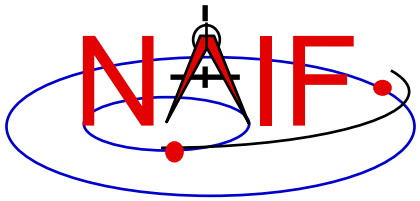
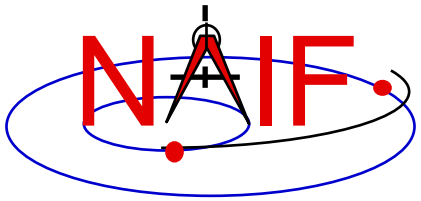



Navigation and Ancillary Information Facility

# Preparing for Programming Using the SPICE Toolkits

August 2016



# Setting Path to Toolkit Executables

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## Recommended for all languages

- **Unix**
  - **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)`
  - **bash**
    - `PATH=$PATH:/`*`my_directory`*`/toolkit/exe`
    - `PATH=$PATH:/`*`my_directory`*`/cspice/exe`
    - `PATH=$PATH:/`*`my_directory`*`/icy/exe`
    - `PATH=$PATH:/`*`my_directory`*`/mice/exe`
- **Windows**
  - **Add location of toolkit executables to the environment variable PATH from the *Advanced* pane on the *System* Control Panel (*Control Panel->System->Advanced*).**
    - *`drive:\my_directory`*`\toolkit\exe`
    - *`drive:\my_directory`*`\cspice\exe`
    - *`drive:\my_directory`*`\icy\exe`
    - *`drive:\my_directory`*`\mice\exe`

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

# Unix/Linux: Builds

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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 *program*–against the CSPICE or SPICELIB library.**
  - **For C:**

    ```
    $ gcc program.c -I/naif/cspice/include /naif/cspice/lib/cspice.a -lm
    ```

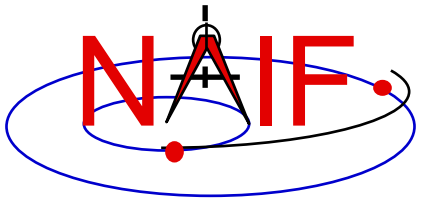
  - **For FORTRAN:**

    ```
    $ gfortran program.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

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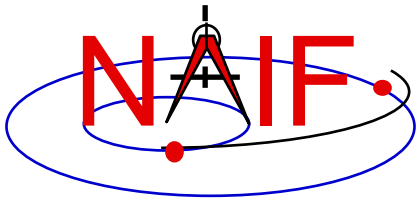
- **The standard installation of Microsoft Visual Studio may not update environment variables needed to use the C compiler (cl) from the standard DOS shell. This depends on your version of the Microsoft development environment.**
  - **If programming in an XP 32-bit environment, you can set the environment variables by executing from a DOS shell one of the "vars32" batch scripts supplied with Microsoft compilers:**
    - `vars32.bat`
    - `vcvars32.bat`
    - `vsvars32.bat`
  - **If available on your system, you can execute the script "Visual Studio *version* Command Prompt" utility from the**

    ***Programs -> Microsoft Visual Studio version -> Visual Studio Tools***

    **menu. The utility spawns a DOS shell set with the appropriate environment variables. Caution: there may be 32-bit and 64-bit versions.**



# Windows: ifort compiler settings

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- **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 shells properly configured for 32-bit or 64-bit Fortran development. Find the scripts by navigating to the menu**

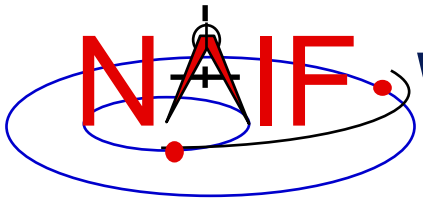
    ***Programs -> Intel Software Development Tools -> Intel Visual Fortran Compiler (version)***

    **The script for a 32-bit ifort environment:**

    **`Fortran Build Environment for applications running on IA-32`**

    **The script for a 64-bit ifort environment:**

    **`Fortran Build Environment for applications running on Intel 64`**



# Windows: Builds for C and Fortran

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- **Assume the SPICE distribution is installed at:**

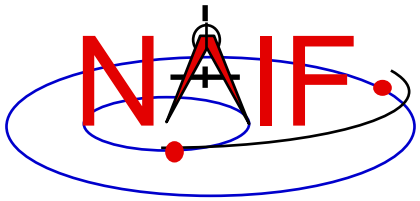
  `C:\naif\cspice\` for C toolkits

  `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.**

» **Unix, X86 architecture**

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

» **Windows, X86 architecture**

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

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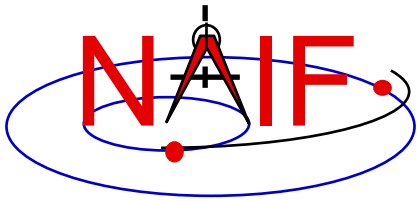

