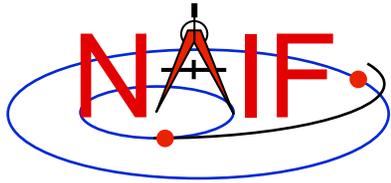


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Navigation and Ancillary Information Facility

# Using the Frames Subsystem

January 2012



# What is the Power of Frames?

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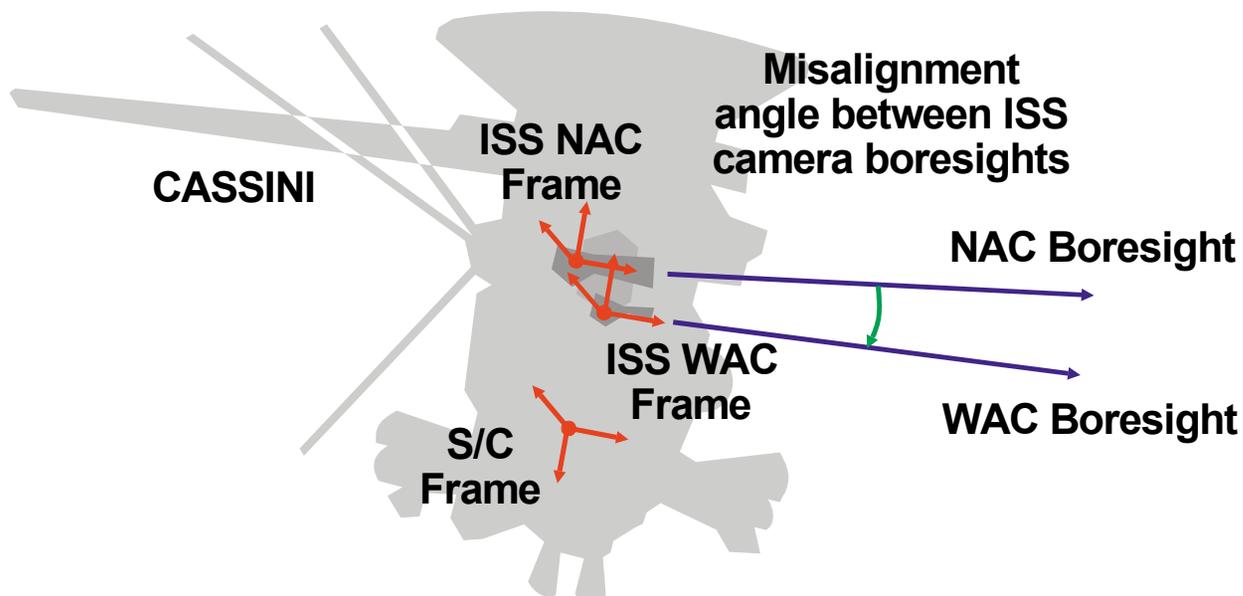
- The “power” of the Frames capability stems from the SPICE system’s ability to construct complex reference frame transformations with no programming effort required of you - the end user
  - But it’s crucial that you select and load the needed kernels
- The principal benefit from the Frames capability is obtained through the main SPK subsystem interfaces (SPKEZR and SPKPOS) and the Frames subsystem interfaces (SXFORM and PXFORM)
- The remaining pages illustrate typical use of frames
- Several **VERY IMPORTANT** usage issues are mentioned in the core Frames tutorial; be sure to also read that.

In SPICE terminology: “reference frame”  $\neq$  “coordinate system”



# Offset Between Instruments

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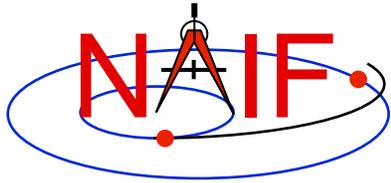


- Required Kernels:
- Generic LSK
  - Mission FK
  - Camera IK(s)

