JSON Generator User's Guide

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Introduction

Cosmographia is a visualization program rendering the solar system and its bodies in 3D to create a freely navigable map of the solar system. The program allows manipulation of time and observer position. It can use SPICE data to visualize trajectory, orientation, and sensors flown on and observations taken by interplanetary spacecraft, to support scientific or engineering analysis, and perhaps even public outreach.

The purpose of this user's guide is to show users how to utilize the java based tool, JSON Generator, to generate catalog files that both connect SPICE data to Cosmographia and provide Cosmographia with certain visualization directives.. These catalog files can be used to run simulations on Cosmographia. The files are formatted in the JavaScript Object Notation (JSON).

For more information on SPICE, Cosmographia and JSON, visit the following links:

Information about Cosmographia:

- www.cosmoguide.org

Information about SPICE:

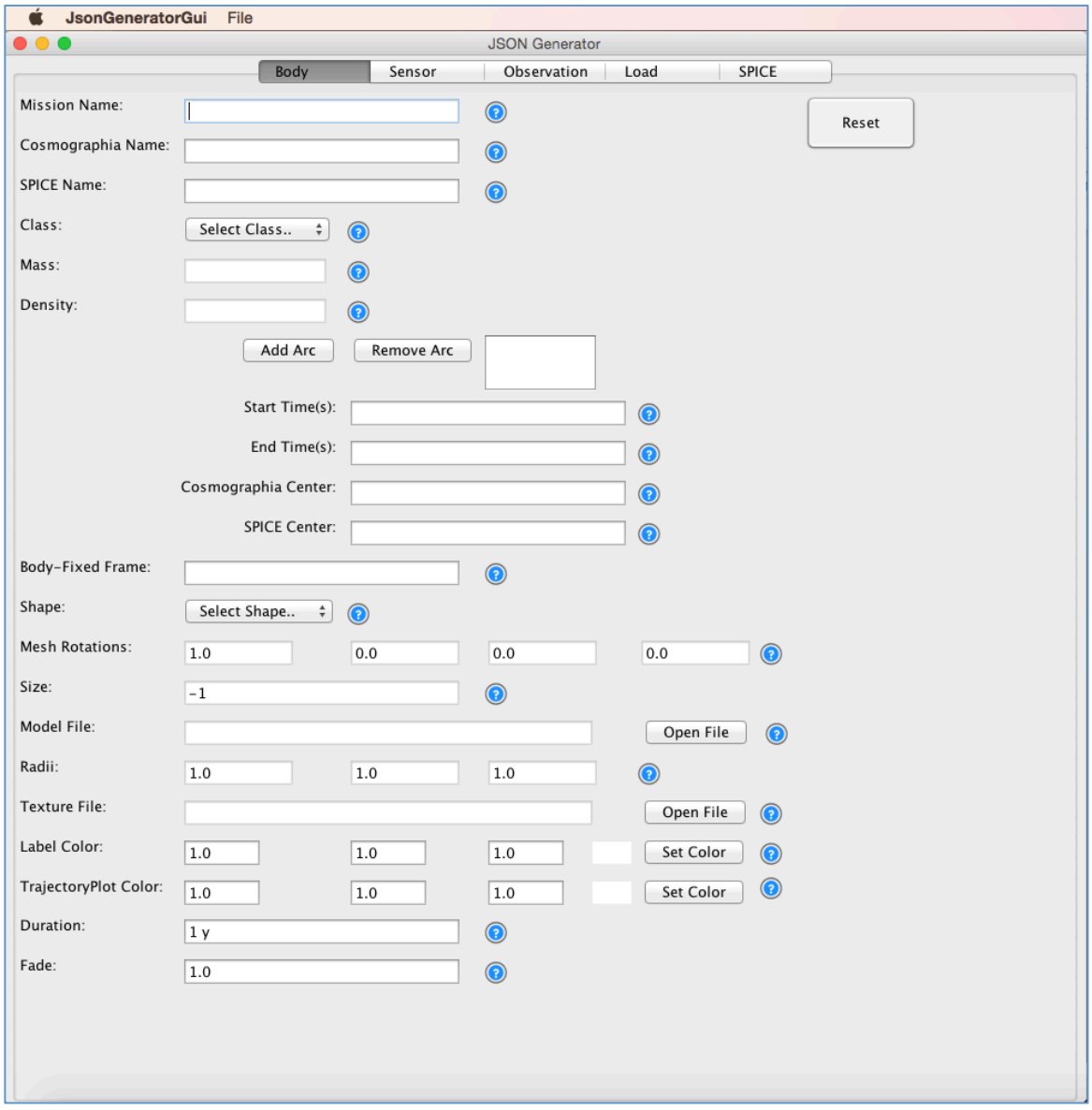
- http://naif.jpl.nasa.gov/naif/aboutspice.html

Information about JSON:

- http://www.json.org

Starting Up

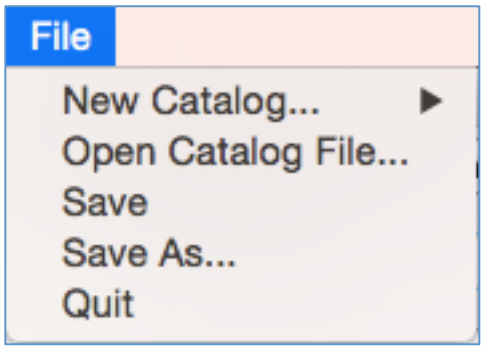
When the tool starts up, the screen, as shown in the picture below, will be the first thing the user sees.



Start up screen

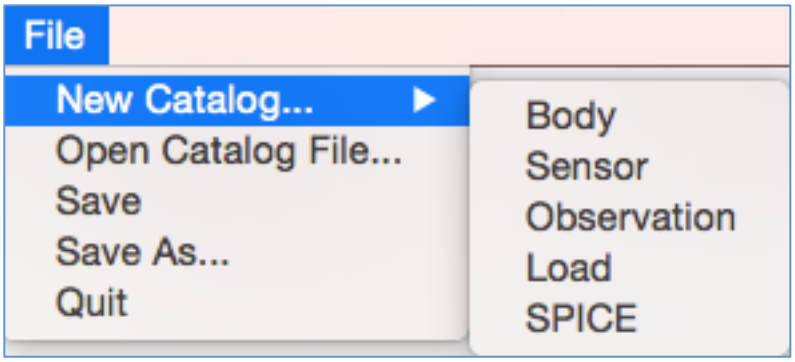
Menu Bar

The menu bar is located at the very top of the screen. It has only one item labeled 'File'. Under the item 'File' there are several options, as shown in the next picture, which the user can select to carry out certain tasks.



Some options listed under the 'File' item are:

- New Catalog: This opens a side menu, as shown below, which lists the types of catalog files the user can create.



Selecting one of the options will prompt the program to create a new catalog file of the selected type.

- Open Catalog File: This opens a dialog box allowing the user to select an existing JSON catalog file. Selecting a file will open up the appropriate interface for the file and allow the user to edit the selected catalog file.

- Save: This saves any changes made to a new or existing catalog files. If the file had not been previously saved after it had been created or opened, the program will Save As.

