# **Machinery Belt Tutorial**

This tutorial teaches you how to create poly-v grooved belt system using the 2D links modeling method. The Adams/Machinery Belt module supports multiple combinations of belt system type and modeling methodology options.

This chapter includes the following sections:

- What You Will Create
- Creating Poly-V Grooved Belt System
- Simulation
- Adams/PostProcessor Results

#### What You Will Create

During this tutorial, you will model a ploy-v grooved belt system consisting of 2 grooved pulleys and one tensioning device which includes a smooth pulley. All 3 pulleys will be constrained via revolute joints. One of the grooved pulleys will be actuated with a motion. Contact forces including friction between the discrete belt segments and the pulleys convey the motion.

The figure shows the poly-v grooved belt system that you are going to create.



Figure 1 Poly-V Grooved Belt System

## **Creating Poly-V Grooved Belt System**

In this section, you will create a belt system.

- 1. Click the **Machinery** tab on the Adams/View ribbon.
- 2. From the **Belt** container, click the icon for **Create Pulley.**



3. The pulley creation wizard will launch. On the first page (**Type**) select **Poly-V Grooved** from the **Type** option menu and click **Next**.

•	Туре	•	Method	٠	Ge	ometry-Pulleys	
elt System							
lame	beltsys_1						
ulley Set							
lame	pulleyset_1		Ту	pe P	oly-V Groo	ved	1
6	The poly-v gr which is groo similarly groo	rooved belt oved along oved pulley	system employ: its primary axis 's, and smooth o	s a cord-re on one sid n the othe	inforced be e, to mate r (back) sid	lt with de.	

4. On the next page (Method) select **2D Links** from the Method option menu and click **Next**.

•	Туре	٠	Method	•	Geometry-Pulleys	
Method	2D Links		•			
	The belt is o to each othe the segmen	constrained to er with stiffnes its and pulleys	a plane. The belt is se elements and anal s. This modeling met	modeled wit lytically calc hod is faster	h planar part segments cor ulated contact forces betw to simulate than 3D links	nnected een but

- 5. On the next page (**Geometry**) fill out the two tabs defining each pulley's geometry as shown below and then click **Next**:
  - a. Pulley1 name as **Driver** and Pulley2 name as **Driven**.
  - b. Pulley1 center location as **0,0,0** and Pulley2 center location as **150,0,0**.

0.0
E

•	Method	•	Geometry-Pulley	rs 🔍	Mat	erial-Pulleys	
umber of Pull	eys 2	Ţ.	Axis of	Rotation	Global Z	• 0.0,0.0,0.0	
2 ulley	n 150 0 0		Name	Driven			
cinci contra							

- 6. The next page (Material-Pulleys) defines the material properties to be used for the mass property calculations for each pulley. Accept the defaults and move on by clicking Next.
- 7. On the next page (Connection-Pulleys) you define how each pulley is to be connected to the rest of the model. For this example, accept the defaults which mount each pulley to ground via revolute joints and click Next.
- 8. On the next page (**Output-Pulleys**) you can optionally reduce the amount of post-processing information about the pulleys to be made available as Adams Requests. For this example, accept the defaults (to get all information) and click **Next**.
- 9. The next page (Completion-Pulleys) informs you that all the information required for the grooved pulleys has been entered. Click Next to proceed to tensioner definition.
- 10. On this page (Geometry Tensioners) enter 1 in the Number of Tensioner with Deviation Pulley field and fill out the tabs defining the tensioner arm and deviation pulley geometry as shown below and then click Next:

Number of Tensioner with Deviation Pulley 1 1 J Type Rotational Tensioner Name press Pivot Center 75,95,0	
1   Type Rotational Tensioner Name press Pivot Center 75.95.0	
Type Rotational   Fensioner Name press Privot Center 75,95,0	
ensioner Name press	
Pivot Center 75,95,0	
Geometry	
ength 50 Width 10 Depth 5	Installation Angle 270
eviation Pulley Name roller Axis Of Rol	ation Global Z 💌 0.0,0.0,0.0
Seometry	
Pulley Radius 30 Pulley Width 30	In/Out C In C Out
Connection Between Tensioner and Deviation Pulley F Yes	C No

- 11. The next page (Material-Tensioners) defines the material properties to be used for the mass property calculations for the tensioner arm and deviation pulley. Accept the defaults and move on by clicking Next.
- 12. On the next page (**Connection-Tensioners**) you define how the tensioner arm is to be connected to the rest of the model. Since we selected a rotational type of tensioner earlier in the wizard, the tensioner arm will be mounted via a revolute joint and a rotational spring-damper will be applied to the remaining rotational degree of freedom. Here we define to which body in the model the tensioner arm is mounted and specify the spring damper coefficients.

