

Knowledge Base

Information



Abaqus/CAE plug-in for creating landing gear models

Portfolio / Domain: SIMULIA Abaqus Unified FEA / SIMULIA Abaqus Unified FEA
Product: SIMULIA Abaqus/CAE

QA Article: QA00000009957e
Applicable Level: 6.9
Last Update Date: 10.09.2020
Rating: Not rated
Views: 558

QUESTION

How can I facilitate the creation of rigid body landing gear models in Abaqus/CAE?

ANSWER

(The following applies to Abaqus 6.9 and higher.)
An Abaqus/CAE plug-in that facilitates the creation of rigid body landing gear models is attached. The plug-in contains a parameterized landing gear model. When you fill in the coordinates of the reference points and relative lengths between joint points, the plug-in automatically creates the display part, connection points, connection joints, and landing gear system of the aircraft. A template airplane model is used as basis.

Installation

To install the plug-in, save the attached archive file to one of the following directories:
abaqus_dir\abaqus_plugins where *abaqus_dir* is the Abaqus parent directory
home_dir\abaqus_plugins where *home_dir* is your home directory
current_dir\abaqus_plugins where *current_dir* is the current directory
Note that if the abaqus_plugins directory does not exist in the desired path, it must be created. The *plugin_dir* directory can also be used, where *plugin_dir* is a directory specified in the abaqus_v6.env file by the environment variable **plugin_central_dir**. You can store plug-ins in a central location that can be accessed by all users at your site if the directory to which **plugin_central_dir** refers is mounted on a file system that all users can access. For example, `plugin_central_dir = r'\\fileServer\sharedDirectory'`
On Windows platforms, right click on the archive file and select **WinZip** → **Extract to here**. On Linux platforms, type **unzip LGS.zip** at the command prompt. A folder named `abq_SumRF` and a file named `lgs_plugin.py` will be extracted. Note that the plug-in will not function properly if this procedure is not followed

General Information

The plug-in creates the aircraft rigid body, nose landing (NLG) gear system, and main landing gear (MLG) system in Abaqus/CAE. The attached file `Airplane.inp` and property files must be available in the working directory; see the notes below. The nose gear system consists of folding gear, main fitting, piston, axle, and tire. The main gear system consists of folding gear, main fitting, tailing gear, shock absorber, axle, and tire. It is assumed that the folding gear is not folded.
Each system consists of rigid body which is represented by display body with beam element. Each rigid body has own mass and inertia properties, which must be assigned in the GUI. Each rigid body is joined with connector elements. The nonlinear spring and damper properties for the tire and shock absorber are imported from the external text file. The schematic view of the landing gear system can be found in the attached `LandingGear-Model-Info.pdf` file.
For the analysis, you can define the gravity and lift force, which is assumed to have the same magnitude of the aircraft weight. The initial landing velocities, the pitch angle of the aircraft, and total simulation time can also be controlled.

Usage

Launch the plug-in by selecting **Plug-ins**→ **Create Landing Gear Model...** from the **Assembly** module, and the following dialog is shown for the primary analysis parameters:

Create Landing Gear Model

Name: Landing_Gear

Analysis Parameters | Nose Gear | Main Gear

Aircraft Condition
Pitch Angle (deg) 0 Downward Initial Velocity -2440 Forward Initial Velocity 2000
Gravity 9800
CG X 0 CG Y -8.3 CG Z -11233

Analysis Condition
Time Constant for Landing 10 Delay Time for Lift 0.4
Time Step 2E-005 End Time 1
Field Output Number 50

Aircraft Mass and Inertia
Airplane Mass 22
Airplane Ixx 6.5E+007 Airplane Iyy 1E+008 Airplane Izz 1E+008

Apply Dismiss

Select the **Nose Gear** tab to specify the attachment points and physical parameters:

MY FAVORITE CONTENT

Create Landing Gear Model

Name: Landing_Gear

Analysis Parameters | Nose Gear | Main Gear

Diagram:

Reference Aircraft Attached Points

| | | | | | |
|-----------|--------|-----------|-------|-----------|-------|
| RP-NLG1 X | 222.75 | RP-NLG1 Y | -756 | RP-NLG1 Z | -2552 |
| RP-NLG2 X | 222.75 | RP-NLG2 Y | -756 | RP-NLG2 Z | -2552 |
| RP-NLG3 X | 230.5 | RP-NLG3 Y | -1115 | RP-NLG3 Z | -3145 |
| RP-NLG4 X | 230.5 | RP-NLG4 Y | -1115 | RP-NLG4 Z | -3145 |

NLG Modeling Parameters

ALPHA_nose (deg) 7.5

SB_NLG 600 MF_NLG 690 Piston_NLG 550 WA_NLG 240 Tire_NLG 212

S.A. Stroke 300 Tire_Damping_Coeff 10

Spring Data File spring_nose.prx Damper Data File damper_nose.p Tire Data File tire_nose.prop