- Save As: This opens a dialog box that allows the user to specify the save path and name for a new or opened catalog file. (Note: Always add the .json extension at the end of the file name.)

- Quit: Closes the program

Creating A Catalog File

5 types of catalog files can be created. They are:

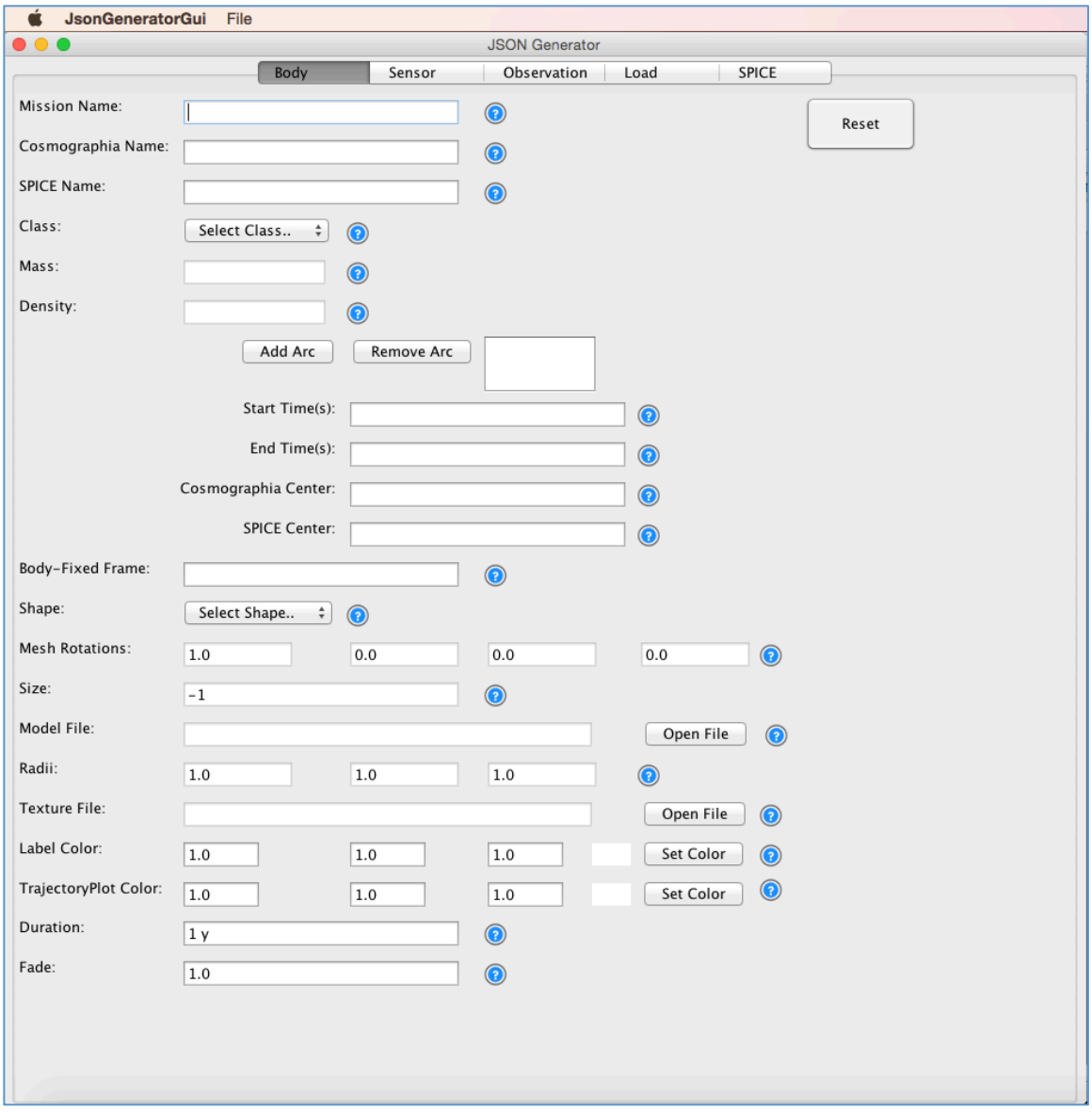
- Body
- Sensor
- Observation
- SPICE
- Load

To prompt the program to bring up the interface for creating any one of these catalog files, select File > New Catalog… > (Desired catalog file type.) from the menu bar.

Creating A Body Catalog File

From the menu bar select
File > New Catalog… > Body

The following screen will be displayed.



This screen is the same as the start up screen. On the screen are multiple text boxes with accompanying labels. These text boxes must be filled with the appropriate values and names provided by the user. Certain parameters are prefilled with default values.

Mission Name: Input an internal name for the catalog file. It is recommended that the space mission name that the body belongs to be used for this parameter.

Cosmographia Name: Input the name that will be used to identify the body within Cosmographia

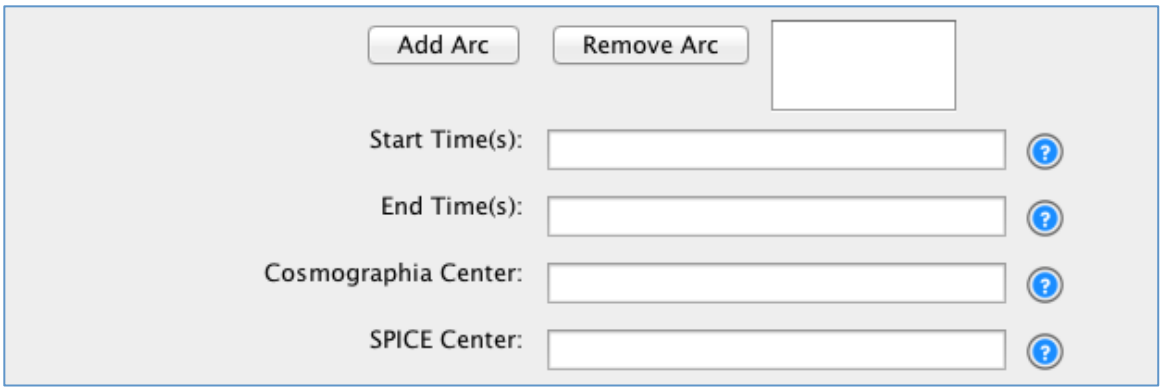
SPICE name: Input the SPICE name of the body as defined in the SPICE kernels. Some bodies have multiple SPICE names–any of these may be used.

Class: Select a class from the drop down menu that best describes the body for which the catalog file is being created. The available classes are spacecraft, asteroids and planets.

Mass: Insert the mass of the body in kilograms. This parameter cannot be specified for bodies that have their class set as spacecraft. Mass is used only for informational purposes–it does not affect rendering.

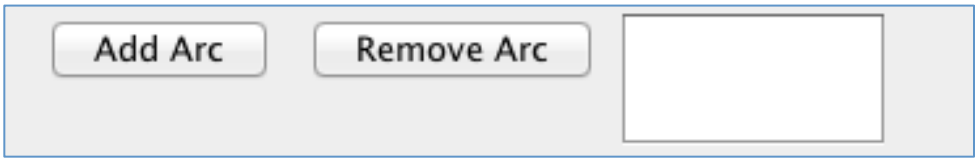
Density: Insert the density of the body in g/m^3. This parameter cannot be specified for bodies that have their class set as spacecraft. Density is used only for informational purposes–it does not affect rendering.