ISS = Imaging Science System

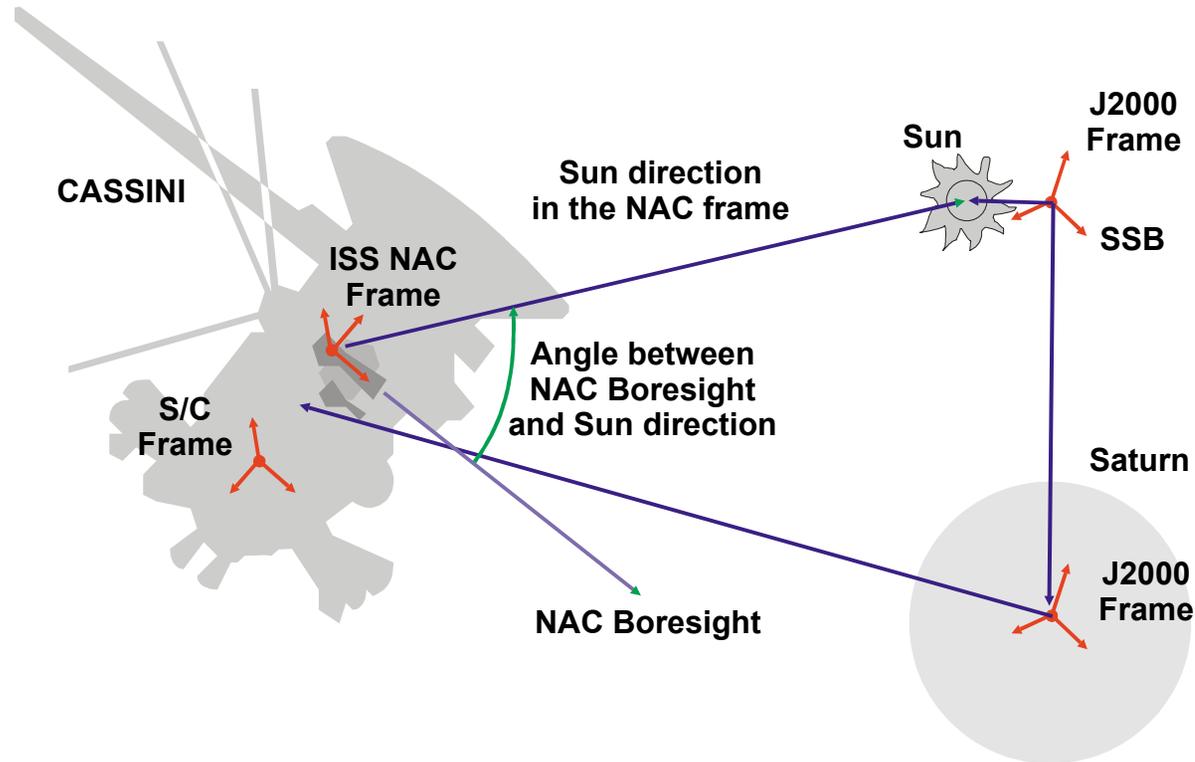
**Compute the angular separation between the ISS Narrow Angle Camera and Wide Angle Camera boresights:**

```
C Retrieve the matrix that transforms vectors from NAC to WAC frame
CALL PXFORM( 'CASSINI_ISS_NAC', 'CASSINI_ISS_WAC', ET, MAT )
C Transform NAC boresight to WAC frame and find separation angle
CALL MXV ( MAT, NAC_BORESIGHT_nac, NAC_BORESIGHT_wac )
ANGLE = VSEP( NAC_BORESIGHT_wac , WAC_BORESIGHT_wac )
```



# Angular Constraints

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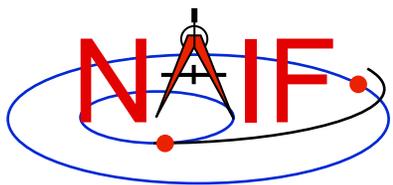


Required Kernels:

- Generic LSK
- Mission FK
- Spacecraft SCLK
- Camera IK
- Planetary Ephemeris SPK
- Spacecraft SPK
- Spacecraft CK

