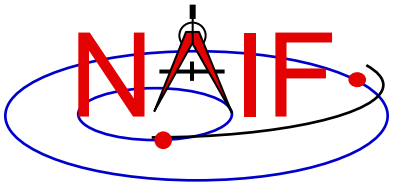

Navigation and Ancillary Information Facility

Preparing for Programming Using the SPICE Toolkits

April 2023

Setting Path to Toolkit Executables (1)

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Recommended for all Toolkits

- **Unix (OS X, Linux, BSD, execute the command echo $SHELL to determine your shell name)**
  - **csh, tcsh: Use the set command to add the location of toolkit executables to your path.**
    - `set path = ($path /my_directory/toolkit/exe)`
    - `set path = ($path /my_directory/cspice/exe)`
    - `set path = ($path /my_directory/icy/exe)`
    - `set path = ($path /my_directory/mice/exe)`
  - **sh, bash, zsh, dash, ksh: Assign the $PATH environment variable.**
    - `PATH=$PATH:/my_directory/toolkit/exe`
    - `PATH=$PATH:/my_directory/cspice/exe`
    - `PATH=$PATH:/my_directory/icy/exe`
    - `PATH=$PATH:/my_directory/mice/exe`

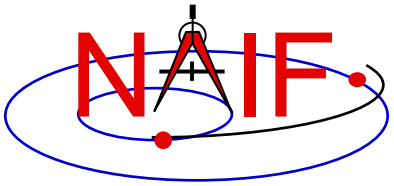
Replace *my_directory* with the path in which you installed the toolkit on your computer.

Setting Path to Toolkit Executables (2)

Recommended for all Toolkits

- **Windows**
  - **DOS shell: Use the set command to add the location of toolkit executables to your path. Use setx for a persistent setting.**
    - `set PATH=drive:\my_directory\toolkit\exe;%PATH%`
    - `set PATH=drive:\my_directory\cspice\exe;%PATH%`
    - `set PATH=drive:\my_directory\icy\exe;%PATH%`
    - `set PATH=drive:\my_directory\mice\exe;%PATH%`
  - **Or edit the environment variable PATH from the Advanced pane on the System Control Panel (Control Panel->System->Advanced).**

Replace *drive:\my_directory* with the path in which you installed the toolkit on your computer.



Unix: Build a SPICE Executable

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- **Assume your Toolkit distribution is installed at:**

  `/naif/cspice/` for CSPICE (C toolkits)

  `/naif/toolkit/` for SPICE (Fortran toolkits)

- **Compile and link an application–let's pretend it's named *prgrm*–against the CSPICE or SPICELIB library.**
  - **For C Linux/BSD/Unix:**

    ```
    $ gcc prgrm.c -I/naif/cspice/include /naif/cspice/lib/cspice.a -lm
    ```
  - **For C OS X:**

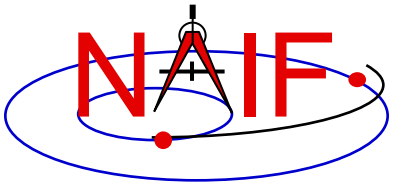
    ```
    $ clang prgrm.c -I/naif/cspice/include /naif/cspice/lib/cspice.a -lm
    ```
  - **For FORTRAN:**

    ```
    $ gfortran prgrm.f /naif/toolkit/spicelib.a
    ```

- **The default SPICE library names do not conform to the UNIX convention `lib`*`name`*`.a`. So you cannot use the conventional library path/name options `-L` and `-l`, e.g.**

  ```
  $ gcc … -L/path_to_libs/ -lname
  ```

  unless you rename the SPICE library.



Windows: C compiler settings

- **The standard installation of Microsoft Visual Studio may not update environment variables needed to use the C compiler (cl) from the standard DOS shell.**
  - **Visual Studio provides scripts to spawn a DOS shell with the needed environment. Find the scripts by navigating to the menu**

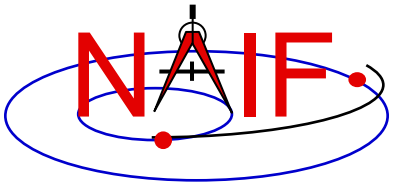
    `Programs -> Visual Studio "version"`

    The script for a 64-bit C/C++ environment is:

    VSversion x64 Native Tools Command Prompt

    The script for a 64-bit ifort environment is:

    VSversion x86 Native Tools Command Prompt



Windows: ifort compiler settings

- **The standard installation of Intel ifort may not update environment variables needed to use the Fortran compiler (ifort) from the standard DOS shell.**
  - **Intel provides batch scripts to spawn DOS shell with the needed environment. Find the scripts by navigating to the menu**