Arcs: Arcs are groups of certain parameters that can have different values for different time periods.



To add arcs click the add arc button. Once clicked an arc will be added to the scroll pane as shown on the right of the picture below. Once an arc has been added the user will have to insert values for the parameters shown in the picture above.

Selecting an arc from the scroll pane and clicking the 'Remove Arc', as shown below, removes the selected arc.



Start Time: Input the time when the arc begins. The start time of the first arc specifies the time when the body will begin to exist in Cosmographia. Format: [YYYY/MM/DD hh:mm:ss.sss]

End Time: Input the time when the arc ends. The end time of the last arc specifies the time when the body will cease to exist in Cosmographia. Format: [YYYY/MM/DD hh:mm:ss.sss]

It is highly recommended that the end time of one arc should be the start time of the next arc. If there are any gaps between arcs, there may be incorrect visualization of the body.

Cosmographia Center: Input the Cosmographia name for the center of the body's trajectory plot. This is usually the object that the body orbits. That object must already exist in Cosmographia.

SPICE Center: Input the SPICE name of the Cosmographia Center.

Body-Fixed Frame: Input the SPICE name of the body's body-fixed frame.

Shape: Select the shape of the body's model.

Mesh Rotations: Input the SPICE quaternion that rotates the body's mesh to align it with the body's reference frame. This parameter can only be specified for bodies with a mesh shape.

Size: Input radius, in kilometers, of the sphere that encloses the body's mesh model. The preset value is -1 indicating that this parameter will not be specified in the output catalog file. This parameter can only be specified for bodies with mesh shape.

Model File: Select the 3D model file of the body by clicking the 'Open File' button shown on the right in the picture below. Only CMOD or 3DS files are acceptable. This parameter can only be specified for bodies with mesh shape.

Radii: Input the radii of the tri-axial ellipsoid used as the body's shape. This parameter can only be defined for Globe shaped objects.

Texture File: Select the body's texture by clicking the 'Open file' button as shown on the right in the picture below. This parameter can only be defined for Globe shaped objects.

Label Color: Select the color of the body's name label shown in Cosmographia. The color is based on the RGB color scheme with each component defined on a 0-1 scale To select a color click on the 'Set Color' button shown on the right in the picture below.

TrajectoryPlot Color: Select the color of the body's trajectory plot shown in Cosmographia. The color is based on the RGB color scheme with each component defined on a 0-1 scale. To select a color click on the 'Set Color' button shown on the right in the picture below.

Duration: Input the time span over which the trajectory is shown. Duration can be specified in Days: d, Months: m or Years: y.

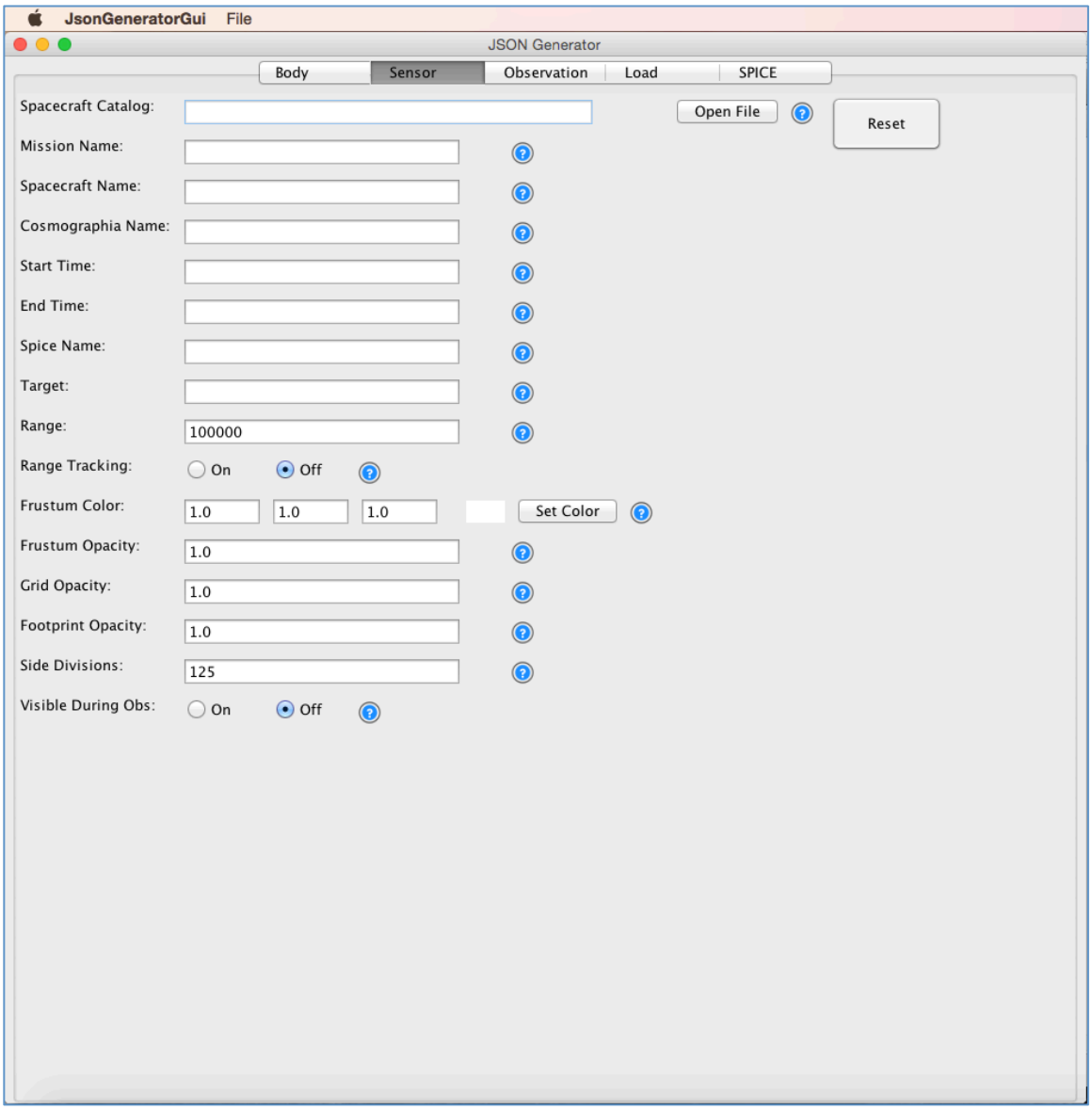
Fade: Input the degree of the fading effect on the trajectory plot visualization, based on a 0-1 scale, with 0 being completely opaque to 1 fading the most while still being visible.

After filling in the values for all the parameters go to the menu bar and select File > Save or File > Save As to save the catalog file.

Creating A Sensor Catalog File

From the menu bar select
File > New Catalog… > Sensor

The following screen will be displayed.



