

Motion Simulation and Analysis Tutorial

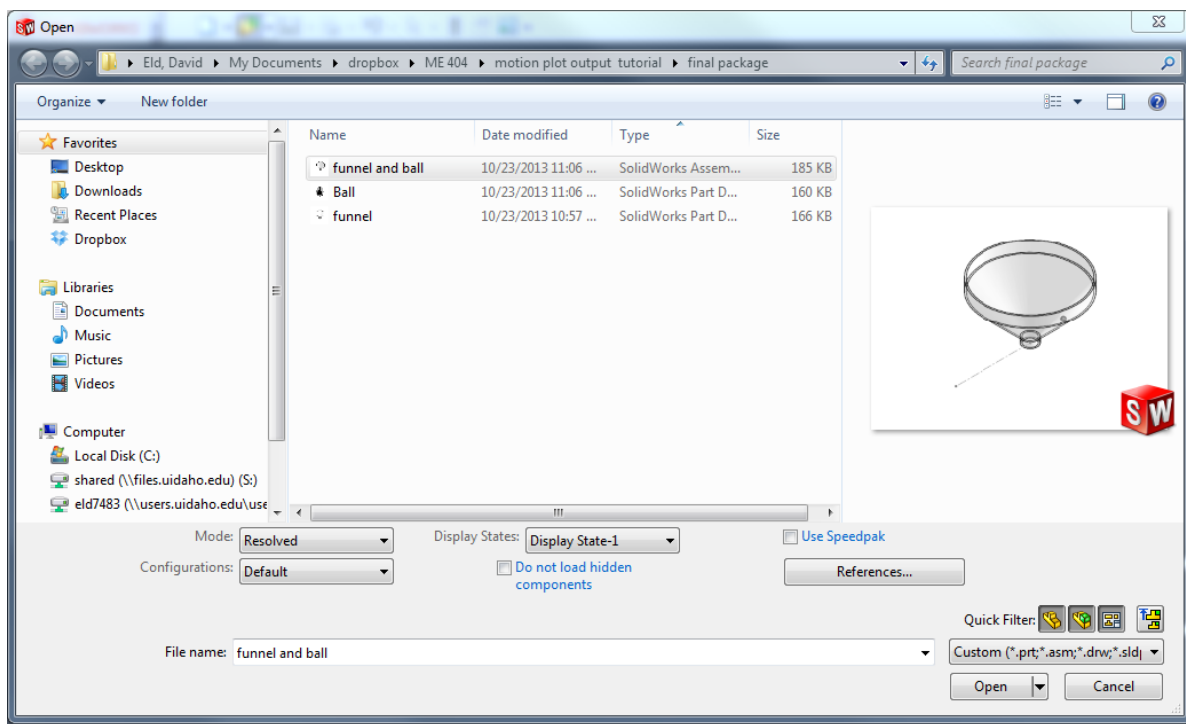
Introduction:

This tutorial will go over how to set up and run a basic motion simulation in Solidworks, how to use position plots, and export and use the data in other programs such as Excel and MATLAB.

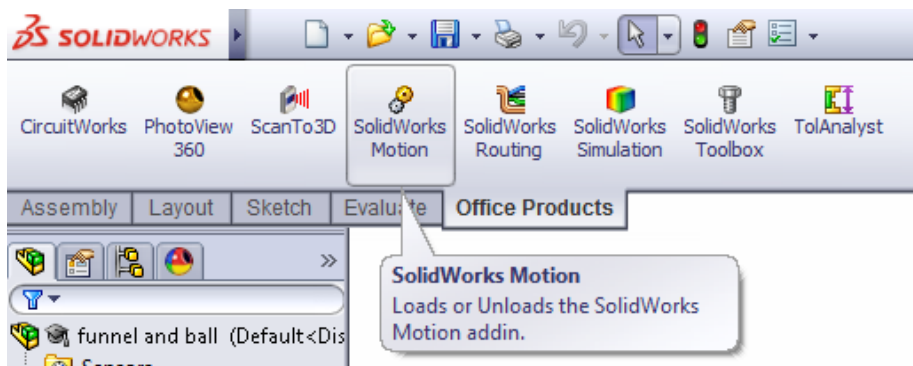
Setting up the simulation

First we will start with opening the assembly and setting up the simulation workbench.

