

# Media Transport System with Design Study Tutorial (MTT2D)





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#### **Edition Note**

This document describes the release information of **RecurDyn V9R4**.

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## **Getting Started**

## **Objective**

This tutorial will help you learn how to use the design study capability of **RecurDyn** with the **2D Media Transport Toolkit (MTT2D)**. You will learn how to create design variables from parametric values and how to define performance indices. This tutorial uses the basic model defined in the first **MTT2D** tutorial as shown in the figure below. It contains three cases, each of which is progressively more sophisticated:

- In the first case, you perform a simple design study with a single parameter to analyze the effect of paper thickness.
- In the second case, you perform a design of experiments, which lets you analyze two variables: paper thickness and curl.
- In the third case, you also consider the x and y locations of two of the guides.



## Audience

This tutorial is intended for experienced users of **RecurDyn** who previously learned how to create geometry, joints, force entities, and 2D contacts. All new tasks are explained carefully.

## **Prerequisites**

You should first work through the 3D Crank-Slider, Engine with Propeller, and Pinball (2D contact) tutorials, or the equivalent. We assume that you have a basic knowledge of physics.

## **Procedures**

The tutorial is comprised of the following procedures. The estimated time to complete each procedure is shown in the table.

Procedures	Time (minutes)
Simulation environment set up	10
Case 1: Parametric Study of Paper Thickness	20
Case 2: Design of Experiments with Paper Thickness and Curl	30
Case 3: Design of Experiments with a Moving Guide Assembly	45
Total	105





# Setting Up Your Simulation Environment

## **Task Objective**

Learn how to set up the simulation environment and adjust the  $\ensuremath{\mathsf{MTT2D}}$  model for the design studies

# Estimated Time to Complete

## **Starting RecurDyn**

To start RecurDyn and create a new model:

- RecurDyn
- 1. On your Desktop, double-click the **RecurDyn** icon.

**RecurDyn** starts and **Start RecurDyn** dialog box appears.

- 2. Exit the Start RecurDyn dialog box.
- Open a copy of the RecurDyn model file that you created in the first MTT2D tutorial, and save it to a new file name, such as MTT2D\_DOE.rdyn.
- 4. Enter the **MTT2D** subsystem by doing one of the following:

Start RecurDyn		×
New Model -		
Name	Model1	
Unit	MMKS(Millimeter/Kilogram/Newton/Second)	Setting
<u>G</u> ravity	-Y 🔽	Setting
		<u>O</u> K
Open Model		Browse
Recent Mode	ls	Icons 💌
Show 'Start	RecurDyn' Dialog when starting	

- In the Database window, right-click MTT2D1 subsystem and select Edit.
- In the modeling window, double-click the MTT2D subsystem geometry.

## Adjusting the MTT2D Model from the First MTT2D Tutorial

In this section, you will adjust the model you created for the first MTT2D tutorial by changing.

- The motion to move the rollers 20 times faster.
- The penetration parameter to 5 from the default of 2.

The penetration parameter is a scale factor used to set the guide contact to continue to act while the sheet penetrates a depth of the sheet thickness multiplied by the penetration parameter. You need a larger penetration parameter because of the increased sheet speed.

#### To adjust the model:

- 1. In the Database window, under the **Expression** category, right-click **Ex1**, and click **Properties**.
- Adjust the motion expression to move the rollers 20 times faster by changing it to 40\*TIME rather than 2\*TIME. Note that this change will affect both RevJoint20 and RevJoint22 because both of these joints reference EX1.
- 3. Display the Properties dialog box for the **MTT2DAssembly1** (last item in the Database window) and do the following.
  - In the **Contact List** tab, click **Parameter**.
  - Adjust the Penetration Parameter to 5.

Parameter	
Buffer Radius Factor	2. Pv
Maximum Stepsize Factor	2. Pv
Penetration Parameter	5. Pv
Resolution	0., 0.
Resolution Maximum Number of Sheet Segment	0., 0.