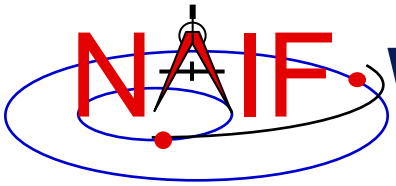
    `Programs -> Intel OneAPI`

    The script for a 32-bit ifort environment is:

    Intel oneAPI command prompt for IA32 for Visual Studio

    The script for a 64-bit ifort environment is:

    Intel oneAPI command prompt for Intel 64 for Visual Studio



Windows: Build a SPICE Executable

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- **Assume the SPICE distribution is installed at:**
  - `C:\naif\cspice\` for C toolkits
  - `C:\naif\toolkit\` for Fortran toolkits

- **Compile and link an application, say *program*, against the CSPICE or SPICELIB library.**
  - For C toolkits:

```
> cl program.c -IC:\naif\cspice\include C:\naif\cspice\lib\cspice.lib
```

  - For FORTRAN toolkits:

```
> ifort program.f C:\naif\toolkit\lib\SPICELIB.LIB
```

Icy: Register the Icy DLM to IDL (1)

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Required for "Icy"

- **Unix and Windows**
  - **Use the IDL register command:**

```
IDL> dlm_register, '_path_to_directory_containing_icy.dlm_'
```

e.g.

```
IDL > dlm_register, '/naif/icy/lib/icy.dlm'
```

  - **Or, copy icy.dlm and icy.so (or icy.dll) to IDL's binary directory located at** *{The IDL install directory}/bin/bin.user_architecture*, **e.g.**
    - » **For Unix, X86 architecture**

```
cp icy.dlm icy.so   /Applications/exelis/idl/bin/bin.darwin.x86_64/
```

    - » **For Windows, X86 architecture**

```
cp icy.dlm icy.dll  C:\Program Files\Exelis\idl83\bin\bin.x86_64\
```

continued on next page

Icy: Register the Icy DLM to IDL (2)

- **Unix specific:**
  - Start the IDL application from a shell in the directory containing both icy.dlm and icy.so.
  - Append the path to your icy.dlm to the IDL_DLM_PATH environment variable to include the directory containing icy.dlm and icy.so, e.g.:

```
setenv IDL_DLM_PATH "<IDL_DEFAULT>:_path_to_directory_containing_icy.dlm_"
```

Warning: do not invoke IDL from the Icy source directory, *icy/src/icy*, nor register that directory, and do not append that directory to IDL_DLM_PATH. This directory contains an "icy.dlm" but not "icy.so."

continued on next page

Icy: Register the Icy DLM to IDL (3)

- **Windows specific:**
  - **Set environment variable IDL_DLM_PATH from the *Advanced* pane of the *System* Control Panel.**
- **Once registered as specified on earlier pages, confirm IDL recognizes and can access Icy.**
  - **Using the help command:**

```
IDL> help, 'icy', /DL
**ICY - IDL/CSPICE interface from JPL/NAIF (not loaded)
```

    - » **Appearance of the words "not loaded" might suggest something is wrong, but this is expected state until you execute an Icy command.**
  - **Execute a trivial Icy command:**

```
IDL> print, cspice_icy('version')
% Loaded DLM: ICY.
Icy 1.4.20 25-DEC-2008 (EDW)
```

Icy: Using the IDL IDE

Recommended for "Icy"

- Use the IDL IDE's preferences panel to set the current working directory to the location where you will be developing your code.
- Optional: Place your `dlm_register` command in a start up script. Specify the script using the IDL IDE's preferences panel.

Required for "Mice"

- **Assume the Mice distribution is installed at `C:\naif\mice\` on Windows, or `/naif/mice/` on Unix/Linux. Use of Mice from Matlab requires the Mice source and library directories exist in the Matlab search path. The easiest way to update the Matlab path is with the "addpath" command.**
  - **On Windows:**

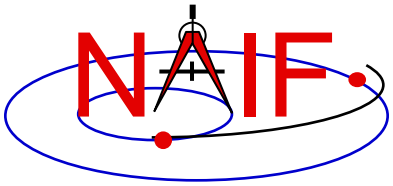
```
>> addpath('C:\naif\mice\lib')
>> addpath('C:\naif\mice\src\mice')
```

  - **On Unix/Linux:**

```
>> addpath('/naif/mice/lib')
>> addpath('/naif/mice/src/mice')
```

