Knowledge Base

Abaqus/CAE plug-in to create orbit plots from rotor dynamic analysis results

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QUESTION

How can I plot orbits using rotor dynamics analysis results?

ANSWER

(The following applies to Abaqus 6.12 and higher.)

In rotor dynamics, the orbit plot is one of the methods used to detect a whirl mode. An Abaqus/CAE plug-in for this purpose is attached to this answer. The plug-in requires an output database (.odb) file with results from either a stability analysis or a frequency response analysis. The stability analysis will contain a complex frequency extraction step and the frequency response analysis will contain a steady state dynamic step (direct or subspace).

In order to trigger the whirl mode, the gyroscopic effect is generated by the application of a spin speed. Either of the following loading conditions can be used:

1. *DLOAD of type ROTDYNF, CENTRIF or CORIO
2. *TRANSPORT VELOCITY

For additional information regarding rotor dynamics analysis, please refer to How to create a rotor dynamics model.

Installation and Usage

Native CAE plug-ins are included with the Abaqus/CAE installation. External plugins (those installed after installation of Abaqus/CAE) should not be put inside the Abaqus/CAE installation. To install the plug-in, save the attached archive file to one of the following directories:

```
home_dir\abaqus_plugins
current_dir\abaqus_plugins
```

where *home_dir* is your home directory and where *current_dir* is the current directory.

The *plugin_dir* directory can also be used, where *plugin_dir* is a directory specified by the environment variable **plugin_central_dir**. This parameter is used to define a specific directory where plugins are stored. This is typically a central location accessed by all users at your site if the directory is mounted on a file system that all users can access. **plugin_central_dir** can be defined in the abaqus_v6.env file or the Abaqus solver custom_v6.env file. For example,

```
plugin_central_dir = '\\\\fileServer\\share\\AbaqusPlugins'
```

On Windows platforms, right click on the archive file and select **WinZip → Extract to here**. On Linux platforms, type **unzip Orbit_Plot_Plug-in.zip** at the command prompt. A folder named abq_OrbitPlot and a file named orbitPlot_plugin.py will be extracted. Note that the plug-in will not function properly if this procedure is not followed.

Usage

The plug-in can be accessed from the Visualization module of Abaqus/CAE. Select **Plug-ins→Tools→Plot Orbits...** to invoke the following dialog:

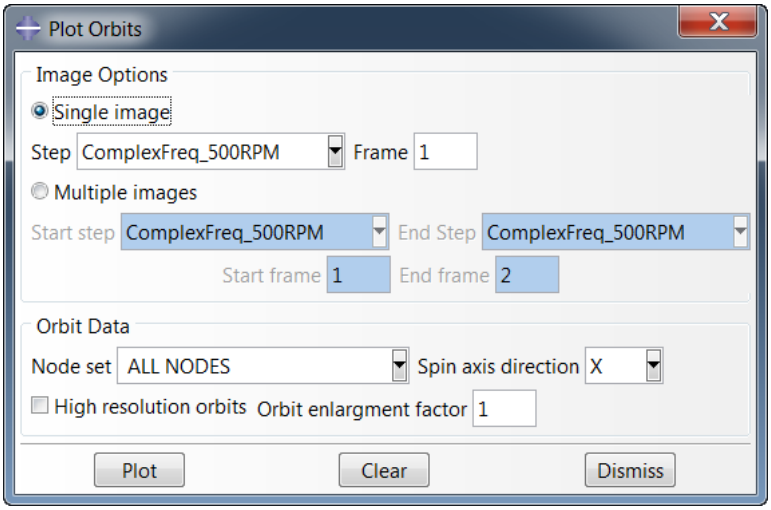

Figure 1: Orbit plot plug-in dialog

Toggle **Single image** to generate the orbit plot image for a specified step and a frame. To create multiple orbit plot images, toggle **Multiple images** and enter two step names with the corresponding frame numbers and the plug-in will create orbit plot images for all the frames in the specified range. The plug-in creates a new directory named 'orbitPlotImages' in the working directory and the orbit plot images are saved in the new directory. If the 'orbitPlotImages' directory already exists then it will not be overwritten. The images are named according to the following convention: 'Step_'+stepName+'_Frame_'+frameNumber+'.png'.