On the screen are multiple text boxes with accompanying labels. These text boxes must be filled with the appropriate values and names provided by the user. Certain parameters are prefilled with default values.

Spacecraft Catalog: Select an existing catalog file for the spacecraft by clicking the 'Open File' button shown on the right in the picture below. Upon selecting the spacecraft catalog file, certain parameters will be populated with data obtained from the catalog file.

If there is no existing spacecraft catalog file, none of the automatic population will be done–you'll have to fill in all of the fields by hand.

Mission Name: Input an internal name for the catalog file. It is recommended that the space mission name that the sensor belongs to be used for this parameter. If a spacecraft catalog file was previously selected then this parameter will automatically be set to the Mission Name specified in the spacecraft catalog file.

Spacecraft Name: Input the Cosmographia name of the spacecraft. If a spacecraft catalog file was previously selected then this parameter will automatically be set to the Cosmographia name specified in the spacecraft catalog file.

Cosmographia Name: Input the name that will be used to identify the sensor within Cosmographia.

Start Time: Input the time when the sensor will begin to exist in Cosmographia. If a spacecraft catalog file was previously selected then this parameter is set to the start time of the spacecraft's first arc. Format: [YYYY/MM/DD hh:mm:ss.sss]

End Time: Input the time when the sensor will cease to exist in Cosmographia. If spacecraft catalog file was previously selected then this parameter is set to the end time of the spacecraft's last arc. Format: [YYYY/MM/DD hh:mm:ss.sss]

SPICE Name: Input the SPICE name of the sensor.

Target: Input the Cosmographia name of the object that the sensor will be targeting.

Range: Input the length of the sensor's FOV frustum shown by Cosmographia, in kilometers.

Range Tracking: A logical flag turning on (true) or off (false) target range tracking. Turning on the range tracking option directs Cosmographia to dynamically set the frustum length equal to the distance between the spacecraft and the target body. Select either on or off radio buttons, as shown below, to enable or disable this feature.

Frustum Color: Select the color of the sensor's frustum shown in Cosmographia. The color is based on the RGB color scheme with each component defined on a 0-1 scale. To select a color click on the 'Set Color' button shown on the right in the picture below.

Frustum Opacity: Input the visibility of the sensor's FOV frustum on the 0 to 1 scale, with 0 being completely transparent to 1 being completely opaque.
Grid Opacity: Input the visibility of the sensor's FOV frustum grids on the 0 to 1 scale, with 0 being transparent to 1 being completely opaque.

Footprint Opacity: Input the visibility of the sensor's FOV footprint on a 0 to 1 scale, with 0 being transparent to 1 being completely opaque. The sensor's FOV footprint is the outline on the far end of the sensor's frustum.

Side Divisions: Input the number of points plotted per each side of the sensor's FOV frustum. A larger number of points will result in a smoother sensor FOV side rendering but could cause slow Cosmographia rendering.

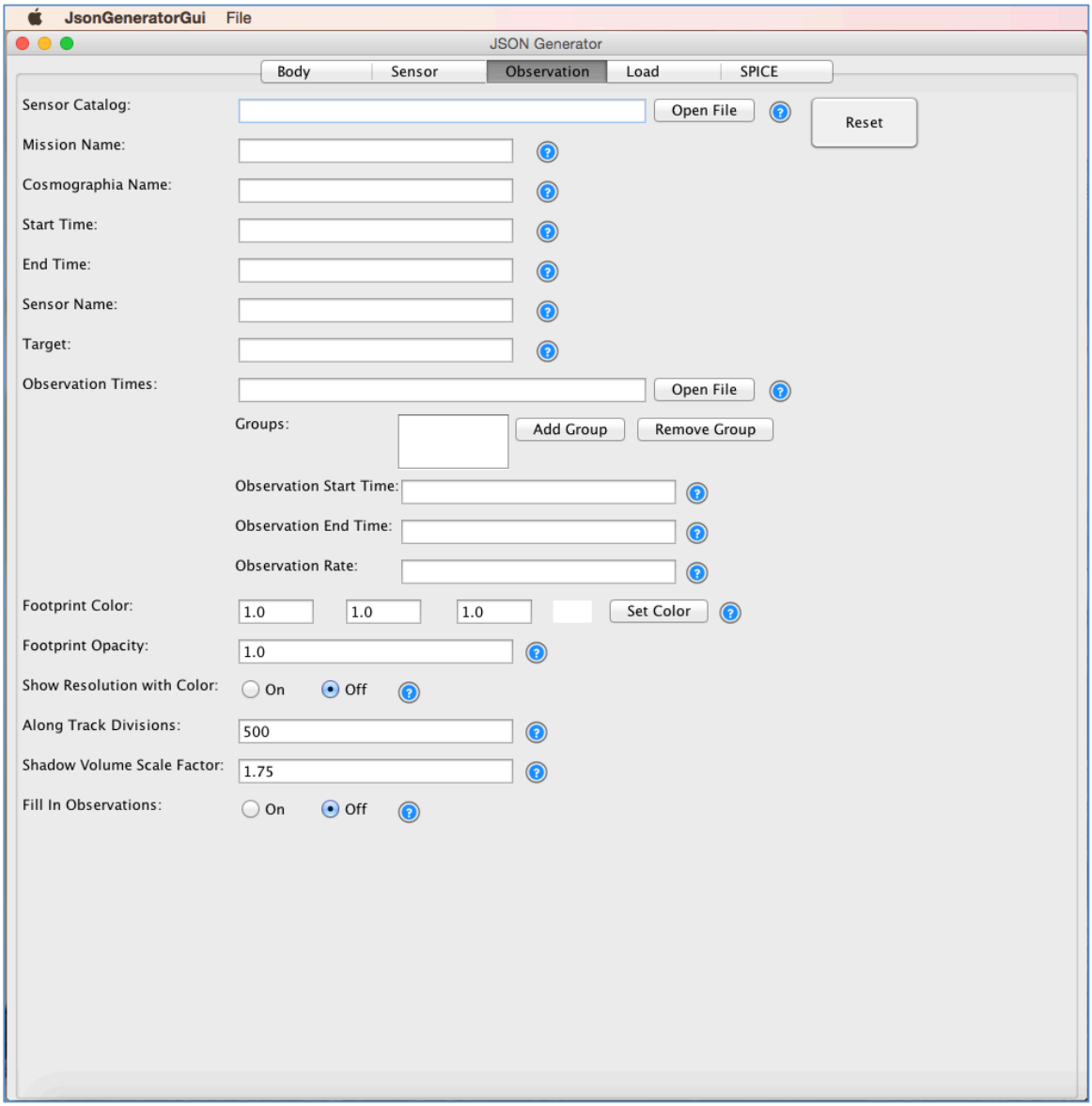
Visible During Obs: A logical flag restricting the sensor's FOV frustum rendering to only times when the sensor is taking observations. Select either on or off radio buttons, as shown below, to enable or disable this feature.

After filling in the values for all the parameters go to the menu bar and select File > Save or File > Save As to save the catalog file.