- 4. Display the **Dynamic/Kinematic** Analysis dialog box and set.
  - End Time to 0.4
  - Step to 220
  - Plot Multiplier to 5

You can run the simulation for a shorter time because of the faster sheet speed.

5. Click **OK** to save the parameters and exit the dialog box.

Dynamic/Kinematic Analysis	×
General Parameter Initial Cond	ition
End Time	0.4 Pv
Step	220. Pv
Plot Multiplier Step Factor	5. Pv
Output File Name	
Static Analysis	
Eigenvalue Analysis	
State Matrix	
Frequency Response Analysis	s
Hide RecurDyn during Simul	ation
Display Animation	
GravityY	5 Z O. Gravity
Unit Newton - Kilogr	ram - Millimeter - Second
Simu	Ilate OK Cancel



# Case 1: Parametric Study of Paper Thickness

In this chapter, you will perform a parametric study to determine the effect paper thickness has on the behavior of the paper in the MTT2D model. The **RecurDyn** simulation results will show the results that are to be expected: that the paper sticks out more to the left as the paper thickness increases (less drooping of the paper).

## **Task Objective**

Learn to:

- Set parametric and design variables
- Set the performance index, the simulation output that you will track
- Run a design study



## **Setting Up the Parametric Variable for Paper Thickness**

Your first step is to set up the parametric variable for paper thickness. This replaces the value of paper thickness with a variable.

#### To set up the parametric variable:

- 1. Display the Properties dialog box for the group, SheetGroup1.
- 2. In the **Sheet Group** tab, clear the **Sheet Thickness** check box. Then, click **Pv** (Parametric Value) next to **Sheet Thickness**.
- 3. In the **Parametric Value List** dialog box, click **Add**.
- Set the parametric value name to Thickness\_SHT and the value to 0.5.
- 5. Click **OK** to exit the **Parametric Value List** dialog box.

The parametric value name appears in the Sheet Thickness text box in place of the value that was there previously.

6. Click **OK** to exit the **SheetGroup1 Properties** dialog box.



## **Setting Up the Design Variable for Paper Thickness**

Now you will set the design variable for paper thickness based on the parametric value you just created for paper thickness. As you run the design study, **RecurDyn** varies this variable to find the optimum thickness for paper.

#### To set the design variable:

- 1. From the Simulation Type group in the Analysis tab, click Design Study(DOE).
- 2. Under the **Design Variables** section, click **Add**.
- 3. In the **Design Variable List** dialog box, click **Create**.
- 4. In the **Design Variable** dialog box, next to the **Value** text box, click **Pv**.
- 5. Select the Thickness\_SHT parametric value and click OK.
- 6. Set the name of the design variable to **DV\_Thickness\_SHT**.
- 7. The **Value Range** should be at its default setting of **+/- Percent relative to Value**.
- 8. Set the Delta values to be -20% and +20%

- 9. Check Use Edit Value.
- 10. Set Edit Value to Equally Spaced and set the Number of Values text box to 3.
- 11. Click **Generate** and you should see the values of 0.4, 0.50, and 0.6.
- 12. Click **OK** to close the **Design Variable** dialog box and return to the **Design Variable List** dialog box.
- 13. Make sure that **Design Variable No. 1** is selected in the **Design Variable List** and click **OK** to close the dialog box and return to the **Design Study** dialog box.

Design Variab	9
Design variab	
Name	DV_Thickness_SHT
Value	Thicknes Pv 0.5 R
Value Range	+/- Percent ralative to Value 🔻
- Delta [%]	-20 + Delta [%] 20
🗹 Use Edit Va	lue
Edit Value —	
Equally Space	ed 👻 Generate
The Number o	f Values 3
0.4 0.5 0.6	
	OK Cancel

#### **Setting Up the Performance Index**

For this simple example, you will track the minimum x value of the leading point of the sheet. This will be your performance index and will tell you how far the sheet extends to the left as it exits the second nip pair.