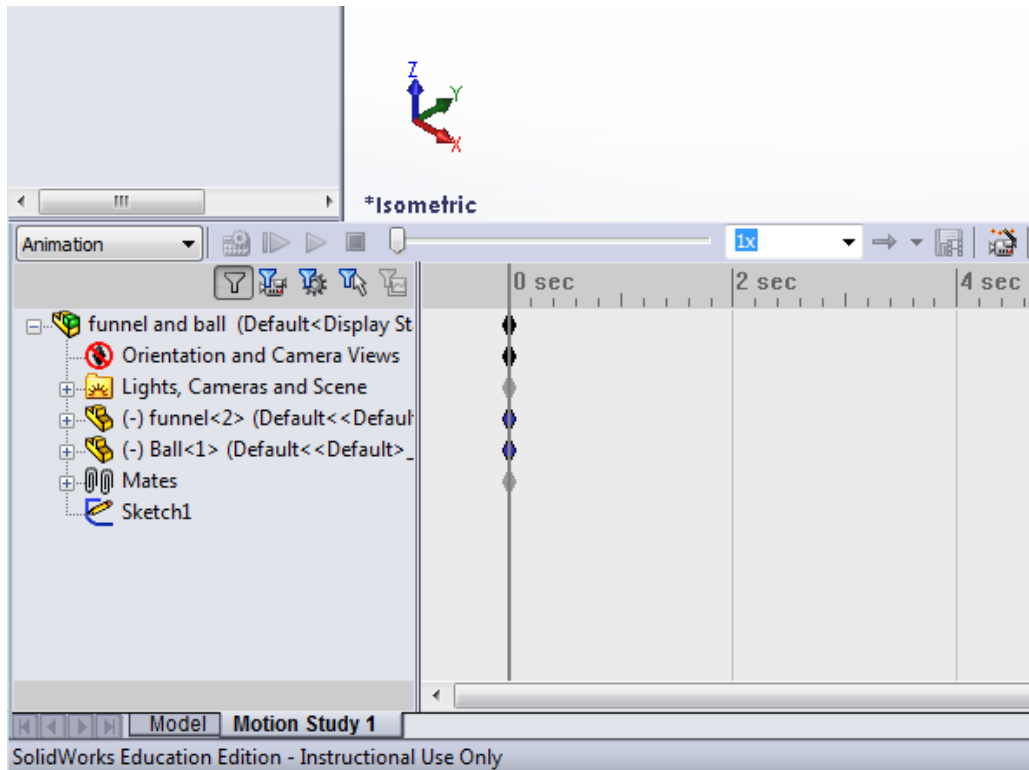
1. Open funnel and ball.asm



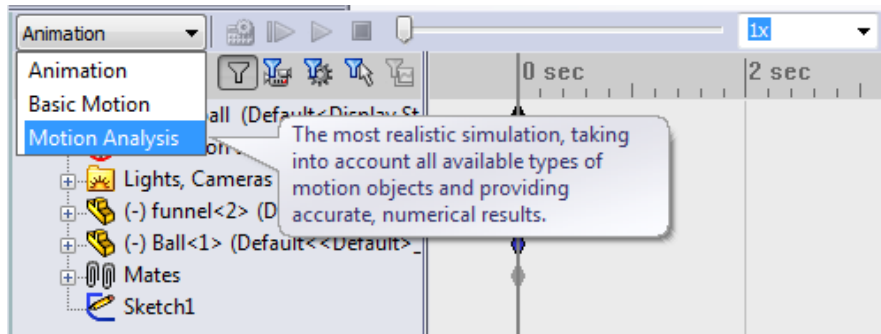
2. Got to the office products tab and click on SolidWorks Motion



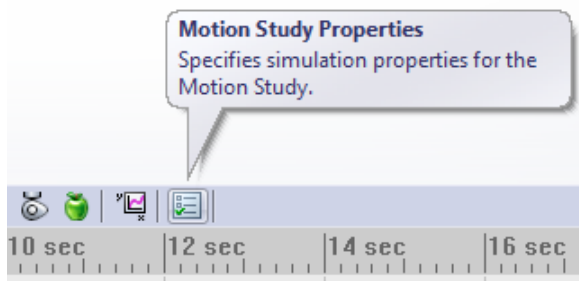
3. Click on the motion study tab in the lower left corner to bring up the animation and motion interface.