Creating An Observation Catalog File

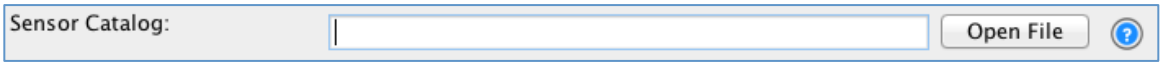
From the menu bar select
File > New Catalog… > Observation

The following screen will be displayed.



On the screen are multiple text boxes with accompanying labels. These text boxes must be filled with the appropriate values and names provided by the user. Certain parameters are prefilled with default values.

Sensor Catalog: Select an existing catalog file for the sensor by clicking the 'Open File' button shown on the right in the picture below. Upon selecting the sensor catalog file, certain parameters will be populated with data obtained from the catalog file.



If there is no existing sensor catalog file, none of the automatic population will be done–you'll have to fill in all of the fields by hand.

Mission Name: Input an internal name for the catalog file. It is recommended that the space mission name that the observation belongs to be used for this parameter. If a sensor catalog file was selected then this parameter will automatically be set to the Mission Name specified in the sensor catalog file.

Cosmographia Name: Input the name that will be used to identify the observation within Cosmographia.

Start Time: Input the time when the observation will begin to exist in Cosmographia. If a sensor catalog file was selected then this parameter is set to the start time of the sensor. Format: [YYYY/MM/DD hh:mm:ss.sss]

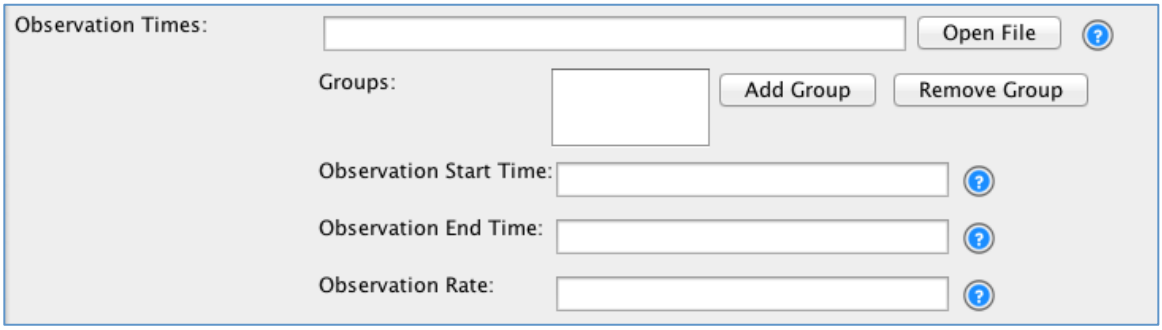
End Time: Input the time when the observation will cease to exist in Cosmographia. If a sensor catalog file was selected

then this parameter is set to the end time of the sensor. Format: [YYYY/MM/DD hh:mm:ss.sss]

Sensor Name: Input the Cosmographia name of the spacecraft. If a spacecraft catalog file was selected then this parameter will automatically be set to the Cosmographia name specified in the spacecraft catalog file.

Target: Input the Cosmographia name of the target body. This should be identical to the target specified in the sensor catalog file.

Groups: This is a group of parameters that specify at which time periods observations are to be visualized and at which rate.



There are two ways of creating groups.

The first method is by clicking on the ‘Add Group’ button shown in the picture below. This will then add a group to the scroll pane shown in the picture below.

Selecting the group in the scroll pane and clicking the ‘Remove Group’ button, as shown in the picture below, can

remove groups. Groups can only be removed one at a time.

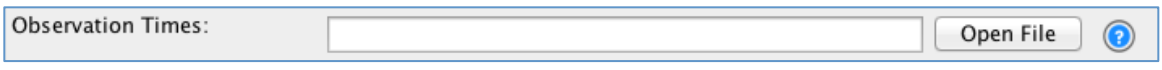
Once a group has been added, fill in the following parameters for that group.

Observation Start Time: Input the time when the sensor will begin to take observations.
Format: [YYYY/MM/DD hh:mm:ss.sss]

Observation End Time: Input the time when the sensor will stop taking observations.
Format: [YYYY/MM/DD hh:mm:ss.sss]

Observation Rate: Input the number of observations the sensor will take per second during the time period specified. If the rate is set to 0, then a single continuous observation will be taken over the time period specified.

The second method is by selecting a comma-separated-values (CSV) file that contains a list of observation start times, end times and rates. To select a CSV click the 'Open File' button shown on the right in the picture below.



The required format of the CSV file is shown in the picture below.

```
2001-01-01 05:48:03.043,2001-01-01 05:48:08.643,0
2001-01-01 05:48:59.650,2001-01-01 05:49:21.650,0
2001-01-01 05:51:07.661,2001-01-01 05:51:29.661,0
2001-01-01 05:53:03.069,2001-01-01 05:53:05.669,0
```

Format: startTime,endTime,observationRate

This will add a list of groups in the scroll pane that can be selected to see the group's value.

Footprint Color: Select the color of the observation's footprint shown in Cosmographia. The color is based on the RGB color scheme with each component defined on a 0-1 scale. To select color click on the 'Set Color' button shown on the right in the picture below.

Footprint Opacity: Input the visibility of the observation's footprint on a 0 to 1 scale, with 0 being transparent to 1 being completely opaque.

Show Resolution With Color: The logical flag enabling the footprints to dynamically change color depending on the distance between the target body and the spacecraft. Select either on or off radio buttons, as shown below, to enable or disable this feature.

Along Track Divisions: Input the number of segments that the side of a swath will be divided into during visualization.

