and the Attitude and Pointing Office's Multi-purpose Attitude and Pointing System (MAPS), highly realistic and accurate visual of complex attitude and pointing problems can now be easily explained.

This work was funded and completed thanks to the 2011 Innovation Charge Account (ICA).

Imagery and videos have been successfully used for planning and executing **real-world** missions:

Proposed STS-133 Soyuz Fly-around
STS-134 Soyuz Fly-around
STS-135 Modified Shuttle Fly-around
Visiting Vehicle dockings and undockings to ISS
Lighting assessment for ISS photogrammetric inspections
ISS External Camera target tracking
Crew Observations of ATV-3



Lighting assessment for ISS TARJ photogrammetric inspections

Mission Operations Directorate:
DM36/Attitude and Pointing Office
http://modspops.jsc.nasa.gov/mod/DM/Pointing/

How can NASA help you?

Attitude and Pointing

Attitude and Pointing Design and Analysis

Create and manage spacecraft's Attitude Timeline and analyze line of sight to any given target.

Create and manage spacecraft's communications with TDRS constellation.

Real-Time Operations

Vehicle independent Space-based Communication Asset Scheduling

- PTG schedules TDRS and Artemis communication resources
  - Shuttle (past)
  - ISS, USOS Visiting Vehicles (current)
  - MPCV (future)
- TDRS/Artemis resources are scheduled factoring in predicted spacecraft/TDRS trajectory, antenna Field of Views, NTIA radiation constraints, vehicle specific communication requirements, spacecraft structural blockage and TDRS Network requirements

Line of Sight Analysis

- Spacecraft Instruments and sensors
- Spacecraft communication antennas
- Camera Operations
- Space and Earth Observations
- Capable of targeting any location on/above the Earth, any spacecraft and any celestial object
- Ground target assessments
- Lighting/Shadowing assessments

Attitude Determination

- Determine attitudes required to meet mission constraints
  - Vehicle Thermal
  - Ground, space based and vehicle to vehicle Communications
  - Scientific Instrument pointing
  - Vehicle sensor pointing
  - Solar Power
  - Crew Observations
  - Convert attitudes between frames

Attitude Timeline

- Create and manage Attitude Timeline
  - Detailed plan and history of a spacecraft's entire attitude profile
- Attitude timeline built to satisfy:
  - Mission timeline
  - On-orbit Trajectory changes
  - ECLSS, Thermal and Communication requirements
  - Public-Affairs Office requirements
  - Spacecraft on-orbit testing and trouble shooting

Vehicle Animations

- Visiting Vehicle Docking/Undocking
- Trajectory Profiles
- Instrument Pointing
- Crew observations
- Sensor Visibility

Post-flight Analysis

Operations Heritage and Experience

- Over ### hours of operations and planning experience
- Supported many different programs and vehicles
  - Mercury, Gemini, Apollo
  - Space Shuttle and Shuttle payloads
  - International Space Station
  - ATV
  - HTV
  - Dragon
  - Cygnus
  - Multi-Purpose Crew Vehicle
- Operations and analytical capability are spacecraft independent and can be applied to almost any spacecraft imaginable

Independent Verification