

Exercises: Importing CAD Models

Physical Modeling for Formula Student



Crank Assembly Import

Task: Import the SolidWorks® model of an automotive crank assembly

Steps: Export SolidWorks assembly and import it into SimMechanics™.

1. * Open **cad_engine.SLDASM** in SolidWorks and export it using **SimMechanics Link™**.

- Verify that SimMechanics Link is installed and registered with SolidWorks.
- Use the SimMechanics Link menu to export the CAD assembly.

2. Import the XML file using **smimport**

- Import the exported xml file from the previous step or the provided file **cad_engine.xml**.
- Check whether the import was successful and if there are any warnings in the MATLAB® Command Window.

3. Simulate the model

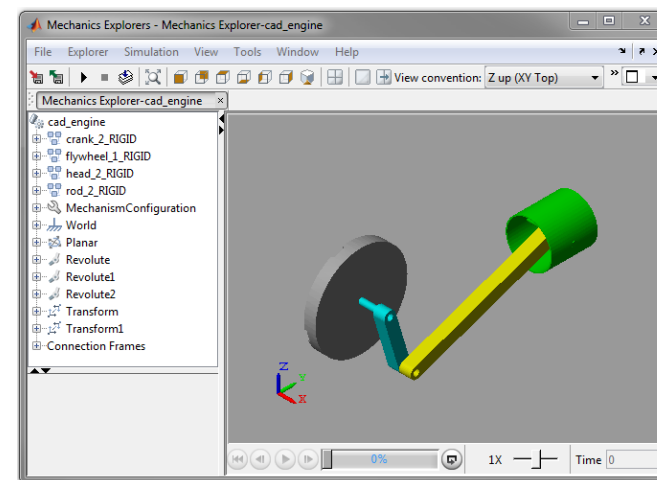
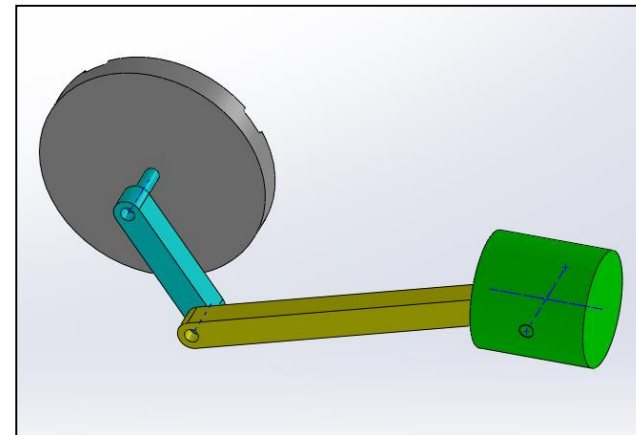
4. (Bonus) Add damping, initial conditions, and sensors to the appropriate joints. Also, change the direction of gravity to match the coordinate convention of the model.

- For the Revolute2 block,
 - Specify a Low priority position target of -55°
 - Specify a High priority velocity target of 10 rev/s
 - Set the **Damping Coefficient** to $5e-4 \text{ N*m/(rad/s)}$
 - Sense the joint position
- Change gravity to be in the negative \hat{x} -direction.

* This step requires SolidWorks and SimMechanics Link to be installed on the system.

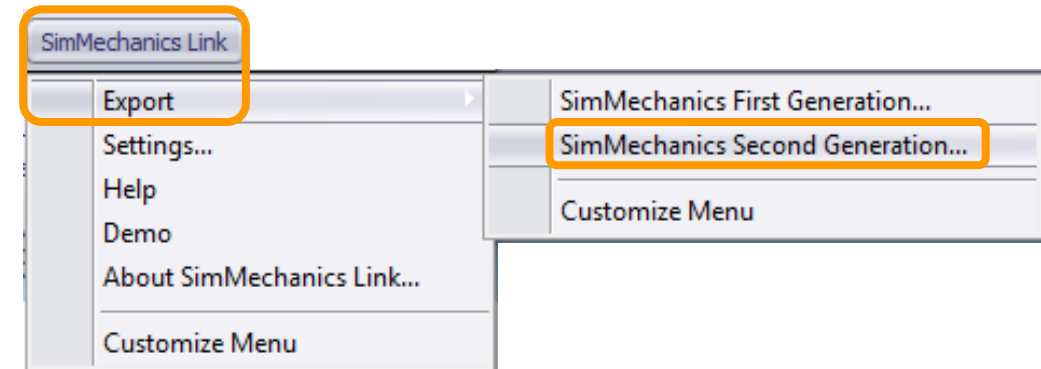
Try

```
>> smimport('cad_engine.xml');
```



Solution: Crank Assembly Import

1. Export in SolidWorks



2.