#### To set the performance index:

- 1. In the **Design Study** dialog box, under the Performance Indexes section, click **Add**.
- 2. In the Performance Index List dialog box, click Add.
- 3. In the **Performance Index List** dialog box, set the name of the **Performance Index** to **PI\_Reach**.
- 4. Set **Type** to **Min Value**.
- 5. Click **EL** to open the **Expression List**.
- 6. Click Create.
- 7. Set the expression name to SHT\_Reach\_Exp.
- 8. Under the Argument List section, click Add.
- 9. In the Database window, expand **Bodies** → **SheetBody1** → **Markers**.
- 10. Drag Marker3 into the text box with the ID of 1 under the Argument list.
- 11. Enter the expression **DX(1)**.

The DX function with one argument outputs the displacement of the marker in the x-axis of the global coordinate system. The number 1 refers to Marker3 because it is in the Argument List with an ID of 1.

- 12. Click **OK** to exit the **Expression** dialog box.
- 13. With the Expression No. 2 selected, click OK to exit the Expression List dialog box.
- 14. With the **Performance Index No. 1** selected, click **OK** to exit the **Performance Index List** dialog box.

## Setting Up and Running the Design Study

Now you will set up and run the design study. You will run three trials for each value of the design variable.

#### To set up and run the design study:

- 1. In the **Design Study** dialog box, notice that.
  - Parametric Study is selected because you have a single design variable. If you
    have two or more design variables, RecurDyn automatically selects the Design of
    Experiments option.
  - The number of levels is set to 3 because you set the number of values for the DV\_Thickness\_Sht design variable to 3.
- 2. Click **R** to recalculate the number of trials. This should now be 3.
- 3. Click **Simulate** to run the design study.

**RecurDyn** runs three simulations, one for each value of the design variable.

- 4. In the **Design Study** dialog box, click **Result Sheet** to see a summary of the simulations as shown in the figure to the right. The results show that the paper sticks out more to the left as the paper thickness increases (less drooping because thicker paper is stiffer than thinner paper).
- 5. Click **Close** to close the **Result Sheet**.
- 6. Click **OK** to close the **Design Study** dialog box





# **Case 2: Design of Experimnets** with Paper Thickness and Curl

In this chapter, you will run a design of experiments to determine the effect of paper thickness and paper curl. You will only need to create a variable for paper curl because you will use the variable you created for paper thickness in the previous case.

## **Task Objective**

You will:

- Create parametric and design variables for paper curl
- Set up and run a design of experiments



## **Setting Up the Parametric Variable for Paper Curl**

#### To set up the parametric variable:

- 1. Display the Properties dialog box for Sheet Group1.
- 2. In front of **Sheet Curl Radius**, click the first check box and clear the selection of the second check box, as shown in the figure on the right.
- 3. Click **Pv** (Parametric Value) for Sheet Curl Radius.
- 4. In the Parametric Value dialog box, click Add.
- 5. Set the parametric value name to Curl\_SHT and the value to 200.
- 6. Make sure the row with the **Curl\_SHT** parametric value is selected and click **OK**.

The parametric value name appears in the Sheet Curl Radius text box in place of the value that defined the paper curl previously.

7. Click **OK** to exit the **SheetGroup** Properties dialog box.

Properties of SheetGroup1 [ Current Unit : N/kg/mm/s/deg ] General Sheet Group Output						
Start Point -10., 120., 0 Pt Direction Point 30., 120., 0 Pt						
Folding Sheet Point List Refresh Preview						
Number of Segment 20						
Segment Length	10.		Pv			
Sheet Thickness		Thickness_SHT	Pv			
Initial Velocity	0.					
🗸 🗹 Density	SH_D	2.2e-006	Pv			
🗸 🗹 Young's Modulus	SH_E	2250.	Pv			
🗹 🗹 Damping Factor	ig Factor SH_C 32. Pv					
Sheet Curl Radius Curl_SHT Pv						
Hold Down the Noise	of Sheet Contact Force	25				
Update Geometry Information Automatically						
Air Resistance Coefficient						
Each Rendering Automatic						
	ОКС	ancel Ap	oply			

## Setting Up the Design Variable for Paper Curl

#### To set up the design variable for paper curl:

1. From the **Simulation Type** group in the **Analysis** tab, click **Design Study**.

# DOE

- Under the **Design Variables** section of the **Design Study** dialog box, click **Add**. 2.
- In the **Design Variable List** dialog box, click **Create.** 3.