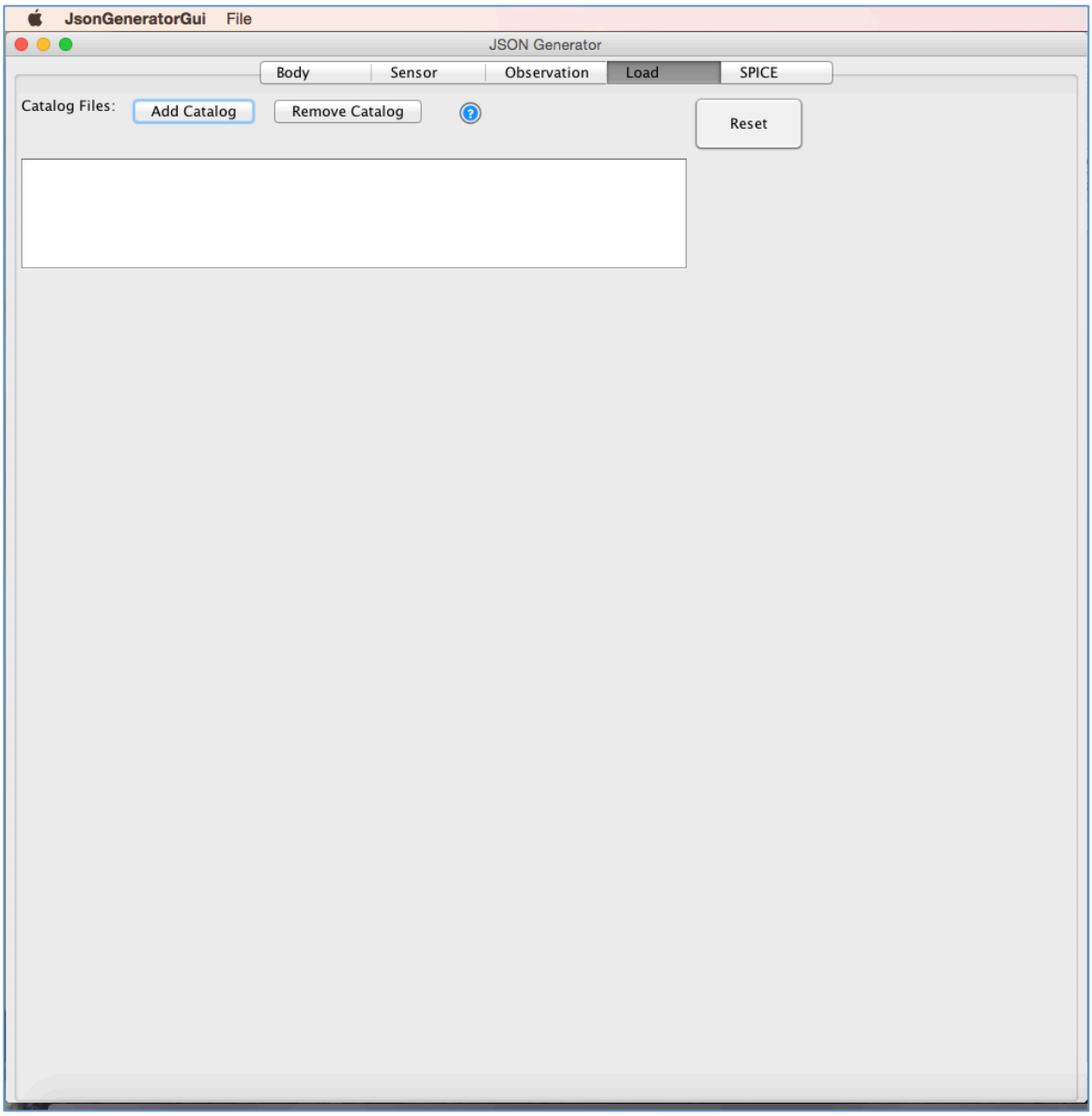
Shadow Volume Scale Factor: The factor scaling the length of the shadow volume used in rendering filled-in observations. Using a larger factor is helpful in ensuring proper footprint rendering on oblong bodies.

Fill In Observations: The logical flag enabling filling of the footprints with color. Select either on or off radio buttons, as shown below, to enable or disable this feature.
After filling in the values for all the parameters go to the menu bar and select File > Save or File > Save As to save the catalog file.

Creating A Load Catalog File

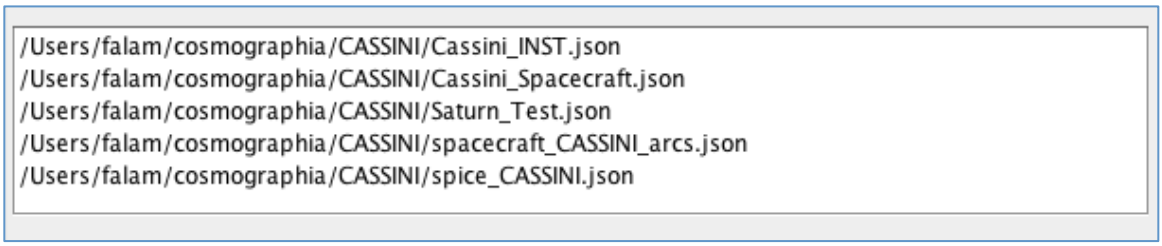
From the menu bar select
File > New Catalog… > Load

The following screen will be displayed.



Catalog Files: Select and add existing catalog files by clicking the 'Add Catalog' button shown in the picture below.

Once catalog files have been added, the paths to these catalog files are added to the scroll pane as shown in the picture below.



Catalog files may be removed from the list by selecting the catalog file's path in the scroll pane and clicking the 'Remove Catalog' button shown in the top most picture on this page.

After adding all the catalog files necessary, go to the menu bar and select File > Save or File > Save As to save the list of catalog files.

Note: When saving load catalog file, the tool will automatically sort between catalog files of different types, such as natural bodies, spacecraft and sensors, and list them in order. However, the tool is incapable of sorting between catalog files of the same type. Therefore, the user is responsible for adding catalog files of the same type in the proper order. The order in which catalog files are sorted is:

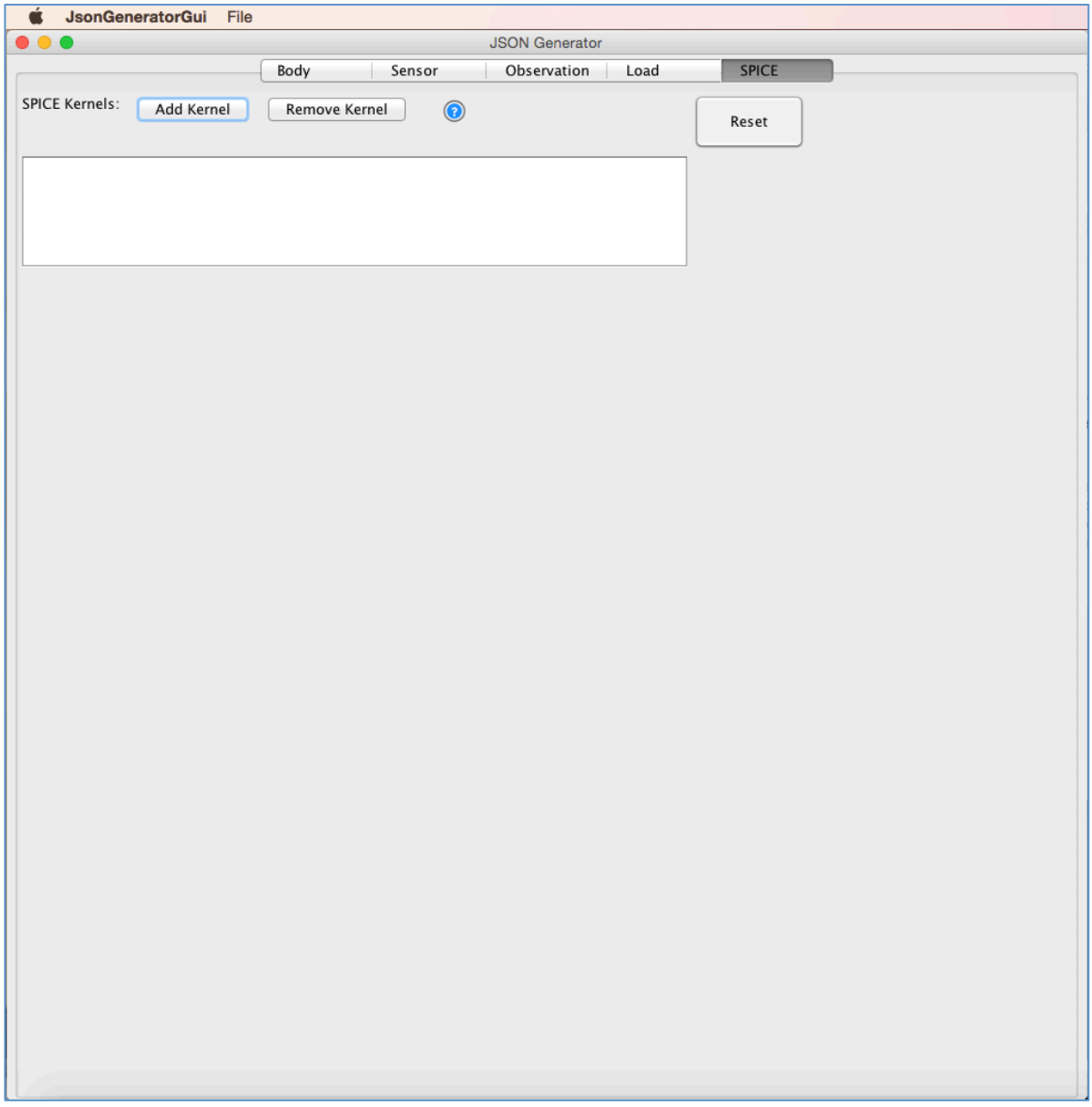
1) SPICE catalog,
2) Natural Body catalog,
3) Spacecraft catalog,
4) Sensor Catalog,
5) Observation Catalog

