Using the Frames Subsystem

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What is the Power of Frames?

- 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, PXFORM, PXFRM2)

- The remaining pages illustrate typical use of frames

- Several **VERY IMPORTANT** usage issues are mentioned in the Frames tutorial; be sure to also read that.
Compute the angular separation between the Cassini 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

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!'```

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

```fortran
CALL SPKEZR( 'EARTH', ET, 'MGS_HGA', 'LT+S', 'MGS', EARTH_STATE, LT )
ANGLE = VSEP( HGA_BORESIGHT, EARTH_STATE )
```
Manipulators - 2

Compute the soil digging location in the 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 )