- 4. In the **Design Variable** dialog box, click **Pv**.
- 5. Select the **Curl\_SHT** parametric value and click **OK**.
- 6. Set the name of the design variable to **DV\_Curl\_SHT**.
- 7. Set the **Percent relative to Value** to **-50%** and **+50%**.
- 8. Click Use Edit Value.
- 9. Set **Edit Value** to **Equally Spaced** and set the number of values in the **Values** text box to 3.
- 10. Click Generate.

The values 100, 200, and 300 appear.

- 11. Click **OK** to return to the **Design Variable List** dialog box.
- 12. Make sure the **DV\_Curl\_SHT** Design Variable is selected and click **OK** to return to the **Design Study** dialog box.

### **Setting Up and Running the Design of Experiments**

You will set up and run the design of experiments. You will run nine trials, one for each possible combination of values for the two design variables.

#### To set up and run the design of experiments:

- 1. Save the **RecurDyn** model file to a new file name, such as **MTT2D\_DOE\_Curl.rdyn**.
- 2. In the Design Study dialog box, notice that.
  - Design of Experiments option is selected because you have two design variables.
  - The Number of Levels is set to 3 because you set the number of values for both design variables to be 3.
- 3. Select **Built-in DOE Techniques** and **Full Factorial** if they are not already selected.
- 4. Click **R** to recalculate the number of trials.

The number of trials changes to 9.

 In the Design Study dialog box, click **Simulate** to run the design of experiments. **RecurDyn** runs nine simulations.

Design Variable			
Name	DV_Curl_SHT		
Value	Curl_SHT Pv 200. R		
Value Range	+/- Percent ralative to Value 🔻		
- Delta [%]	-50. + Delta [%] 50.		
🗹 Use Edit Va	lue		
Edit Value —			
Equally Space	ed 👻 Generate		
The Number o	f Values 3		
100. 200. 300.			
	OK Cancel		

#### To review the results of the design of experiments:

1. Click **Result Sheet** to see a summary of the simulations as shown in the figure on the right.

The results show that, in general, the paper sticks out more to the left as the paper thickness increases and as the curl radius decreases (tighter curl). The data for the sheet with a thickness of 0.6 mm and a curl of 100 mm is very different, however. Something dramatic must have happened.

Trial	DV_Thickness_SHT	DV_Curl_SHT	Pl_Reach
1	0.4	100.	-206.19499459764
2	0.4	200.	-186.520109254452
3	0.4	300.	-174.158214331894
4	0.5	100.	-208.00234234385
5	0.5	200.	-196.428262293083
6	0.5	300.	-186.302037941158
7	0.6	100.	-54.0526184827568
8	0.6	200.	-203.32670009744
9	0.6	300.	-195.605541707739

- 2. Click **OK** to exit the **Design Study** dialog box.
- 3. Review the animation data (**RecurDyn Animation Data** contained in files with a .rad file extension) for trials 7 and 8 using the **Import** command under the **File** menu.

A set of rad files that have \_1 through \_9 added to the original file name appear.

- Import the file for trial 7 and animate it
- Import the file for trial 8 and animate it.
- What can you conclude?

The figure to the right superimposes the final position of trials 7 and 8. You should observe that in trial 7, a combination of a tight curl and thick (stiff) sheet causes the sheet to stub in the corner between the guide and the roller. In all other cases, the sheet is able to go through the second roller pair.