Sorting within the same catalog type is slightly more complicated because the user must know whether those catalog files are dependent on each other.

Creating A SPICE Catalog File

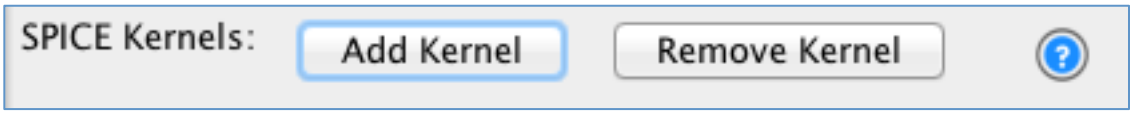
From the menu bar select
File > New Catalog… > Load

The following screen will be displayed.

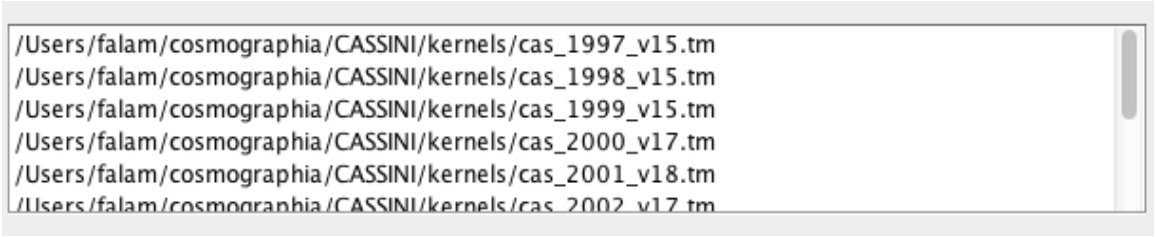


Parameters:

Spice Kernels: Select and add SPICE kernels by clicking the 'Add Kernel' button shown in the picture below.



Once SPICE kernels have been added, the paths to these SPICE kernels are added to the scroll pane as shown in the picture below.



Kernels may be removed from the list by selecting the kernel path in the scroll pane and clicking the 'Remove Kernel' button shown in the top most picture on this page.

After adding all the SPICE kernels necessary, go to the menu bar and select File > Save or File > Save As to save the catalog file.

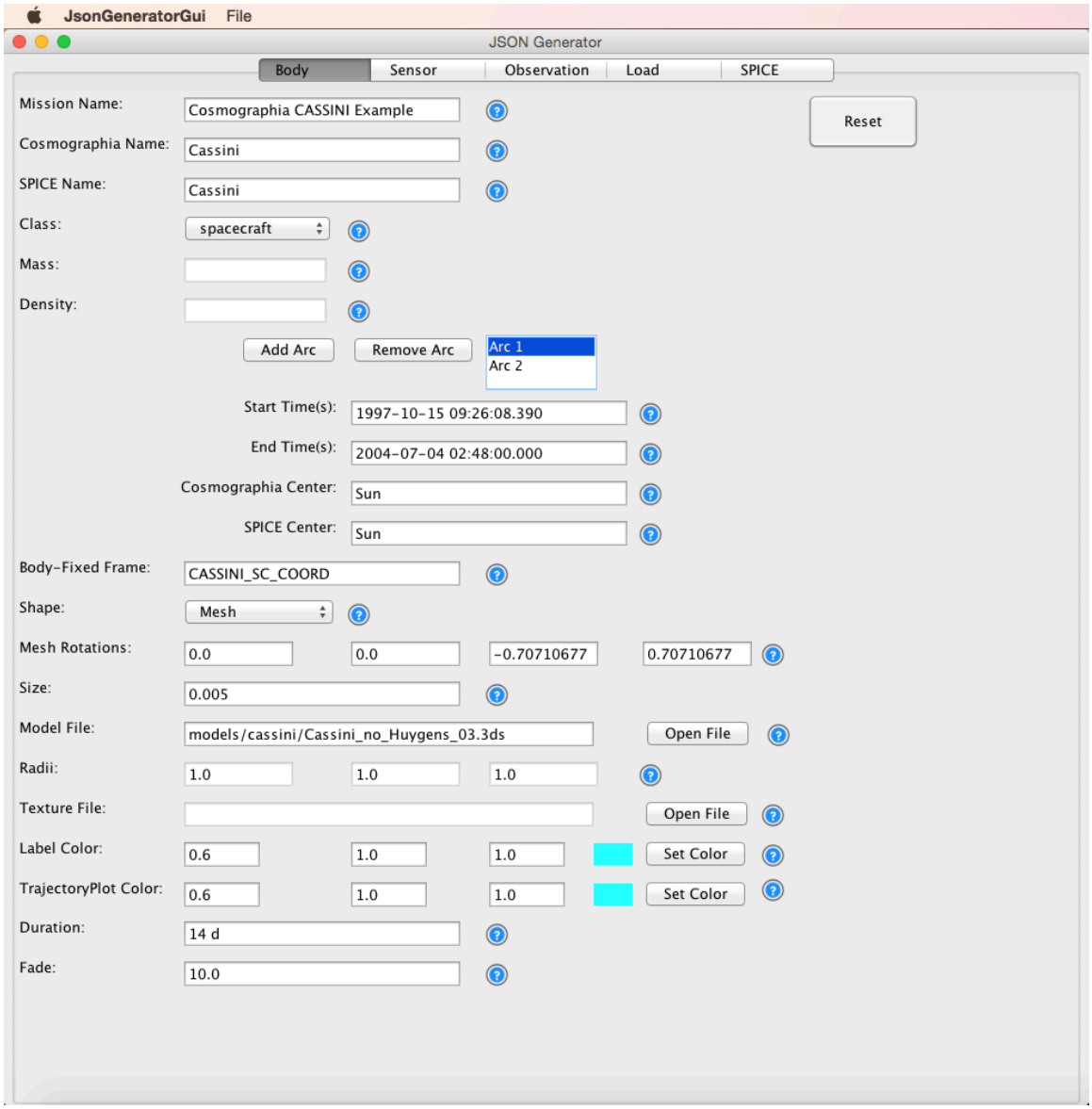
Editing Existing Catalog Files

The JSON Generator tool can also be used to edit existing catalog files that have previously been made by the tool, or catalog files obtained from other sources. There may be exceptions to editing

existing catalog files, such as files that contain additional parameters that are not specified in the tool. The tool will overlook parameters that are not specified in the tool.