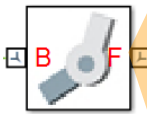
```
>> smimport('cad_engine.xml')
Warning: The set of constraints between flywheel_1_RIGID and
crank_2_RIGID could not be mapped to a joint. A rigid connection has been
added between port F of flywheel_1_RIGID and port F of crank_2_RIGID for
these constraints.
```

In this case, the warning about the unmapped constraint can be ignored since the flywheel and the crank are rigidly connected.


Try

```
>> cad_engine_imported
>> cad_engine_modified
```

3.



Z Revolute Primitive (Rz)		
State Targets		
Specify Position Target	<input checked="" type="checkbox"/>	
Priority	Low (approximate)	
Value	-55	deg
Specify Velocity Target	<input checked="" type="checkbox"/>	
Priority	High (desired)	
Value	10	rev/s
Internal Mechanics		
Equilibrium Position	0	rad
Spring Stiffness	0	N*m/rad
Damping Coefficient	5e-4	N*m/(rad/s)
Actuation		
Sensing		
Position	<input checked="" type="checkbox"/>	
Velocity	<input type="checkbox"/>	
Acceleration	<input type="checkbox"/>	
Actuator Torque	<input type="checkbox"/>	




Uniform Gravity	Constant	
Gravity	[0 0 -9.81]	m/s^2
Linearization Delta	0.001	

Creating Frames from Geometric Features

Task: Use a Solid block to import geometries from CAD and create coordinate frames based on geometric features.

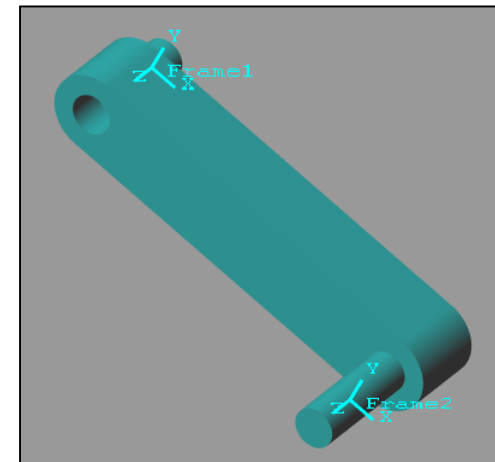
Steps: In a previous chapter, you used Rigid Transform blocks to create coordinate frames at the midpoints of the crank connection pins. Open the `cadFramesStart` model and take the following steps.

1. Add a Solid block to the model and load its geometry from the `crank.STEP` file.
2. Expand the **Frames** menu of the Solid block dialog and select the New Frame () button.
3. In the new dialog that appears, select a feature (face, edge, or vertex).
4. Change the **Frame Origin** option to **Based on Geometric Feature**. Then, click the **Use Selected Feature** button.
5. Use the **Frame Axes** option to align the axes as needed.

Note This approach works for all solid geometries except for those imported from STL files.

Try

```
>> cadFramesStart
```



Solution : Creating Frames from Geometric Features

Try

```
>> cadFramesSoln
```

The top part of the image shows a 'Mechanism Configuration' diagram. It includes a 'Solver Configuration' block with the equation $f(x) = 0$, a 'World Frame' (W), a 'Rigid Transform' (B to F), a 'Revolute Joint' (B to F), and a 'Solid' (F1 to F2). A callout from the 'Solid' block points to a 'Geometry' table:

Geometry	
Shape	From File
File Type	STEP
File Name	crank.STEP

The bottom part of the image shows a detailed view of the 'Frame F2' definition dialog. The 'Frame Origin' is set to 'Based on Geometric Feature' with the selected feature being 'Center of cylindrical surface 3'. The 'Frame Axes' are defined as follows:

- Primary Axis: +Y
- Secondary Axis: +X

Both axes are set to 'Along Reference Frame Axis'. The right side of the dialog shows a 3D model of a crank arm with a coordinate system (X, Y, Z) at its end, where the Z-axis is aligned with the cylinder's axis.