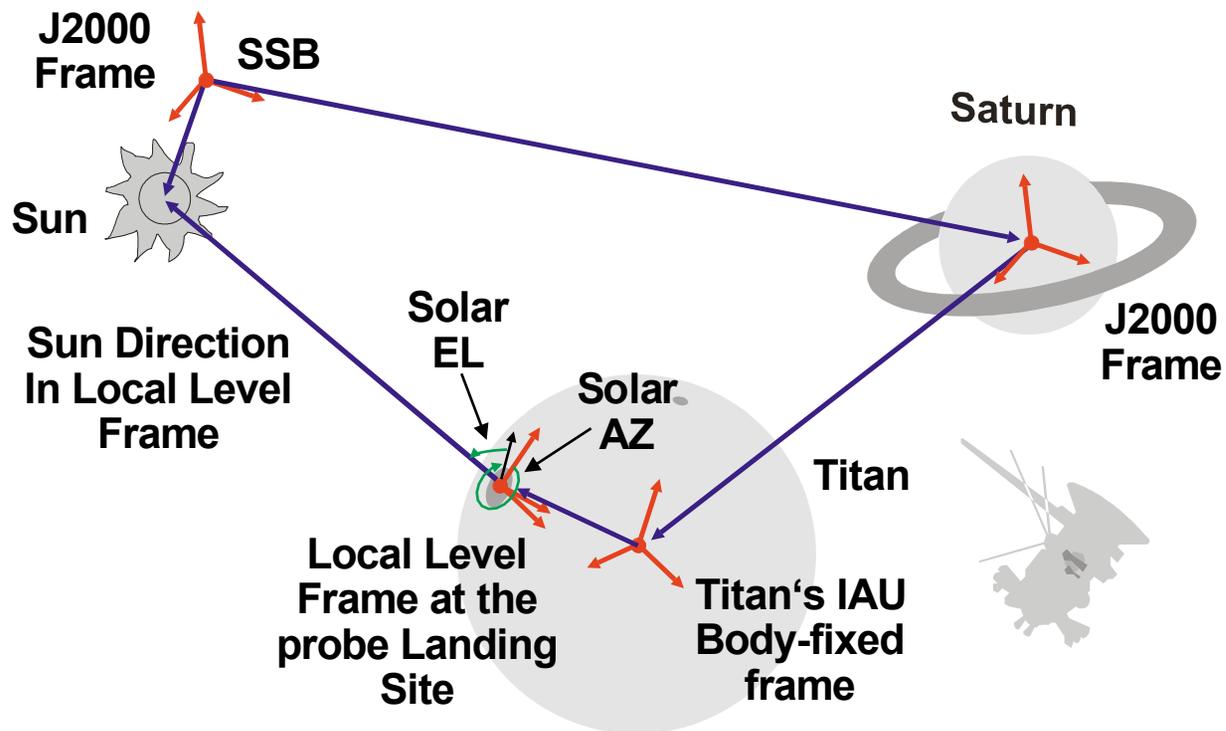
**Check whether the angle between the camera boresight and the direction to the Sun is within the allowed range:**

```
CALL SPKPOS( 'SUN', ET, 'CASSINI_ISS_NAC', 'LT+S', 'CASSINI', SUNVEC, LT )
ANGLE = VSEP( NAC_BORESIGHT_nac, SUNVEC )
IF ( ANGLE .LE. CONSTRAINT ) WRITE(*,*) 'WE ARE IN TROUBLE!'
```



# Angles at the Surface

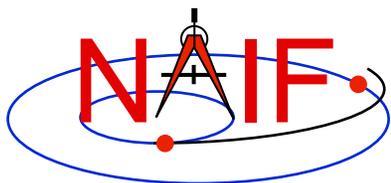
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- Required Kernels:**
- Generic LSK
  - Generic PCK
  - Mission FK
  - Planetary Ephemeris SPK
  - Satellite Ephemeris SPK
  - Landing Site SPK