To edit an existing catalog file, select from the menu bar:
File > Open Catalog File…

This will allow the user to browse for the catalog file and once the file has been selected, the tool will automatically determine what type of catalog file it is and will open up the appropriate display. The contents of the catalog file will populate the text fields and other components to the extent possible. An example is shown below.

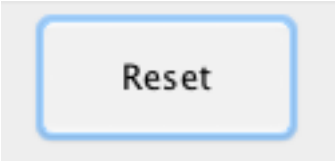


To edit the catalog file, simply change any of the values for the parameters and save the catalog file.

Other Tips And Features

The  icon at the end of every parameter can be clicked to give information about that parameter.

The reset button, shown below, can be clicked to clear all fields and parameters of any values and to set all values back to their auto-filled values (if there were any).



Users can work on multiple catalog files of different types and switch between these files quickly by using the tabs as shown below.

Example Catalog Files

The examples belong to a set of catalog files made for the NEAR mission.

Natural Body Catalog File (Asteroid)

```
{
  "version": "1.0",
  "name": "NEAR",
  "items": [
    {
      "class": "asteroid",
      "name": "Eros",
      "mass": "6.69e15",
      "denisty": 2.67,
      "center": "Sun",
      "trajectory": {
        "type": "Spice",
        "target": "EROS",
        "center": "Sun"
      },
      "bodyFrame": {
        "type": "Spice",
        "name": "EROS_FIXED"
      },
      "geometry": {
        "type": "Mesh",
        "meshRotation": [
          0.0,
          0.0,
          0.0,
          0.0
        ],
        "size": 17.0,
        "source": "models/near-a-msi-5-erosshape-v1_0_64q.cmod"
      },
```

```
      "label": {
        "color": [
          1.0,
          0.5,
          1.0
        ]
      },
      "trajectoryPlot": {
        "color": [
          1.0,
          0.5,
          1.0
        ],
        "duration": "1.76",
        "fade": 0.1
      }
    }
  ]
}

```

Spacecraft Catalog File

```
{
  "version": "1.0",
  "name": "NEAR",
  "items": [
    {
      "class": "spacecraft",
      "name": "NEAR",
      "arcs": [
        {
          "startTime": "1996-05-31 01:00:00.000 UTC",
          "endTime": "2000-02-01 00:00:00.000 UTC",
          "center": "Sun",
          "trajectory": {
            "type": "Spice",
            "target": "NEAR",
            "center": "Sun"
          },
          "bodyFrame": {
            "type": "Spice",
            "name": "NEAR_SC_BUS_PRIME"
          }
        },
        {
          "startTime": "2000-02-01 00:00:00.000 UTC",
          "endTime": "2002-08-01 00:00:00.000 UTC",
          "center": "Eros",
          "trajectory": {
            "type": "Spice",
            "target": "NEAR",
            "center": "Eros"
          },
          "bodyFrame": {
            "type": "Spice",
            "name": "NEAR_SC_BUS_PRIME"
          }
        }
      ],
```

```
      "geometry": {
        "type": "Mesh",
        "meshRotation": [
          0.38268343,
          0.0,
          0.0,
          0.0
        ],
        "size": 0.003,
        "source": "models/near.cmod"
      },
      "label": {
        "color": [
          0.6,
          1.0,
          1.0
        ]
      },
      "trajectoryPlot": {
        "color": [
          0.6,
          1.0,
          1.0
        ],
        "duration": "0.1",
        "fade": 0.5
      }
    }
  ]
}
```

Sensor Catalog File

```
{
  "version": "1.0",
  "name": "NEAR",
  "items": [
    {
      "class": "sensor",
      "name": "NEAR_GRS",
      "parent": "NEAR",
      "startTime": "1996-05-31 01:00:00.000 UTC UTC",
      "endTime": "2002-08-01 00:00:00.000 UTC UTC",
      "center": "NEAR",
      "trajectoryFrame": {
        "type": "BodyFixed",
        "body": "NEAR"
      },
      "geometry": {
        "type": "Spice",
        "instrName": "-93004",
        "target": "Eros",
        "range": 500,
        "rangeTracking": true,
        "frustumColor": [
          0.0,
          1.0,
          1.0
        ],
        "frustumOpacity": 0.3,
        "gridOpacity": 1.0,
        "footprintOpacity": 0.8,
        "sideDivisions": 30,
        "onlyVisibleDuringObs": false
      }
    }
  ]
}
```

Observation Catalog File


```
{
  "version": "1.0",
  "name": "NEAR",
  "items": [
    {
      "class": "observation",
      "name": "NEAR_GRS_OBS",
      "startTime": "1996-05-31 01:00:00.000 ",
      "endTime": "2002-08-01 00:00:00.000 ",
      "center": "Eros",
      "trajectoryFrame": {
        "type": "BodyFixed",
        "body": "Eros"
      },
      "bodyFrame": {
        "type": "BodyFixed",
        "body": "Eros"
      },
      "geometry": {
        "type": "Observations",
        "sensor": "NEAR_GRS",
        "groups": [
          {
            "startTime": "2001-01-01 05:48:03.043",
            "endTime": "2001-01-01 05:48:08.643",
            "obsRate": 0
          },
          {
            "startTime": "2001-01-01 05:48:59.650",
            "endTime": "2001-01-01 05:49:21.650",
            "obsRate": 0
          },
          {
            "startTime": "2001-01-01 05:51:07.661",
            "endTime": "2001-01-01 05:51:29.661",
            "obsRate": 0
          },
          {
            "startTime": "2001-01-01 05:53:03.069",
            "endTime": "2001-01-01 05:53:05.669",
            "obsRate": 0
          }
        ],
```

```
        "footprintColor": [
          0.0,
          1.0,
          1.0
        ],
        "footprintOpacity": 0.5,
        "showResWithColor": false,
        "alongTrackDivisions": 10,
        "shadowVolumeScaleFactor": 1.75,
        "fillInObservations": false
      }
    }
  ]
}
```

Load Catalog File

```
{
  "version": "1.0",
  "name": "",
  "require": [
    "spiceKernels.json",
    "Eros.json",
    "NEAR.json",
    "NEAR_XRS.json",
    "NEAR_XRS_OBS.json",
    "NEAR_NIS_SQUA.json",
    "NEAR_NIS_SQUA_OBS.json",
    "NEAR_NIS_RECT.json",
    "NEAR_NIS_RECT_OBS.json",
    "NEAR_NLR.json",
    "NEAR_NLR_OBS.json",
    "NEAR_MSI.json",
    "NEAR_MSI_OBS.json",
    "NEAR_GRS.json",
    "NEAR_GRS_OBS.json"
  ]
}
```

SPICE Catalog File