SIEMENS EDA



Monte Carlo Analysis



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Objective

At the end of this Support Kit, you should be able to do the following:

- Set parameter distribution
- Run a Monte Carlo simulation
- Analyze Monte Carlo simulation results

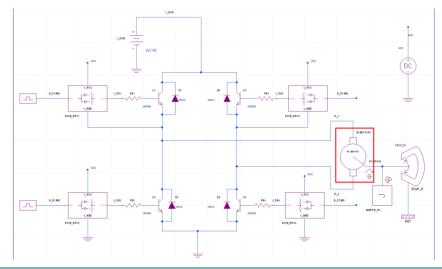
Description

Monte Carlo (MC) Analysis is a statistical analysis method that randomly varies model parameters within a specified tolerance range and distribution. A Monte Carlo Analysis is often used to help determine the "manufacturability" of a design, that is, given the tolerances used, how robust the design is when manufactured in large quantities.

Exercise 1: Setup Parameter Distribution

It is important to include the values and tolerances that will be used in the simulation. Downloading and installing Xpedition and Xpedition AMS will include the files mentioned below. However, they are also included in the Support Kit for download.

- 1. From within Xpedition AMS, load the project:
 - Select File > Open > Project and navigate to C\MentorGraphics\EEVX.2.14\SDD_HOME\sim\systemvision\tutor\Beyond_Spice\Beyond_ Spice.prj
 - b. Select the Beyond_Spice.prj file
 - i. Click Yes if asked to close any open documents
- 2. In the schematic, right click on the "DCMOTOR1" symbol and select Edit Model Properties



- 3. In the Model Properties dialog box, select the "Parameters" tab
- 4. Check the "Show All Properties" box

Name	Туре	Default	Value	Visibility
POS_IC	ANGLE	REAL'LOW	0.0	 Invisible
R_WIND	RESISTANCE	REAL'LOW	100.0	 Invisible
кт	REAL		3.0	 Invisible
L	INDUCTANCE		1.0E-3	 Invisible
D	REAL		0.1	 Invisible
J	MOMENT_IN	MOMENT_INERTIA	0.001	 Invisible
Pin Order		P1 P2 SHAFT_ROT		 Invisible
Parameter Distri			R_WIND,20.0%,Normal;KT,10.0%,No	 Invisible

5. A new property will appear "Parameters Distribution" In the *Model Properties* dialog, confirm it has the following values:

R_WIND,20.0%,*Normal; KT*,10.0%,*Normal; L*,20.0%,*Uniform; D*,10.0%,*Normal; J*,10.0%,*Normal*

Note: You can experiment and change the "Parameters Distribution" values to find different results.

Name	Туре	Default	Value	Visibility
POS_IC	ANGLE	REAL'LOW	0.0	 Invisible
R_WIND	RESISTANCE	REAL'LOW	100.0	 Invisible
кт	REAL	REAL'LOW	3.0	 Invisible
L	INDUCTANCE	REAL'LOW	1.0E-3	 Invisible
D	REAL		0.1	 Invisible
J	MOMENT_IN	MOMENT_INERTIA	0.001	 Invisible
Pin Order		P1 P2 SHAFT_ROT		 Invisible
Parameter Distri			R_WIND,20.0%,Normal;KT,10.0%,Normal;L,20.0%,Uniform;D,10.0%,Normal;J,10.0%,Normal	 Invisible
Ref Designator			DCMOTOR1	 Invisible
				 Invisible

Note: Most of the motor parameters are specified with distribution information (this information can be specified by clicking on the button with the three dots [...] next to the desired parameter).

6. Select OK

Exercise 2: Run the Monte Carlo Simulation

With the parameters assigned, the next step is to run the analysis.

The Monte Carlo Analysis is run in combination with one of the main analysis types (time or frequency domain) and the controls are built into the *Multi-Run* tab of the *Simulation Control* dialog.

- 1. Go to Simulation > Simulate
- 2. Select the Multi-Run tab
- 3. Change the Multi-Run Type to "Monte Carlo"
- 4. Set the Number of Runs to "20"

Multi-Run				_	
Monte C	arlo		~	DC Monte Carlo	
Monte Ca					
Number of	f Runs:	20			
Seed :	Fixed	~ 1			
🗌 Use E	otreme V	alues			

5. Select the Simulations tab and verify that Time-Domain Analysis is enabled with End Time set to "1"

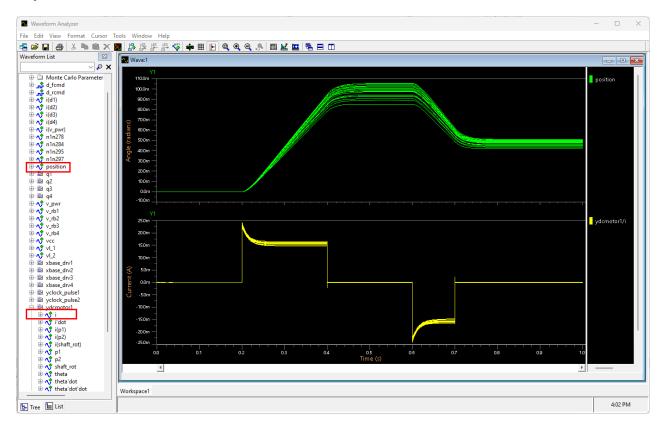
1	Simulations	Results	tb_hbridge_s		×
	Experimen Operating Enabled	Point Ana	expt1.cmd	~	
-	─ Time-Dom ✓ Enable End Time	nain Analy: ;	Setup	Freq Start	up
[Enable	FFT		Freq Stop Noise Analysis Set	up

6. Click "OK" to run the simulation. The Waveform Analyzer will popup after the simulation is complete

Note: Running the simulation may take a few minutes - monitor the progress by observing the lower left-hand corner of the Xpedition AMS window.

Exercise 3: Plot the Simulation Results

1. In the Waveform Analyzer window, right click position and select "Plot". Do the same for ydcmotor1/i



Note: Notice that the motor position and current both exhibit some variation and are displayed as compound waveforms. Each member of the family of curves represents one of the Monte Carlo simulation runs.

- 2. Select Tools > Measurement Tool to begin performing measurements
- 3. Select the "position" waveform using the drop-down list from the Source Waveform(s) field
- 4. Select "Maximum" as the Measurement Setup

- 5. Select "Annotate Waveform(s) with Result Markers" in the Measurement Results field
- 6. Select "Entire Waveform" in the Apply Measurement to: field then click "Apply" and "Close"

Neasurement Tool	×
Settings	
Measurement : All Typ	ves v Maximum v
position	
Measurement Setup	
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AC Coupled RMS	🗌 Peak To Peak
Amplitude	
Average	Topline
🗌 🗆 Baseline	🗌 X at Maximum
🛃 Maximum	🗌 X at Minimum
O Minimum	
□	
	rm(s) with Result Markers
Plot New Wavefor	
O Plot Statistical Ser	nsitivity of Maximum 🗸 🗸
Apply Measurement to	: Entire Waveform 🗸
🗙 🗌 Remove All Prev	vious "Levels" Results
	Apply Abort Close Help

7. Right click the measurement marker and select "Measurement Result" Now you can select whichever measurement you want to see, from the table shown

Wave: I		
Y1	Statistics:1	
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90.0m —	and beleve	
	Delete All Related Waveform: position	
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70.0m —	Save Measurement	
60.0m —	Measurement Results	
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