4. Save the **RecurDyn** model file with the current results.



# Chapter 55

# **Case 3: Design of Experiments** with a Moving Guide Assembly

In this chapter, you run a design of experiments that moves the linear and arc guides that guide the sheet between the first and second sets of rollers.

## **Task Objective**

You will create parametric points that are needed to control the position of the guides:

- A center point controls the position of the arc guide.
- Starting and ending points control the position (and size) of the linear guide.

You will define the starting and ending points of the linear guide relative to the center of the arc guide. You will define a marker at the parametric point of the arc guide that will be used as reference for defining the location of the parametric points for the linear guide. You will define the x and y coordinates of the arc guide parametric point by specifying two parametric values. Given the above relationships, you will be able move the arc and linear guides as an assembly by adjusting the values of the two parametric values.



## Saving the Model to a New File Name

You will save the model to a new file name because the new setup for this DOE will disturb the previous DOE setup.

#### To save the file to a new name:

Use the Save As command under the File menu to save the **RecurDyn** model file to a new file name, such as **MTT2D\_DOE\_Move.rdyn**.

### **Defining Parametric Points**

You will create a parametric point, called **PP\_ArcGuide**, which acts as the reference point for two other parametric points, a marker, the arc guide, and the linear guide.

#### To define the parametric points:



- 1. From the **Parameter** group in the **SubEntity** tab, click **Parametric Point(PP)**.
- 2. Click Add in the Parametric Point List window.
- 3. Define a parametric point named **PP\_ArcGuide** located at **-30**, **95**, **0** or the center of the arc guide.
- 4. Click **Apply**.



- 5. From the **Professional** tab of the **Marker and Body** group, click **Marker** to define a marker that is on the **Mother Body** and located at **the PP\_ArcGuide** parametric point.
- 6. Display the Properties dialog box for the marker and check the origin definition. You should see the name **PP\_ArcGuide** in the **Origin** text box under the **Origin & Orientation** tab.

**Tip**: If you see a set of numbers, click **Pt** and select the **PP\_ArcGuide** icon in the modeling window. Do this until the parametric point name appears in the origin text box. Click **OK** to close the Marker Properties dialog box

7. Define two additional parametric points as shown in the figure on the below. Define them relative to the marker that you just created by clicking **F** and selecting the marker located at **the PP\_ArcGuide** parametric point.

The values in the Point text box are the relative coordinates from the center of the arc guide to the starting and ending points of the linear guide.

ame	tric Po	ints						
No	DP	Name	Point		Relative to		Comment	
1		PP_ArcGuide	-30.,95.,0.	Pt		F		
2		PP_LinGuide1	0,30,0	Pt	MotherBody.M	F		
2		-						

8. Click **OK** to exit the **Parametric Point List** dialog box. You should see three Parametric Point icons.

#### Add the Parametric Points to the Guide Definitions

You will the guide definitions to include the parametric points. The parametric points will define the location of the guides.

- Display the Properties dialog box for the arc guide (GuideArc1), click the Pt button for the Center Point of the arc guide, and click the PP\_ArcGuide parametric point. The text box for the Center Point of the arc guide should now contain the name, PP\_ArcGuide, as shown in the figure to the right.
- 2. Click **OK** to exit the **Arc Guide** dialog box.

Properties of GuideArc1 [ Current Unit : N/kg/mm/s/deg ]					
General Graphic Property Arc Guide					
Guide Mother Body	MotherBody		В		
Radius	30.		Pv		
Angle	70.		Pv		
Center Point	PP_ArcGuide		Pt		
Direction to Start Point	0, 30., 0		Pt		
Imaginary PEdge					
Edge	Start	End End			
Radius	AG_IM_R	1.	Pv		
To Sheet					
Contact Direction	◯Up	Down	Preview		
Contact Parameter		To Sheet			
☑ No. of Max Contact Points	GTS_MAXCP	10.	Pv		
Force Display	Inactivate		<b>•</b>		
	ОК	Cancel	Apply		

- 3. Display the Properties dialog box for the linear guide located next to the arc guide (GuideLinear2), and then:
  - In the Linear Guide tab, click Pt for the Start Point of the guide, and click parametric point PP\_LinGuide2 (located at the right side of the guide).
  - Repeat the same step for the End Point of the guide and click parametric point PP\_LinGuide1 (located at the left side of the guide).