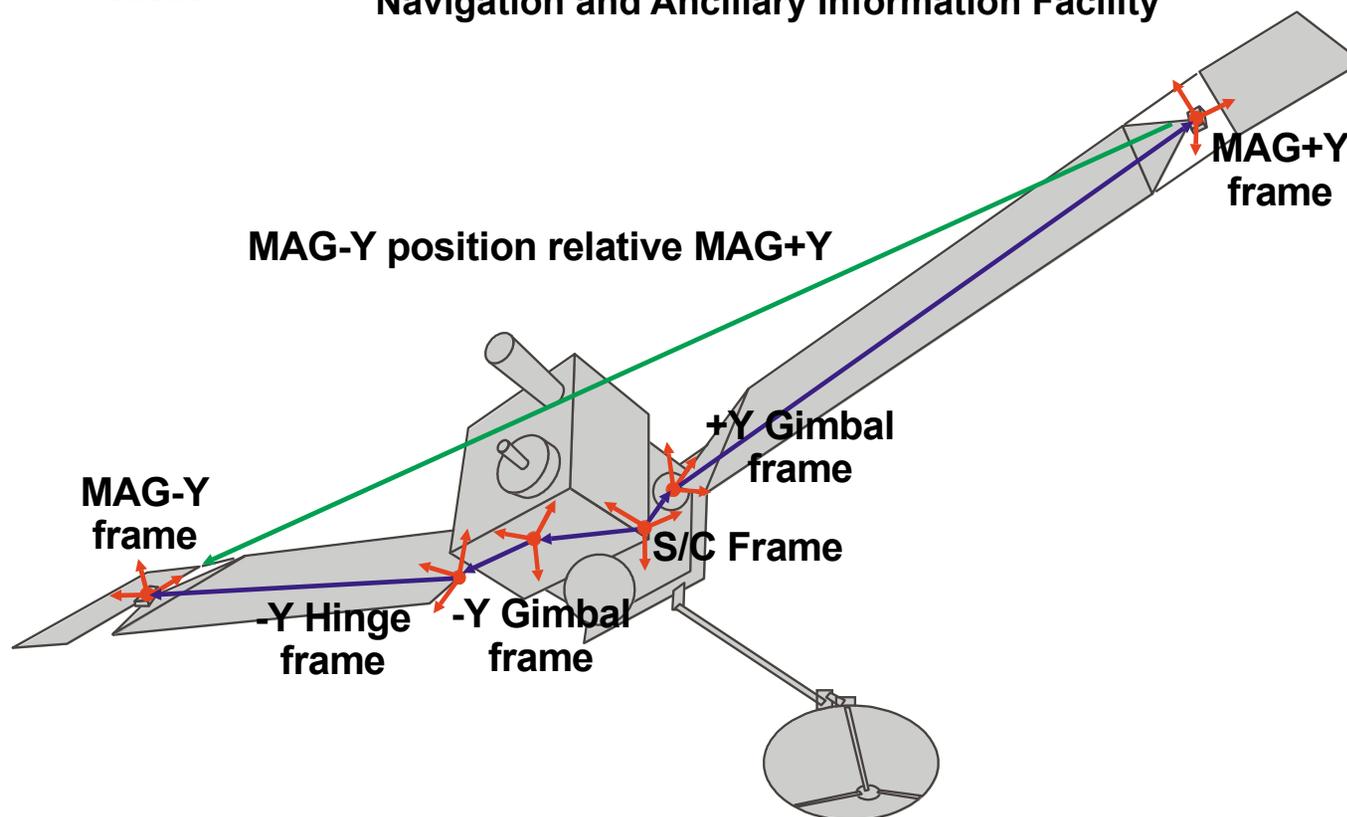
## Compute solar azimuth and elevation at the Huygens probe landing site

```
CALL SPKPOS('SUN', ET, 'HUYGENS_LOCAL_LEVEL', 'LT+S', 'HUYGENS_PROBE', SUNVEC, LT)
CALL RECLAT(SUNVEC, R, AZIMUTH, ELEVATION)
ELEVATION = -ELEVATION
IF (AZIMUTH .LT. 0.D0) THEN
    AZIMUTH = AZIMUTH + TWOPI()
ENDIF
```



# Relative Position of Sensors

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- Required Kernels:
- Generic LSK
  - Mission FK
  - Structure Locations SPK
  - Spacecraft SCLK
  - Solar Array CK