# Icy: Register the Icy DLM to IDL (2)



- **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_"
```

**Caveat: with regards to the Icy source directory, *icy/src/icy*, do not invoke IDL from the directory, do not register the directory, and do not append to IDL_DLM_PATH the directory. This directory contains an "icy.dlm" but not "icy.so."**

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# Icy: Register the Icy DLM to IDL (3)

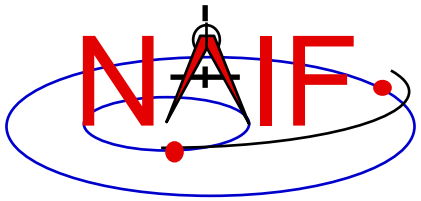


- **Windows specific:**
  - **Set environment variable IDL_DLM_PATH from the *Advanced* pane of the *System* Control Panel.**
- **Once registered (by whatever means) confirm IDL recognizes and can access Icy.**
  - **Using the help command:**

```
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

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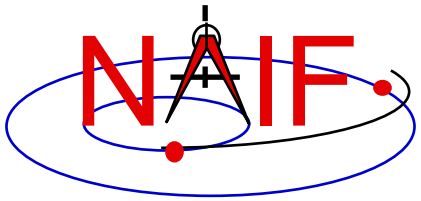
## Recommended for "Icy"

- 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.



# Mice

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## 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:**

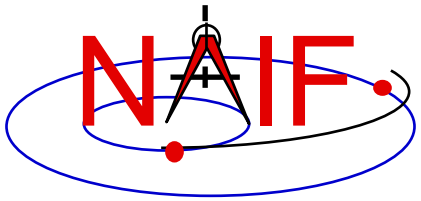
```
>> addpath('C:\naif\mice\lib')
>> addpath('C:\naif\mice\src\mice')
```

  - **On Unix/Linux:**

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

# Backup

- Icy programming example
- Mice programming example
- References



# Simple Icy Example

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- **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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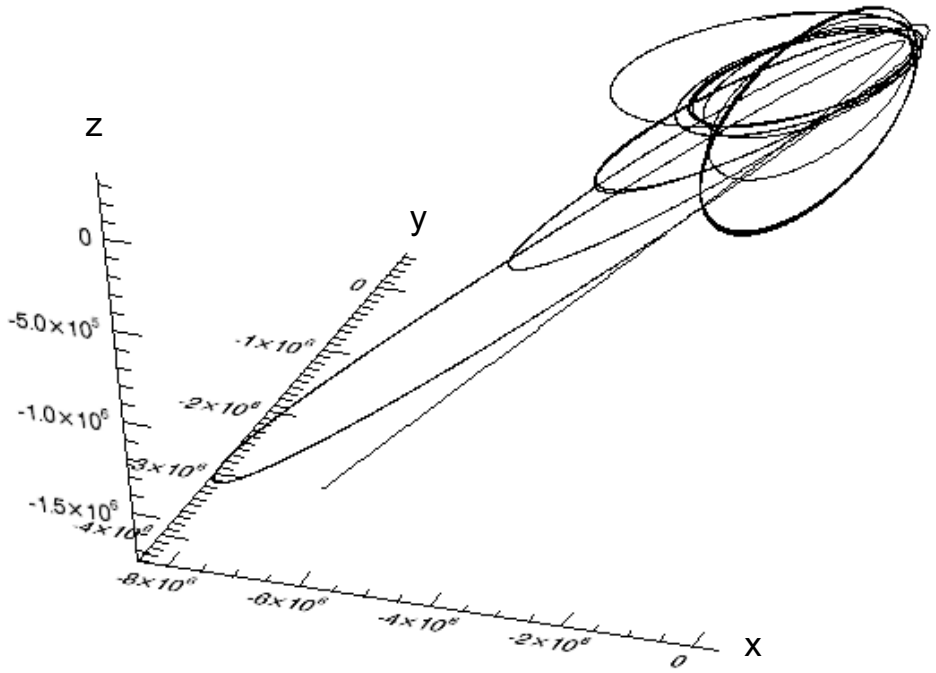
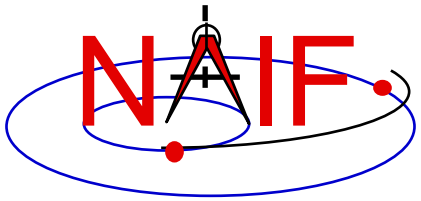