	Material-Tensioners	•	Connection-Tensioners	• Con	npletion
l ensioner ody otational	Tr Ground Tensioner	ensioner c	onnector 🕝 Yes 🤇 No		
S	Stiffness 1e05		Damping 100	Preload	0.0

13. The next page (**Completion**) informs you that all the information required for the pulley set has been entered. Optionally save the content of the entire wizard to a file for re-use later by clicking the **Save** icon. Click **Finish** to create the pulley set.



16. From the Ribbon go to the Machinery tab's Belt container and click the icon for Create Belt.



- 14. The Belt Creation wizard is launched. In the **Name** field enter the name of the pulley set you just created (right-mouse-click in the field and use **Pick** or **Guesses** to quickly select) and then click **Next**.
- 15. The next page (**Method**) defaults to the method you chose when creating the pulley set. Accept this default by clicking **Next**.
- 16. The next page (Geometry) is for specification of the Belt geometry. Make the modification as shown below and click Next to move on.

4	Method		Geometry		Contact and M	
	Neulou		Geomeny	-	Contact and Ma	
lelt				Name	belt_1	
ois of Rotation	Global Z	• 0.0,	0.0.0.0	Reference	Location 0.0,0.0,0	.0
eometry						
Total Segmer	ts 0	Segment	Length 7.5	_		
Belt Height 3.	5	Belt Width	25	Cor	dial Distance 0.5	
tib Height 2.	1	Rib Width	3.56	Rib	Angle 40.0	
elt Stiffness						
tiffness	Geometry &	Material 💌				
egment Area	30.0	Section	Inertia	0.5		
oung's Modulus	1.0E+00	Damping	Rate	1.0		
eometry Setting	e					
conteny oetting						
lelt Graphics	Shell	<u> </u>	Force Graphics	Enable	-	

- 17. The next page (Mass) defines the material properties to be used for the mass property calculations for the belt segments. Accept the defaults and move on by clicking **Next**.
- 18. On the next page (Wrapping Order) the belt routing is defined. Right-click in the field and use the Guesses menu to first pick the Driver, then the roller and finally the Dirven so that the field is populated as such: "pulleyset\_1\_Driver, pulleyset\_1dev\_roller, pulleyset\_1\_Driven", then click Next.

- 19. When prompted about the belt number of segments, tension and strain; click **OK** to continue. A warning message will be displayed informing you that the 2D parts for the belt segments are unique to the Adams/Solver C++ executable (the default mode).
- 20. Now you will be on the Output Request page. Create a request of type **Segment Request** and populate the **Link Part(s)** field (for example, via right-click **Pick**) with a belt segment (57) near the bottom of the follower pulley. This will create output requests to track the forces on that segment as the belt runs around the pulleys. You may want to toggle the icon display off to better see the belt (one way to do this is to click inside the graphics window and press the "v" key on your keyboard). Click **Next.**



21. The next page (**Completion**) informs you that all the information required for the belt has been entered. Optionally save the content of the entire wizard to a file for re-use later by clicking the **Save** icon. Click **Finish** to create the belt.

22. From the Ribbon go to the **Machinery** tab's **Belt** container and click the icon for **Belt Actuation Input**.



- 23. The **Actuate Belt** wizard is launched. In the Pulley Set **Name** field enter the name of the pulley set you just created (right-mouse-click in the field and use **Pick** or **Guesses** to quickly select). In the Actuator Pulley field enter the name of the driver pulley (right-mouse-click in the field and use **Pick** or **Guesses** to quickly select). Then click **Next**.
- 24. On the next page (Type) select Motion and click Next.
- 25. Complete the next page (Function) as shown below and click Next.

•	Туре	٠	Function	٠	Output	
Function		User Def	ined 💌			
User Ente	red Func.	30d*time	1			
Direction		Anti C	lockwise 🔻			
Geometry	Scaling	1	•			
		On	•			
Active						

- 26. On the next page (**Output**) you can optionally reduce the amount of post-processing information about the actuator to be made available as Adams Requests. For this example, accept the defaults (to get all information) and click **Next**.
- 27. The next page (**Completion**) informs you that all the information required for the actuation has been entered. Optionally save the content of the entire wizard to a file for re-use later by clicking the **Save** icon. Click **Finish** to create the actuator.

## Simulation

Simulate your model for 2 seconds at 2000 steps by clicking the **Interactive Simulation** icon from the **Simulate** container on the **Simulation** tab, entering the values shown below and clicking the **Start Simulation** button.



#### Adams/PostProcessor Results

Explore the results in Adams/PostProcessor

