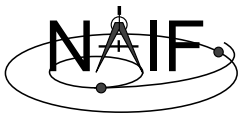




# Using the Frames Subsystem

October 2007



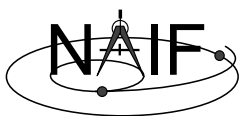
## What is the power of Frames?

---

Navigation and Ancillary Information Facility

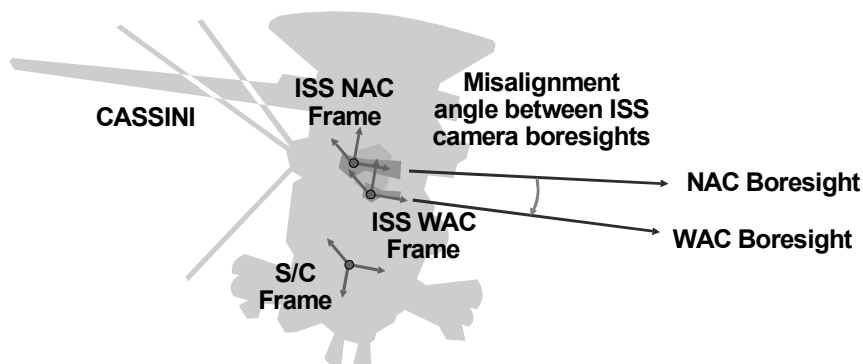
- The “power” of the Frames capability stems from the SPICE system’s ability to construct complex reference frame transformations with no programming effort required of you - the end user
  - But your selecting and loading the needed kernels is crucial
- The principal benefit from the Frames capability 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 (fk.\*); be sure to also read that.

SPICE usage: “reference frame”  $\neq$  “coordinate system”



# Offset between Instruments

Navigation and Ancillary Information Facility

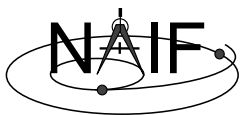


**Compute the angular separation between the ISS Narrow Angle Camera and Wide Angle Camera boresights:**

```
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 )
```

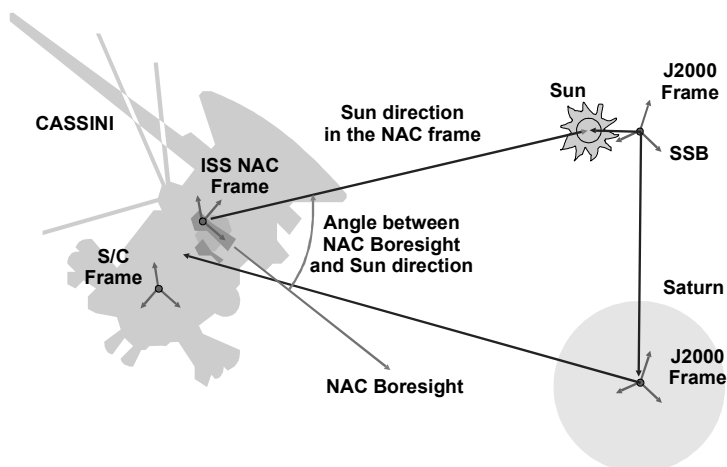
Using Frames

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# Angular Constraints

Navigation and Ancillary Information Facility



**Check whether the angle between camera boresight and direction to Sun is within 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!'
```

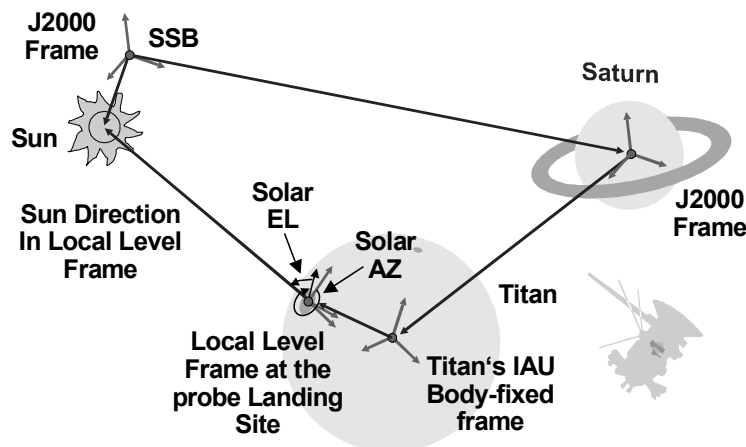
Using Frames

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## Angles at the Surface

Navigation and Ancillary Information Facility



**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
```