**Trajectory of the Cassini vehicle in the J2000 frame, for June 20, 2004 to Dec 1, 2005**



# Simple Mice Example

Navigation and Ancillary Information Facility

- **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

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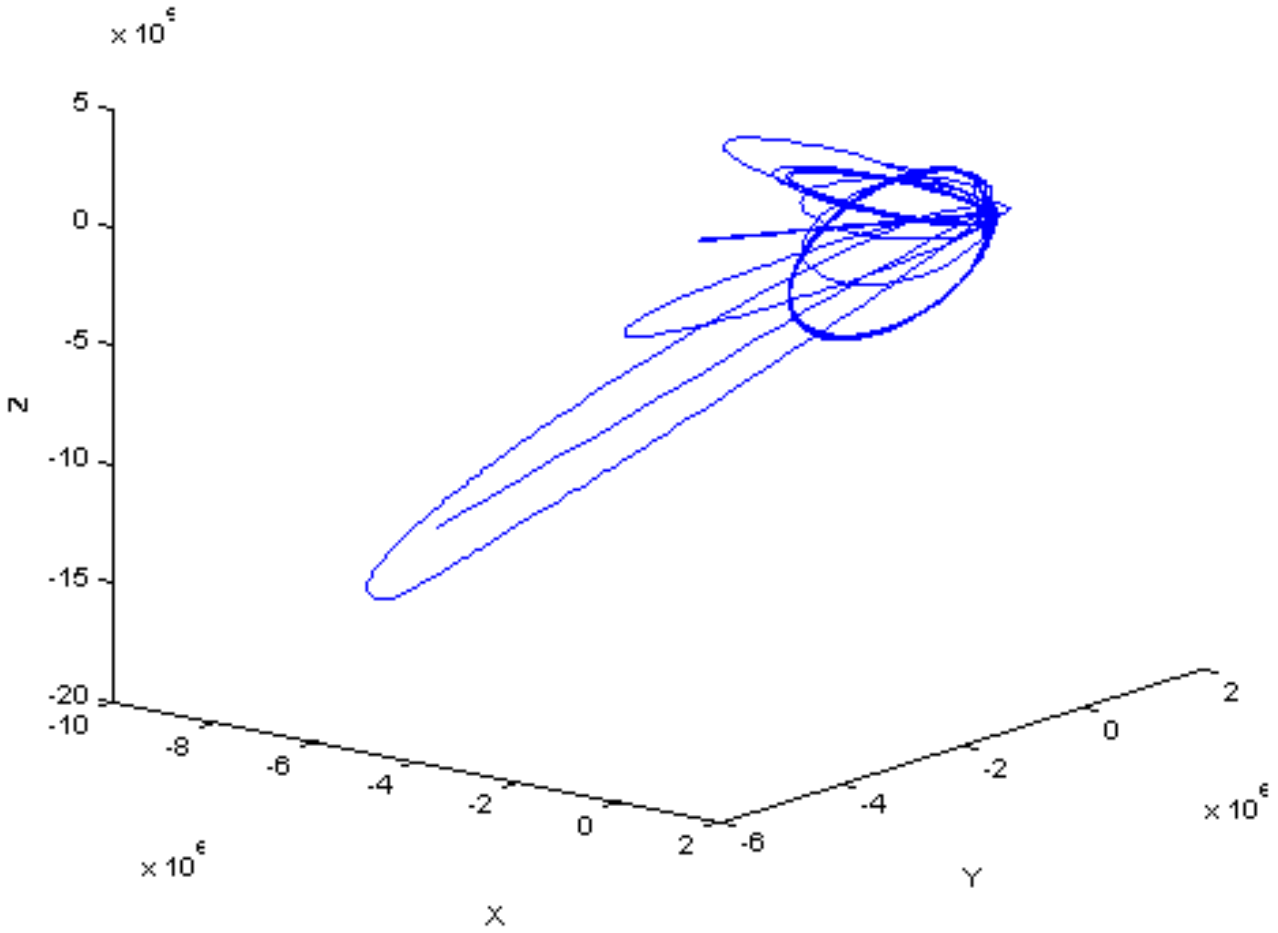
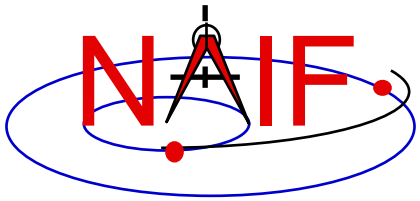



Trajectory of the Cassini vehicle in the J2000 frame, for June 20, 2004 to Dec 1, 2005




# References



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