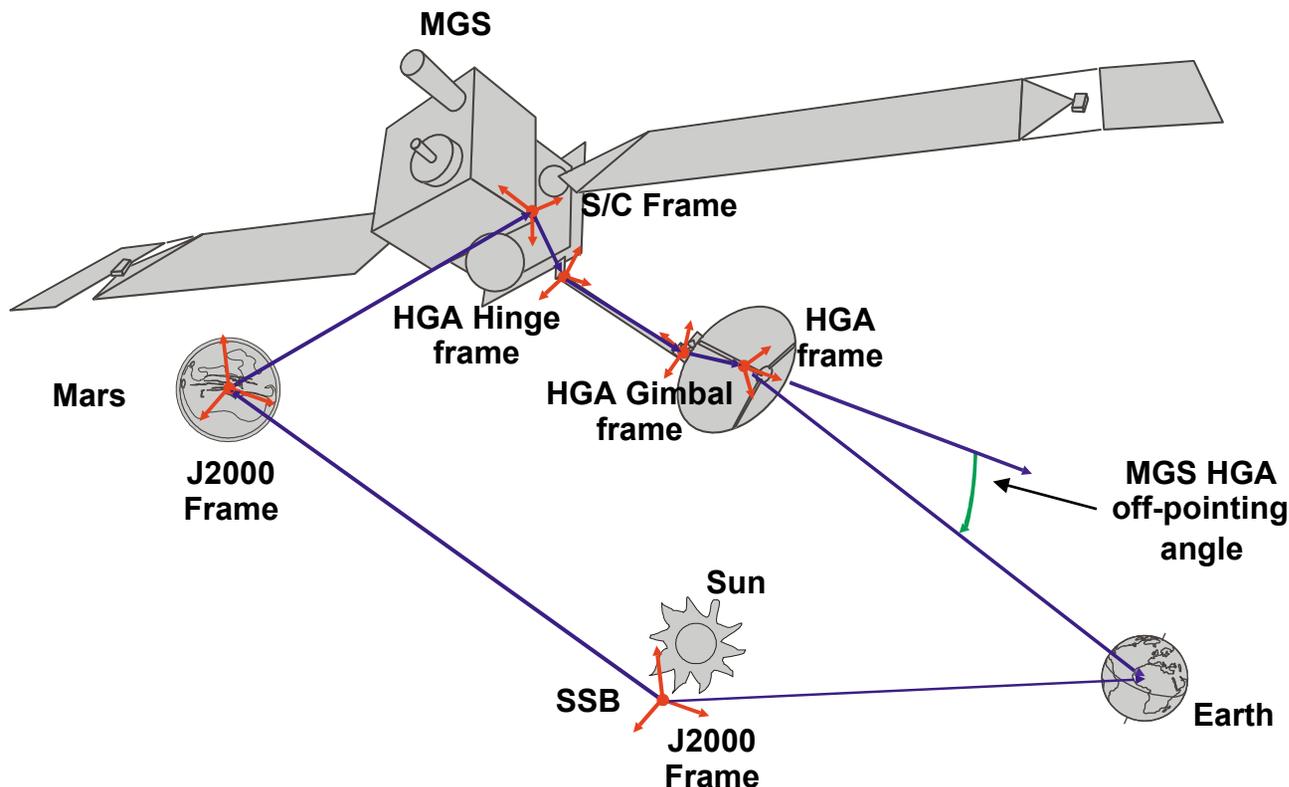
Find the position of one MGS MAG sensor with respect to the other in the MGS s/c frame. Also find the relative orientation of the sensors:

```
CALL SPKEZR('MGS_MAG-Y', ET, 'MGS_SPACECRAFT', 'NONE', 'MGS_MAG+Y', STATE, LT)
CALL PXFORM('MGS_MAG_+Y_SENSOR', 'MGS_MAG_-Y_SENSOR', ET, MAT)
```



# Manipulators - 1

## Navigation and Ancillary Information Facility



### Required Kernels:

- Generic LSK
- Mission FK
- Spacecraft SCLK
- HGA IK
- Structure Locations SPK
- Planetary Ephemeris SPK
- Spacecraft SPK
- Spacecraft CK
- HGA CK

HGA = High Gain Antenna

**Compute the angle between the direction to Earth and the MGS HGA boresight:**

```
CALL SPKEZR( 'EARTH', ET, 'MGS_HGA', 'LT+S', 'MGS', EARTH_STATE, LT )
ANGLE = VSEP( HGA_BORESIGHT, EARTH_STATE )
```

