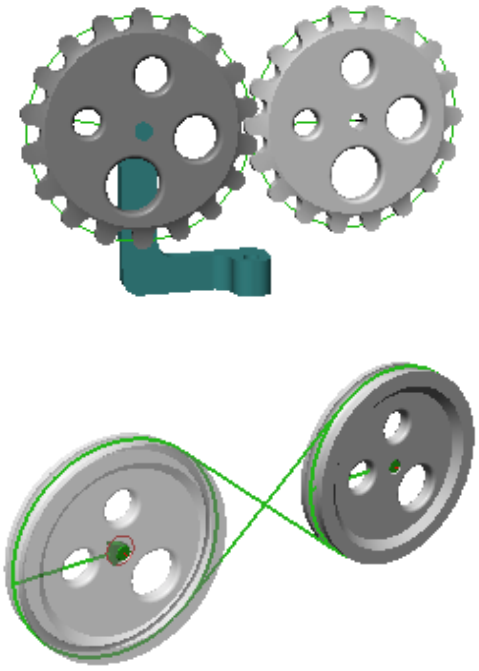
CHAPTER 10

# Belts and Gears



## Exercise 10-1 Create a Belt Constraint

***Objectives***

In this exercise you will learn to

- Model a belt constraint.
- Model a cross belt constraint.
- Add friction to a joint.

***Software***

- MSC.visualNastran 4D, MSC.visualNastan Motion

***Support Files***

- Tutorials\Chapter 10\Exercise 10.1\Pulleys.wm3

1. Launch MSC.visualNastran Desktop.
2. Choose **Open** from the **File** menu.
3. Browse the **Tutorials\Chapter 10\Exercise 10.1** folder and open the file **Pulleys.wm3**.

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**NOTE:** The default location for the Tutorials folder is **Program Files\visualNastran Desktop.**

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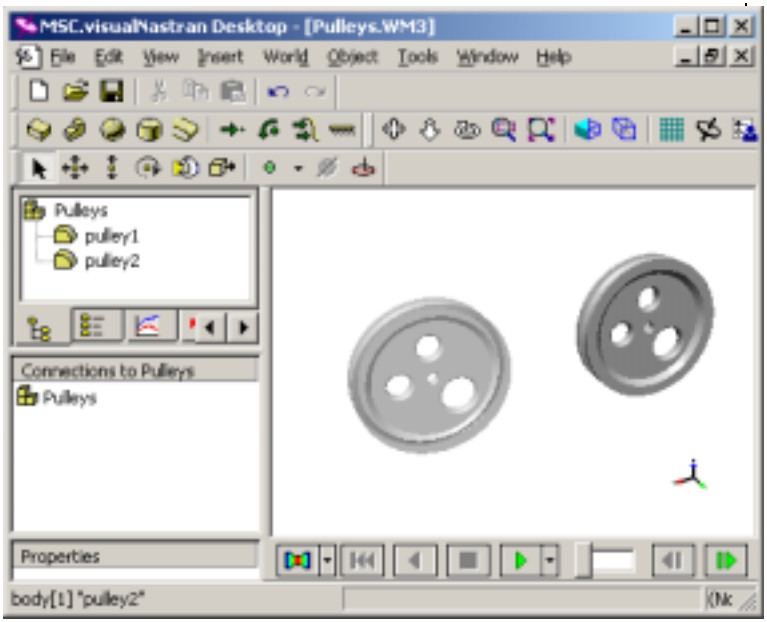



***Figure 10-1***
*Pulleys*

Two pulleys display in the modeling window, as shown in Figure 10-1.

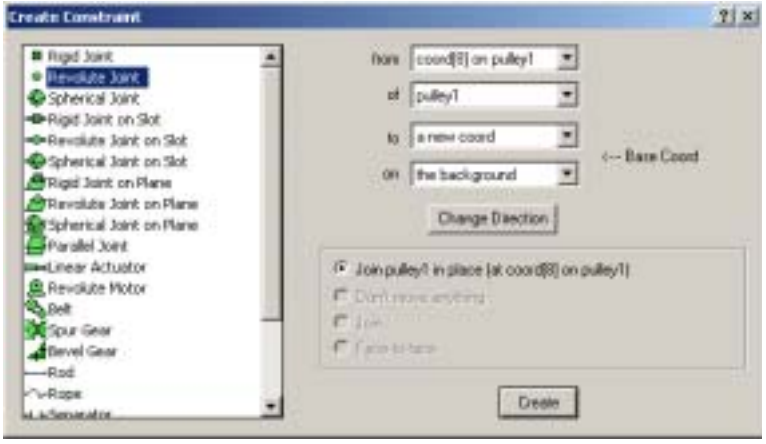
4. Click the **Coord** tool in the **Edit** toolbar, and place a Coord on **pulley1** near the center hole.
5. Double-click the newly created **coord[8]** in the **Connections List** to display the **Properties** window.