The names of the parametric points should appear in the text boxes for the Start Point and Second point, as shown in the figure to the right.

4. Click **OK** to exit the **Linear Guide** dialog box.

Properties of GuideLinear2 [ Current Unit : N/kg/mm/s/deg ]					
General Graphic Property Linear G	uide				
Guide Mother Body	MotherBody				
Start Point	PP_LinearGuide2 Pt				
Second Point	PP_LinearGuide1 Pt				
Imaginary PEdge					
Edge	Start End				
Radius	LG_IM_R 1. Pv				
To Sheet					
Contact Direction	Up Obwn Preview				
Contact Parameter	To Sheet				
No. of Max Contact Points	GTS_MAXCP 10. Pv				
Force Display	Inactivate 💌				
	OK Cancel Apply				

#### To test the parametric points:

- 1. Select the **PP\_ArcGuide** parametric point.
- 2. Use the **Object Control** dialog box to move the point back and forth 10 mm in the x and y directions. Check that all three parametric points, the marker, and both guides move together.
- 3. If not, review the definition procedure and get help as needed until the objects move together. Make sure the **PP\_ArcGuide** parametric point is left in its original position.

## **Creating Parametric Values to Control Location of the Assembly**

You will create two parametric values to represent the x and y location of the parametric point.

#### To create parametric values:

- Create two new parametric values to represent the x and y location of the parametric point as shown in the figure on the right (from the **Subentity** tab, click **Parametric Value**).
- Display the Parametric Points dialog box (from the Subentity menu, click Parametric Point).
- Manually enter the parametric values into the Point text box of the PP\_ArcGuide parametric point as shown in the figure

point as shown in the figure on the right.

amet	ric Va	lues			
No	DP	Name	Value		Comment
1	$\square$	Thickness_SHT	0.5	E	
2		Curl_SHT	200.	E	
3		PP_PV_X	-30.	Е	
4		PP_PV_Y	95.	E	

arame	tric P	oint List						
Parame	tric Po	ints						
No	DP	Name	Point		Relative to		Comment	-
1		PP_ArcGuide	PP_PV_X, PP_PV_Y,0.	Pt		F		
2		PP_LinGuide1	0.,30.,0.	Pt	MotherBody.M	F		
		PP LinGuide2	15 30 0	Dt	Mather Redu M	-		

#### **Setting Up and Running the Design of Experiments**

Now you will create design variables for the two parametric values you created in the previous section that control the position of the guide assembly. You will then set up and run the design of experiments.

#### To add the design variables and set up and run the design of experiments:

- Add a design variable to the Design Variable dialog box (as shown in the figure on the right) for each of the new parametric values. For each design variable, set:
  - Value Range to +/-Delta relative to Value.
- Design Variable List Design Variable No Name Value Ā 1 Thickness\_SHT DV DV\_Curl\_SHT 2 DV Curl SHT DV\_PP\_PV\_X PP PV X DV 3 DV PP PV Y PP\_PV\_Y 4 DV
  - –Delta to -4 and the +Delta to 4.
- 2. Click **OK** to exit the **Design Variable List** dialog box.
- 3. In the **Design Study** dialog box, select the two new design variables to be the two design variables for this study. You want the Design Variable portion of the window to appear as shown in the figure on the right. You will do the following.
  - Click on the DV button for Design Variable No. 1
  - Select Design Variable DV\_PP\_X
  - Click OK to exit the Design Variable List dialog box.
  - Click on the DV button for Design Variable No. 2
  - Select Design Variable DV\_PP\_Y
  - Click OK to exit the Design Variable List dialog box.
  - There should only be two Design Variables in the Design Study window. If there is a row for a third Design Variable, select the row and hit the Delete button.
- Be sure the **Design of Experiments** option is selected and set up as before as explained in the section, Setting Up and Rupping the **Design o**