Backup

- Icy programming example
- Mice programming example
- References
- Matlab 2016a MEX Change



Simple Icy Example

- **As an example of Icy use with vectorization, calculate and plot the trajectory in the J2000 inertial frame of the Cassini spacecraft from June 20, 2004 to December 1, 2005.**

```
;; Construct a meta kernel, "standard.tm", which will be used to load the needed
;; generic kernels:  "naif0009.tls", "de421.bsp", and "pck0009.tpc".

;; Load the generic kernels using the meta kernel, and a Cassini spk.

cspice_furnsh, 'standard.tm'
cspice_furnsh, '/kernels/cassini/spk/030201AP_SK_SM546_T45.bsp'

;; Define the number of divisions of the time interval and the time interval.
STEP = 10000
utc  = [ 'Jun 20, 2004', 'Dec 1, 2005' ]
cspice_str2et, utc, et
times = dindgen(STEP)*(et[1]-et[0])/STEP + et[0]

cspice_spkpos, 'Cassini', times, 'J2000', 'NONE', 'SATURN BARYCENTER', pos, ltime

;; Plot the resulting trajectory.
x = pos[0,*]
y = pos[1,*]
z = pos[2,*]
iplot, x, y, z

cspice_kclear
```

Graphic Output

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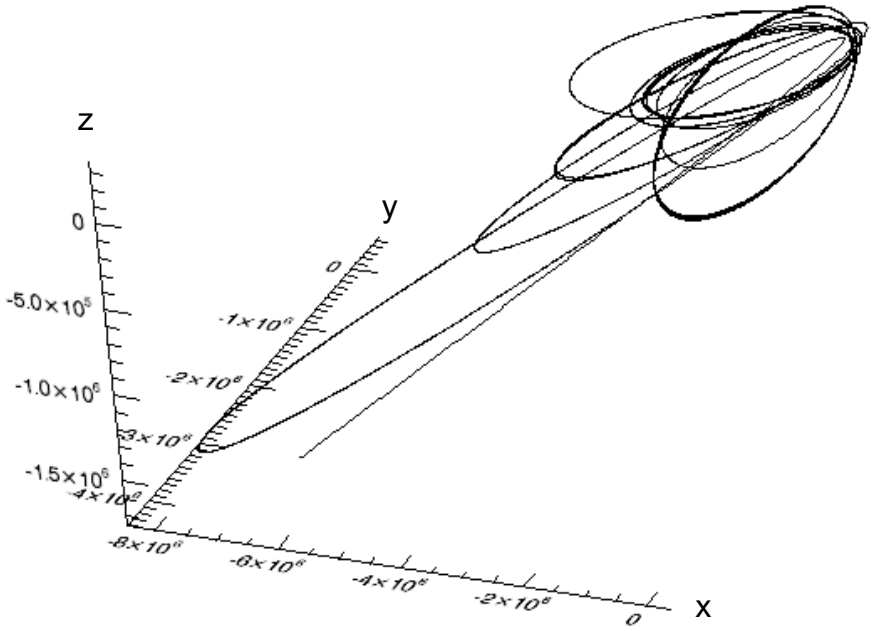
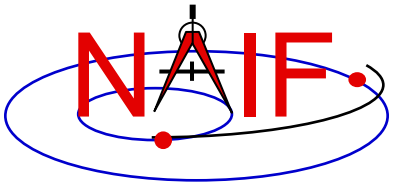


Trajectory of the Cassini vehicle in the J2000 frame, for June 20, 2004 to Dec 1, 2005