6. Click the Position (**Pos**) tab in the **Properties** window to make sure the coord is positioned at the axis of rotation. The configuration is given as (X, Y, Z) = (-0.01, 0, 0), and (Rx, Ry, Rz) = (-90, 0, 0). If any values are different, correct them.

7. Close the **Properties** window.

8. With **coord[8]** still selected click the **Create Constraint** button on the **Edit** toolbar. The **Create Constraint** dialog appears (Figure 10-2).

***Figure 10-2***
*Create Constraint Window*




9. Select a **Revolute Joint** as the constraint type, and note that the first option, **Join [bodies] in place**, is selected.

10. Click the **Create** button in the **Create Constraint** window.

11. Repeat steps 4 thru 10 for **pulley2**.

## Add Friction to a Joint

Joint friction allows a dynamic coefficient of friction property to be assigned to a constraint for more realistic simulations.

1. Double-click **constraint [17]** (revolute joint on **pulley2**) in the **Object List** to open the **Properties** window.

2. Select the **Friction** tab and click the **Enabled** radio button.

3. Enter 0.38 as the **Rotational Coefficient** of friction.

4. Enter 0.08 as the **Effective Radius** of the bearing or rotational joint.

5. Click **Close** to close the **Properties** window.

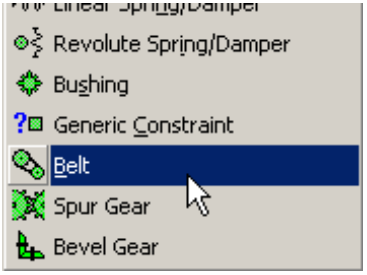
## Create a Belt Constraint Between Two Bodies

1. Select **coord[8]** on **pulley1** in the **Object List**.

2. With **coord[8] still** selected, hold down the **Ctrl** key and select the **coord[15]** on **pulley2** in the **Object List**.

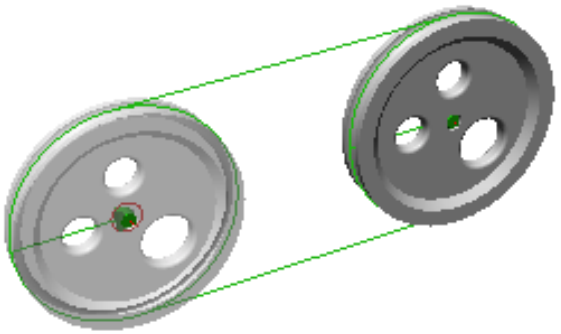
3. Click the drop-down arrow to the right of the **Create Constraint** button on the **Edit** toolbar and select **Belt.**

***Figure 10-3***
*Selecting Belt Constraint*




A **Belt** constraint is created between **pulley1** and **pulley2**.

***Figure 10-4***
*Belt Constraint*



4. Click the **Torque** button in the **Sketch** toolbar.

5. Click the surface on **pulley1** anywhere between the center and the edge of the pulley.

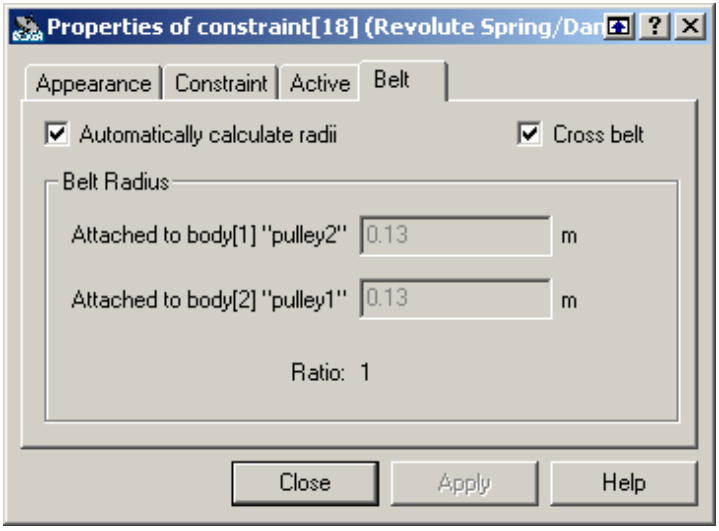
6. Click the **Run** button on the **Tape Player Control** and watch the result. Notice that the pulleys turn in the same direction.