Design	Variables —		Performance Indexes
No 1	Name DV_PP_PV_X	DV	No         Name           1         Pl_Reach         Pl
Add	I Insert	Delete	Add Insert Delete
Ado Para Built-i	I Insert Imetric Study n DOE Technique	Delete	Add Insert Delete  Obsign of Experiments    Full Factorial
Ada Para Built-i	I Insert Imetric Study In DOE Technique Ir of Levels 3	Delete Pv	Add Insert Delete Design of Experiments Full Factorial  Number of Trials 9 R
Add Para Built-i Numbe	I Insert ametric Study n DOE Technique er of Levels 3 e Results	Delete	Add Insert Delete Design of Experiments Full Factorial Number of Trials 9 R
Ado	I Insert ametric Study n DOE Technique rr of Levels 3 e Results 2 e Model in Each C	Delete Pv Case	Add     Insert     Delete <ul> <li>Design of Experiments</li> <li>Full Factorial</li> <li>Number of Trials</li> <li>9</li> <li>R</li> <li>Simulate</li> <li>Result Sheet</li> </ul>

Setting Up and Running the **Design of Experiments**, on page 15.

5. Click **Simulate** to run the design of experiments.

You will see the arc guide and linear guide move to different position in the graphics window as the various trials are run. **RecurDyn** runs nine simulations, one for each value of the variables. Remember that the sheet will have the nominal curl of **200 mm** that you set up in Case 2.

6. In the **Design Study** dialog box, click **Result Sheet** to see a summary of the simulations as shown in the figure on the right. The largest reach is with trial 4, where the guide is lowered from the original position. The lowest reach is for trial 6, and it appears that the sheet may not have been able to pass through both rollers. You will look at the animation for trial 6 in the next section.

Trial	DV_PP_PV_X	DV_PP_PV_Y	Pl_Reach
1	-34.	91.	-195.514812713879
2	-34.	95.	-55.187362792394
3	-34.	99.	-56.8099212294265
4	-30.	91.	-204.666934444838
5	-30.	95.	-196.3873305979
6	-30.	99.	-54.9160275316081
7	-26.	91.	-143.807475643573
8	-26.	95.	-202.832030560103
9	-26.	99.	-199.592899208163

### **Reviewing the Results of the Design of Experiments**

The review of the animation results for this DOE is different than the review of the previous DOE and design study because the model has a changing geometric configuration for the various trials. You will get a confusing animation if you display the various trials without adjusting the parametric values such that the guides are in the correct position. You will see the sheet follow along the guides in a different position that the guides being displayed. **RecurDyn** includes a feature that allows you to adjust the parameters efficiently before displaying the results of a trial.

#### To view the animations for trial 6:

- 1. Click on the **Update DV** check box in the lower right of the Result Sheet window, as shown in the figure to the right.
- 2. Click **Close** to close the Result Sheet window.
- 3. Click **OK** in the **Design Study** window and you will see the guides move from their nominal position to the position used in Trial 6.
- Click on the **Import** option in the File menu, set the File Type to RecurDyn animation data (.rad files) and select the file named MTT2D\_DOE\_Move\_6.rad.

5. You will see that the sheet is caught in the corner between the arc guide and the movable roller in the second roller pair. That explains the low reach value of the sheet for trial 6.



#### To plot a family of curves for all of the trials:

- Display the plot window and import the results for all of the trials (MTT2D\_DOE\_Move\_\*.rplt files) other than trial 6 (already loaded in the plot window).
- 2. (Under the **Bodies** category, expand **SheetBody1**, right-click on **Pos\_TM** and select **MultiDraw**). The MultiDraw command will plot that output for all output cases that have been imported into the plot window. The figure below shows the results of plotting the magnitude of the translation of the first segment of the sheet.



Thanks for participating in this tutorial!