NLG Mass and Inertia

| | | | | | |
|------------|-------|------------|-------|-------------|-------|
| FB mass | 0.001 | MF mass | 0.003 | piston mass | 0.003 |
| TP mass | 0.001 | TB mass | 0.001 | WA mass | 0.001 |
| FB Ixx | 10000 | FB Iyy | 10000 | FB Izz | 2000 |
| Piston Ixx | 40 | Piston Iyy | 40 | Piston Izz | 0.1 |
| TB Ixx | 0.1 | TB Iyy | 0.1 | TB Izz | 0.001 |
| Wheel Ixx | 3000 | Wheel Iyy | 3000 | Wheel Izz | 1000 |

| | | | | | | | |
|------------|-----|--------|------|--------|-------|--------|----|
| Wheel mass | 0.1 | MF Ixx | 600 | MF Iyy | 600 | MF Izz | 80 |
| TP Ixx | 0.1 | TP Iyy | 0.1 | TP Izz | 0.001 | WA Ixx | 2 |
| WA Iyy | 2 | WA Izz | 0.02 | | | | |

Apply

Dismiss

Similarly select the **Main Gear** tab to specify the properties of the main landing gear:

Create Landing Gear Model

Name: Landing_Gear

Analysis Parameters | Nose Gear | Main Gear

Diagram:

Reference Aircraft Attached Points (mm)

| | | | | | |
|-----------|------|-----------|-------|-----------|--------|
| RP-MLG1 X | 2169 | RP-MLG1 Y | -1074 | RP-MLG1 Z | -11567 |
| RP-MLG2 X | 2233 | RP-MLG2 Y | -1136 | RP-MLG2 Z | -11065 |
| RP-MLG3 X | 1429 | RP-MLG3 Y | -1136 | RP-MLG3 Z | -10806 |

MLG Modeling Parameters

ALPHA_mf (deg) 4 ALPHA_shock (deg) 9

SB_MLG 880 MF_MLG 950 TA_MLG 460 SA_MLG 1330

WA_MLG 480 Tire_MLG 370 Offset_SA_MLG 146 Offset_MF_MLG 270

S.A. Stroke 360 Tire_Damping_Coeff 10

Spring Data File spring_main.prx Damper Data File damper_main.p Tire Data File tire_main.prop

MLG Mass and Inertia

| | | | | | | | | | |
|-----------|-------|------------|-------|-----------|-------|----------|-------|----------|-------|
| FB mass | 0.006 | MF mass | 0.006 | TA mass | 0.005 | SAT mass | 0.001 | SAB mass | 0.001 |
| WA mass | 0.001 | Wheel mass | 0.1 | | | | | | |
| FB Ixx | 1000 | FB Iyy | 1000 | FB Izz | 2 | MF Ixx | 5000 | MF Iyy | 5000 |
| TA Ixx | 7 | TA Iyy | 7 | TA Izz | 0.04 | SAT Ixx | 200 | SAT Iyy | 200 |
| SAB Ixx | 40 | SAB Iyy | 40 | SAB Izz | 0.07 | WA Ixx | 20 | WA Iyy | 20 |
| Wheel Ixx | 80000 | Wheel Iyy | 80000 | Wheel Izz | 40000 | | | | |

Apply

Dismiss

Preset values are entered in each text field. The plug-in creates the landing gear model using the default values if you do not modify them. Each parameter in the GUI is described in the attached LandingGear-Model-Info.pdf file.

After clicking **Apply** the landing gear rigid body model is created.

Notes

1. The elements created by the plug-in are used in a display body, which is not deformable.
2. The aircraft mesh is not changed by the plug-in.
3. Once the model is created, the display body mesh is not changed even if one of reference points is changed.
4. The input file and property files listed below are available in the attached **files.zip** file
 - The property files for shock absorber are required for NLG and MLG in your working directory (nonlinear spring and damper data: spring_nose.property, spring_main.property, damper_nose.property, and damper_main.property).
 - The property files for the tire are required for NLG and MLG in your working directory (nonlinear spring data: tire_nose.property and tire_main.property).
 - The airplane input file Airplane.inp must be in your working directory.
5. Once the input file is generated, it should be run with double precision in Abaqus/Explicit.

Disclaimer

The attachments to this article are subject to certain usage conditions. Please [click here](#) for details.

Acknowledgement

Dassault Systemes SIMULIA would like to acknowledge FOKKER Landing Gear for their contributions.

KEYWORDS plug-in, plugin, 4509

ATTACHMENT

[LandingGear-Model-Info.pdf](#)

[files.zip](#)

[answer_4509_fig3.png](#)

[answer_4509_fig2.png](#)

[answer_4509_fig1.png](#)

[answer_4509_fig4.png](#)

[LGS.zip](#)

SUBSCRIBE TO CHANGES ☐

RATING **On a scale of 1-5, how would you rate the technical content of the article?**
Please rate this article...

LET US KNOW IF THIS ARTICLE NEEDS TO BE ENHANCED

- UNCLEAR
- MISSING INFO
- DUPLICATE
- OUT OF DATE
- ERROR DETECTED

MY FAVORITE CONTENT