7. Click the **Stop** button.

8. Double-click the belt constraint either in the workspace or **Object List** to open the **Properties** window.

9. Click the **Cross belt** check box and click **Close**.

***Figure 10-5***
*Properties Window*

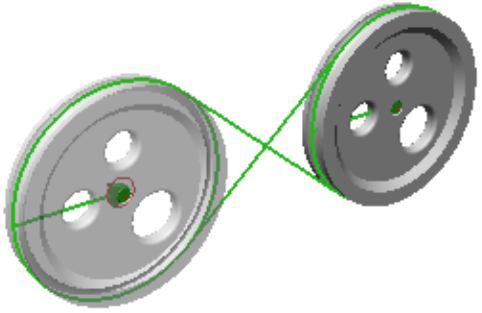



10. Click the **Run** button on the **Tape Player Control** and watch the result.

Notice that the pulleys now rotate in opposite directions.

11. Click the **Stop** button on the **Tape Player Control** to stop the simulation.

***Figure 10-6***
*Cross Belts*



# Exercise 10-2 Create a Spur Gear Constraint

***Objectives***

In this exercise you will learn to

- Model a spur gear constraint.
- Add friction to a joint.

***Software***

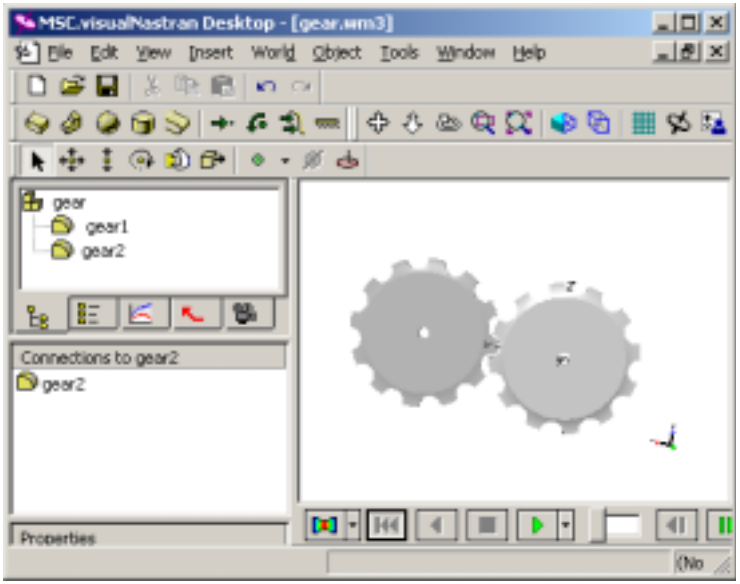
- MSC.visualNastran 4D, MSC.visualNastan Motion.

***Support Files***

- Tutorials\Chapter 10\Exercise 10.2\gear.wm3

1. Launch MSC.visualNastran Desktop.
2. Choose **Open** from the **File** menu.
3. Browse the **Tutorials\Chapter 10\Exercise 10.2** folder and open the file **gear.wm3**.

***Figure 10-7***
*Spur Gears*




4. Click the **Coord** tool in the **Edit** toolbar, and place a Coord near the center hole of **gear1**.
5. Double-click the newly created **coord[6]** in the **Connections List** to display the **Properties** window.

6. Click the Position (**Pos**) tab on the **Properties** window to make sure the coord is positioned at the axis of rotation. The configuration is given as (X, Y, Z) = (-0.01, 0, 0), and (Rx, Ry, Rz) = (-90, 0, 0). If any values are different, correct them.

7. Close the **Properties** window.

8. With **coord[6]** still selected click the **Create Constraint** button on the **Edit** toolbar. The **Create Constraint** dialog appears.

9. Select a **Revolute Joint** as the constraint type, and note that the first option, **Join [bodies] in place**, is selected.

10. Click the **Create** button in the window.

11. Repeat steps 4 thru 10 for **gear2**.

## Add Friction to a Joint

Joint friction allows a dynamic coefficient of friction property to be assigned to a constraint for more realistic simulations.