The orbits are created for the user specified nodes. The node set including the required nodes can be selected from the **Node set** combo box. In some cases the size of the orbits can be very small and not easy to visualize. Using the **Spin axis direction** combo box only one of the following global directions can be selected: X, Y, Z, -X, -Y and -Z. The

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plug-in uses the spin direction in order to calculate the whirl direction. Using the **Orbit enlargement factor**, the orbit size can be enlarged. The enlarged size is enlargement factor times the original size. For creating high resolution orbits select the **High resolution orbits** check box. The **Plot** button saves the plotted orbit images in the orbitPlotImages directory. The **Clear** button removes the orbits from the viewport. A sample orbit plot created from a frequency response analysis is shown below:

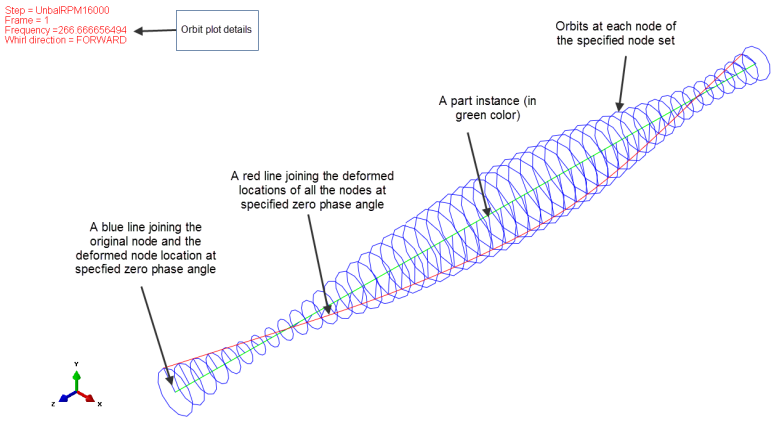

Figure 2: Orbit plot using frequency response analysis

A full cycle harmonic animation file of the orbit plot above is attached. You may compare the 'red line' of the image with the animation. Similarly the image below displays an orbit plot created from stability analysis results.

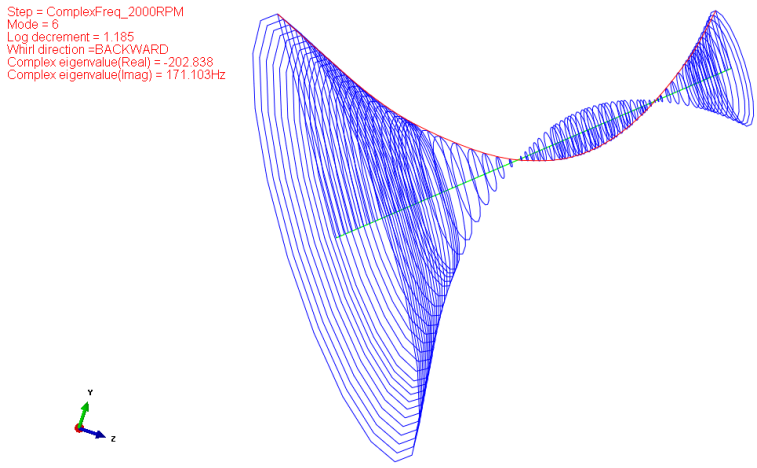

Figure 3: Orbit plot using stability analysis

Please use the attached input files (example1_rotor.inp and example2_rotor.inp) as example models.

Notes

- The plug-in is supported only for a part instance with beam elements.
- You can manually change the view of the plot and save an image using **File → Print** (File).
- The spin axis direction cannot be local - it must be global.
- The orbits are created using annotations. As the number of nodes in the node set increases, the performance of the plug-in may decay. Selecting **High resolution orbits** causes more annotations to be created and as a result performance may be still slower.
- In case of the identical names of the orbit plot images, the existing images in the orbitPlotImages directory will be overwritten by the plug-in.

Revision History

31 Dec 12	Release 1.1-1
5 Apr 13	Release 1.1-2 (added Spin axis direction combo box)

Disclaimer

The attachments to this article are subject to certain usage conditions. Please click here for details.

KEYWORDS **whirl, shaft, rotor, spin, gyro, whirling, turbine, rotordynamic, 5026**

ATTACHMENT example1_rotor.inp | answer_5026_image1.png | harmonicAnimation.avi | example2_rotor.inp | Orbit_Plot_Plug-in.zip | answer_5026_image3.png | answer_5026_image2.png

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