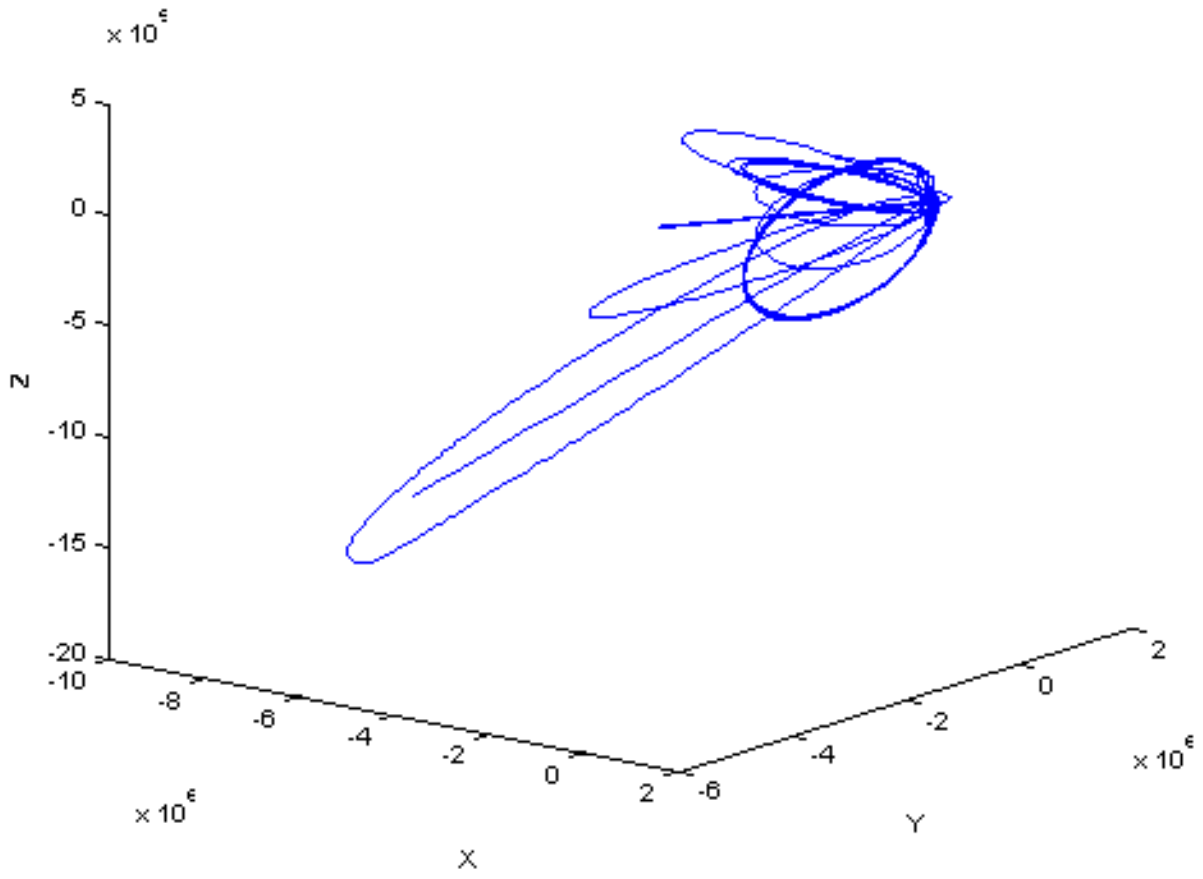


Simple Mice Example

- **As an example of Mice use with vectorization, calculate and plot the trajectory in the J2000 inertial frame of the Cassini spacecraft from June 20, 2004 to December 1, 2005**

```
% Construct a meta kernel, "standard.tm", which will be used to load the needed
% generic kernels:  "naif0009.tls", "de421.bsp", and "pck0009.tpc".

% Load the generic kernels using the meta kernel, and a Cassini spk.

cspice_furnsh( { 'standard.tm', '/kernels/cassini/spk/030201AP_SK_SM546_T45.bsp'} )

% Define the number of divisions of the time interval and the time interval.
STEP        = 1000;
et          = cspice_str2et( {'Jun 20, 2004', 'Dec 1, 2005'} );
times       = (0:STEP-1) * ( et(2) - et(1) )/STEP + et(1);

[pos, ltime]= cspice_spkpos( 'Cassini', times, 'J2000', 'NONE', 'SATURN BARYCENTER' );

% Plot the resulting trajectory.
x = pos(1,:);
y = pos(2,:);
z = pos(3,:);

plot3(x,y,z)

cspice_kclear
```

Graphic Output



Trajectory of the Cassini vehicle in the J2000 frame, for June 20, 2004 to Dec 1, 2005

References

- **NAIF documents providing more information concerning SPICE programing:**
  - **“icy.req,” Icy Required Reading**
    - **icy/doc/icy.req**
    - **icy/doc/html/req/icy.html**
  - **“mice.req,” Mice Required Reading**
    - **mice/doc/mice.req**
    - **mice/doc/html/req/mice.html**
  - **“cspice.req,” CSPICE Required Reading**
    - **cspice/doc/cspice.req**
    - **cspice/doc/html/req/cspice.html**
  - **“Introduction to the Family of SPICE Toolkits” tutorial**

Matlab 2016a MEX Change

- Mathworks changed the operation of the MEX utility in the Matlab 2016a. Use of the mkprodct.csh/mkprodct.bat build script included with SPICE Toolkit N0066 or earlier will fail to build Mice against 2016a or later. The N0067 Toolkits include a modified version of the build scripts.
- Most Mice users should *NOT* rebuild the Mice Toolkit.