1. Double-click **constraint [8]** (revolute joint on **gear1**) in the **Object List** to open the **Properties** window.

2. Select the **Friction** tab and click the **Enabled** radio button.

3. Enter 0.58 as the **Rotational Coefficient** of friction.

4. Enter 0.078 as the **Effective Radius** of the bearing or rotational joint.

5. Click **Close** to close the **Properties** window.

## Create a Spur Gear Constraint Between Two Bodies

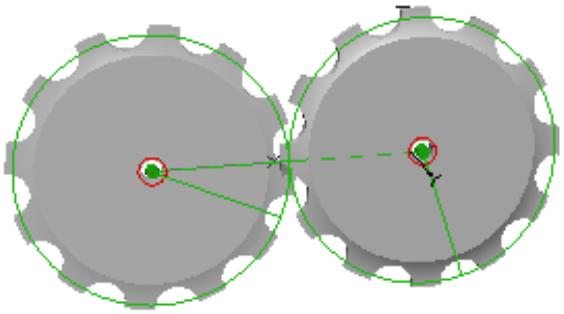
1. Select the **coord[6]** on **gear1** in the **Object List**.

2. With **coord[6]** still selected, hold down the **Ctrl** key and select the **coord[10]** on **gear2** in the **Object List**.

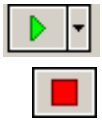
3. Click the drop-down arrow to the right of the **Create Constraint** button on the toolbar and select **Spur Gear.**

A **Spur Gear** constraint is created between the two gears.

***Figure 10-8***
*Gear Constraint on Spur Gears*



4. Click the **Torque** button in the **Sketch** toolbar.
5. Click the surface on **gear1** any where between the center and the edge of the gear.



6. Click the **Run** button on the **Tape Player Control** and watch the result.
7. Click the **Stop** button.

# Exercise 10-3 Create a Bevel Gear Constraint

***Objectives***

In this exercise you will learn to

- Model a bevel gear constraint.

***Software***

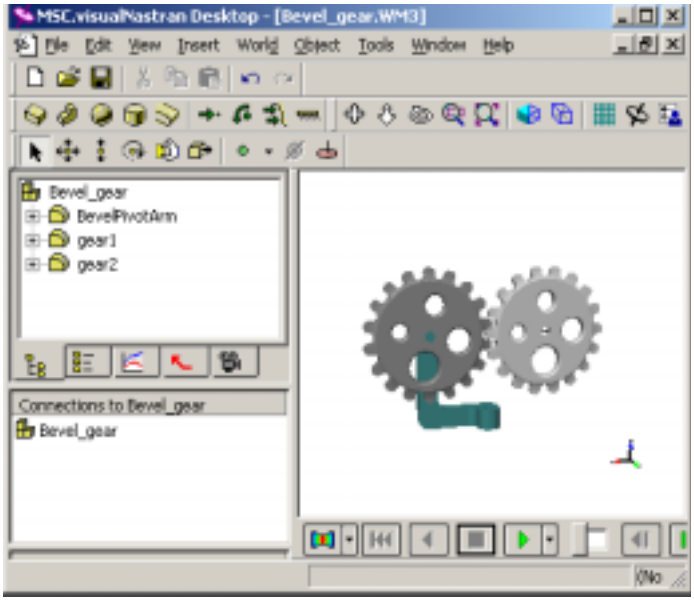
- MSC.visualNastran 4D, MSC.visualNastan Motion.

***Support Files***

- Tutorials\Chapter 10\Exercise 10.3\Bevel_gear.wm3

1. Launch MSC.visualNastran Desktop.
2. Choose **Open** from the **File** menu.
3. Browse the **Tutorials\Chapter 10\Exercise 10.3** folder and open the **Bevel_gear.wm3**.