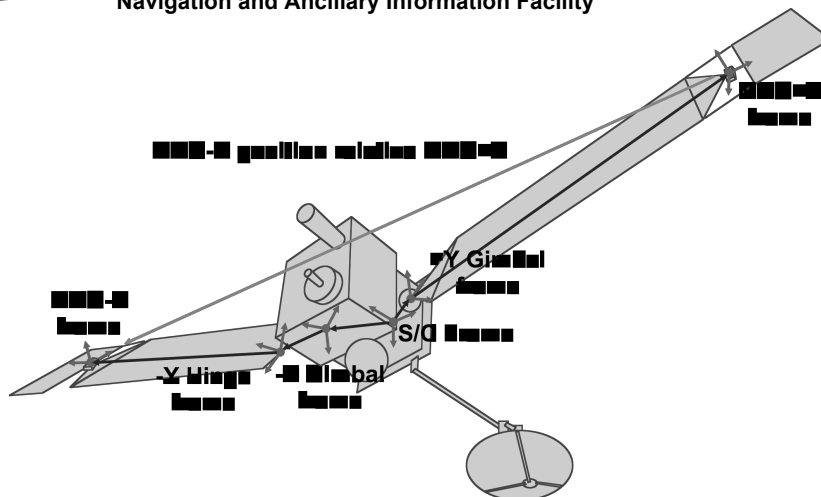
Using Frames

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## Relative Position of Sensors

Navigation and Ancillary Information Facility

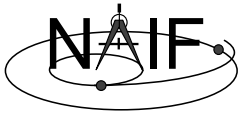


**Find the position of one MGS MAG sensor with respect to the other in the MGS s/c frame. Also find the relative orientation of sensors:**

```
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)
```

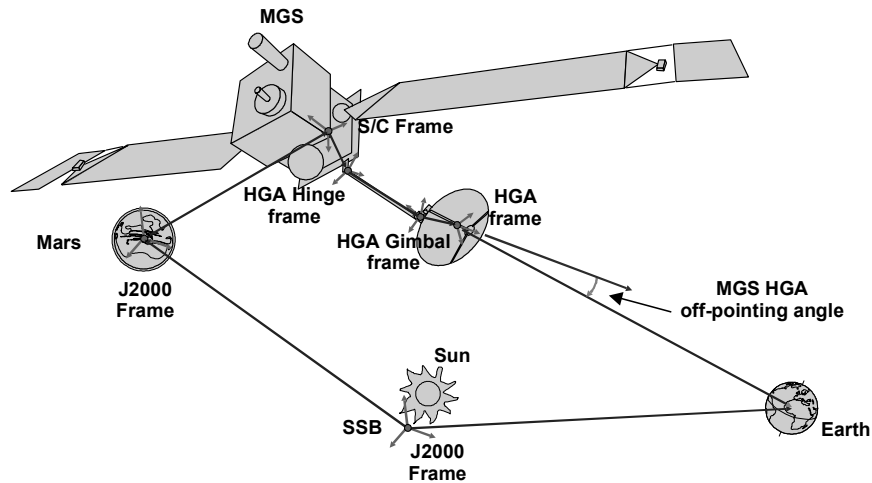
Using Frames

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# Manipulators - 1

## Navigation and Ancillary Information Facility



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 )
```

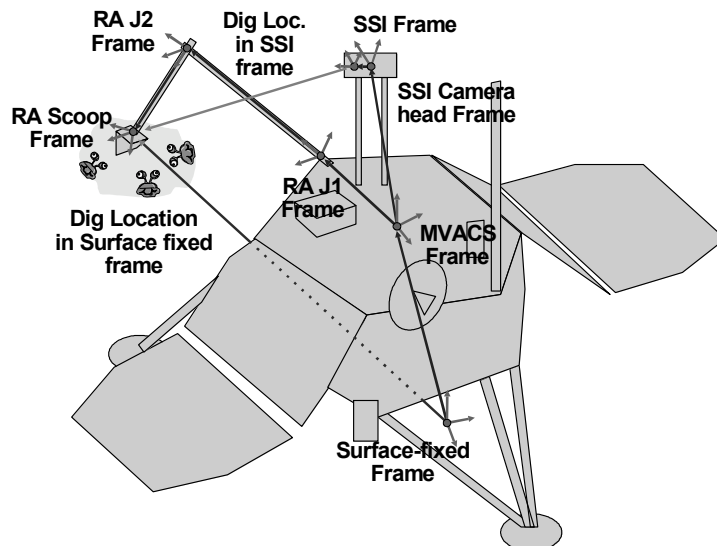
Using Frames

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# Manipulators - 2

## Navigation and Ancillary Information Facility



Compute the dig location in MPL surface-fixed and camera left eye frames:

```
CALL SPKEZR( 'MPL_RA_SCOOP', ET, 'MPL_SURFACE_FIXED', 'NONE', 'MPL_SURF', ST1, LT )
CALL SPKEZR( 'MPL_RA_SCOOP', ET, 'MPL_SSI_LEFT', 'NONE', 'MPL_SSI', ST2, LT )
```

Using Frames

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