***Figure 10-9***
*Bevel Gears*




4. Click the **Coord** tool in the **Edit** toolbar, then place a Coord near the center hole of **gear2**.

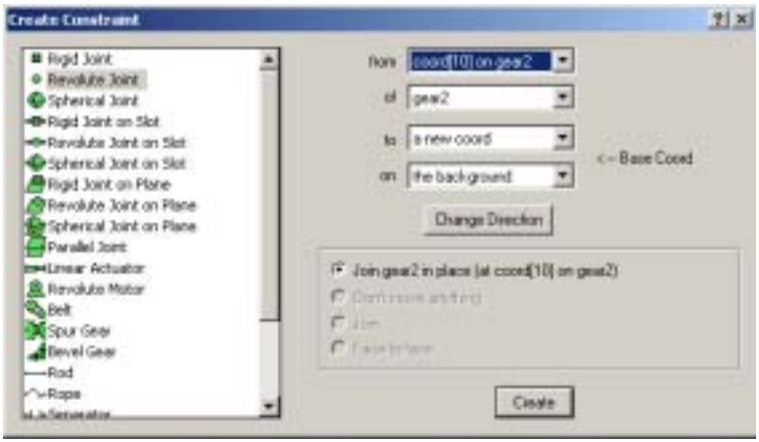
5. Double-click the newly created coord, referred to here as **coord[10]**, in the **Object List** to display the **Properties** window.

6. Click the Position (**Pos**) tab in the **Properties** window to make sure the coord is positioned at the axis of rotation. The configuration is given as (X, Y, Z) = (-0.01, 0, 0), and (Rx, Ry, Rz) = (-90, 0, 0). If any values are different, correct them.

7. Close the **Properties** window.

8. With the coord still selected, click the **Create Constraint** button on the **Edit** toolbar. The **Create Constraint** dialog appears (Figure 10-10).

***Figure 10-10***
*Create Constraint - Revolute Motor*



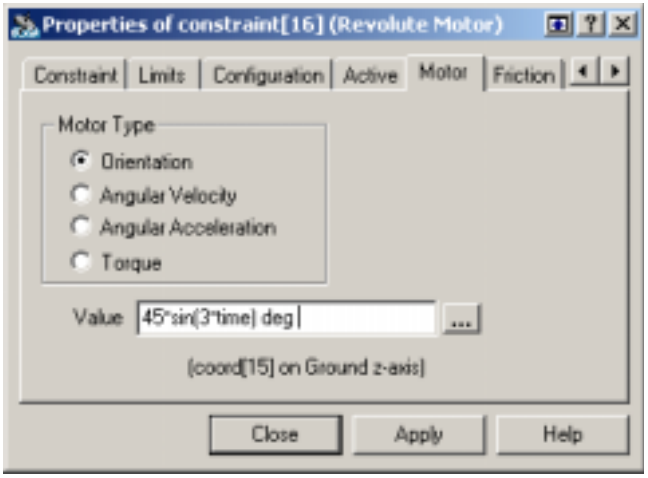

9. Select a **Revolute Motor** as the constraint type, and note that the option **Join [bodies] in place** is selected.

10. Click the **Create** button.

11. Double-click **constraint [12]** (revolute motor) in the **Object List** to open the **Properties** window.

12. Select the **Motor** tab and select the **Orientation** radio button under **Motor Type**. Enter 45*sin(3*time) deg as the **Value** (Figure 10-11).

***Figure 10-11***
*Constraint Properties of Revolute Motor*



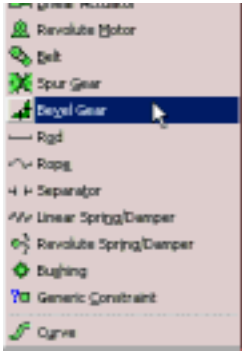
13. Click **Close** to close the Properties window

## Create a Bevel Gear Constraint Between Two Bodies

1. Select the **coord[8]** on **gear1** in the **Object List**.
2. With **coord[8]** still selected, hold down the **Ctrl** key and select the **coord[10]** on **gear2** in the **Object List**.

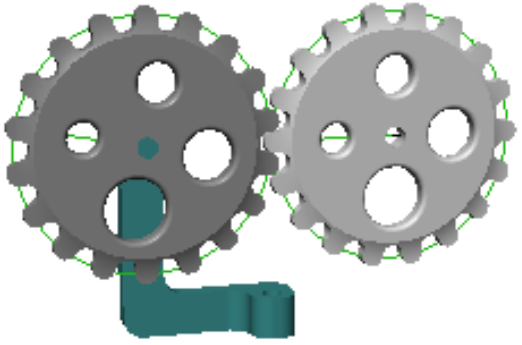
3. Click the drop-down arrow to the right of the **Create Constraint** button on the toolbar and select **Bevel Gear.**

***Figure 10-12***
*Constraint Pull-down Menu*




The **Bevel Gear** constraint is created between the two gears.

***Figure 10-13***
*Bevel Gear Constraint*



4. Click the **Run** button on the **Tape Player Control** and watch the result.

5. Click the **Stop** button.