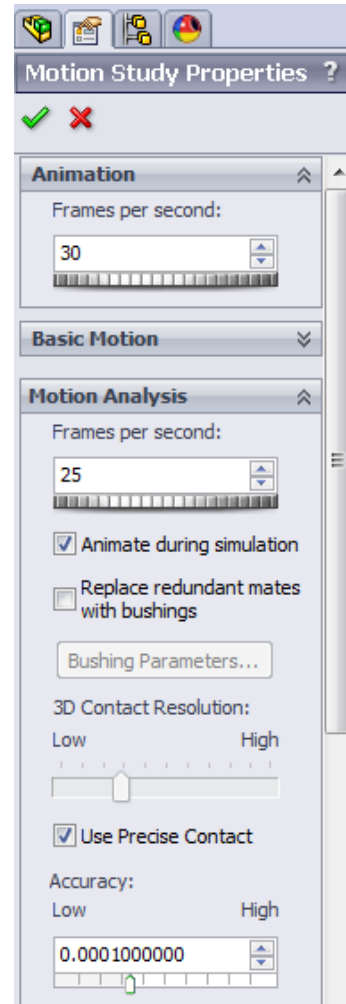


4. In the drop down menu select Motion Analysis



5. Click on the Motion Study Properties menu



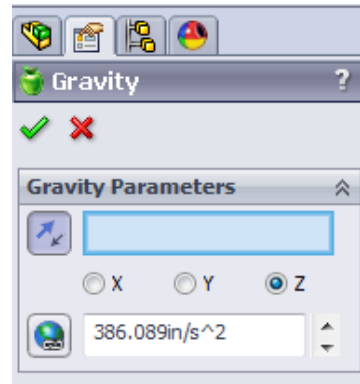


6. Make sure the Use Precise Contact check box is selected

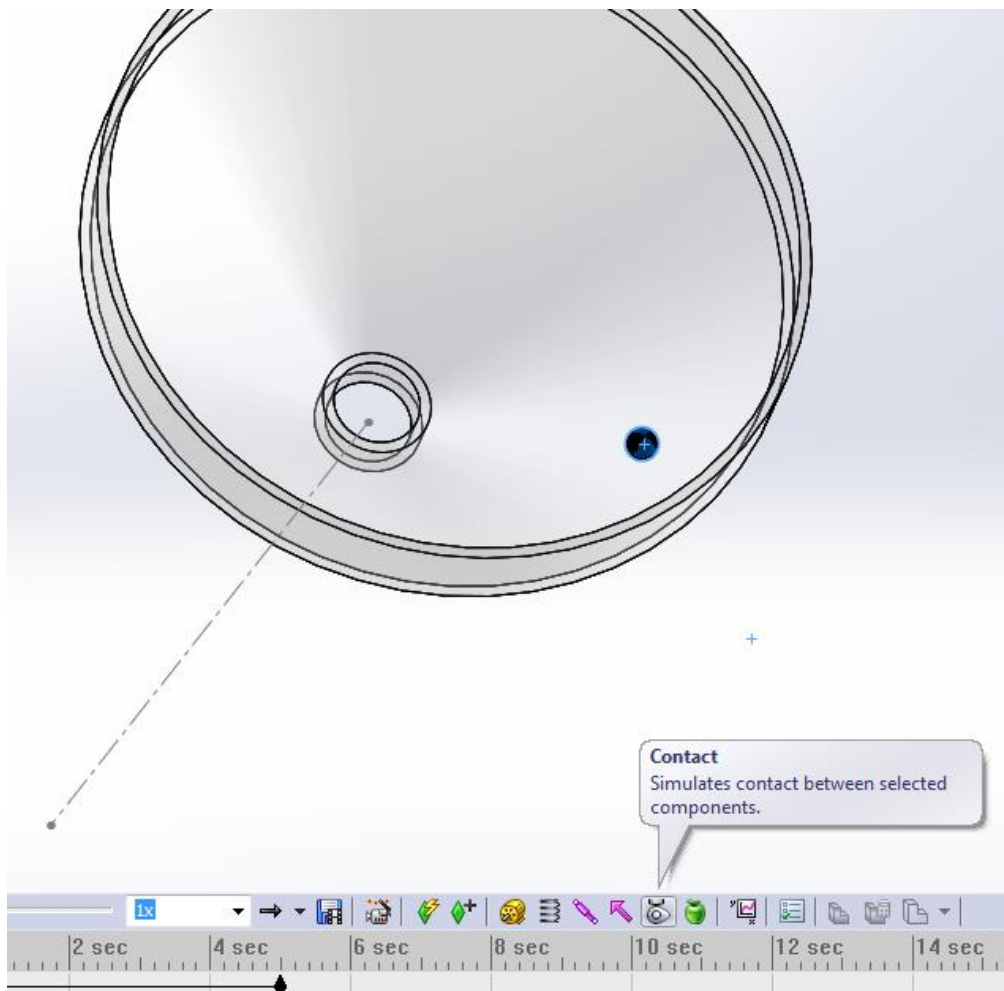
Adding simulation constraints

1. Click on the gravity constraints button

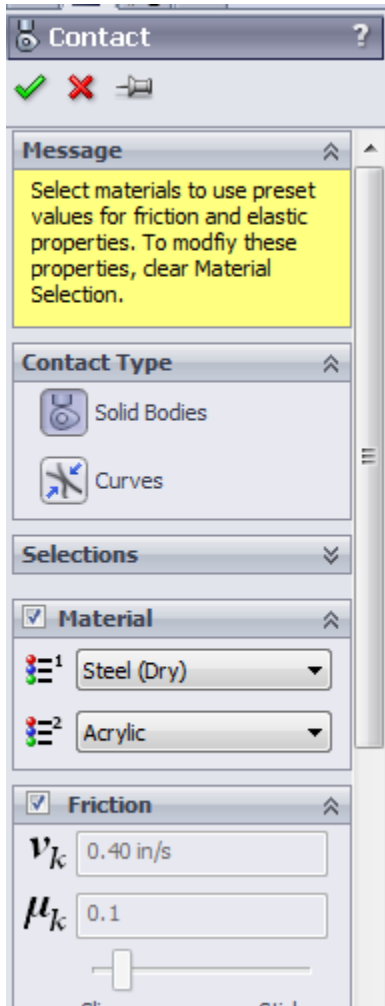




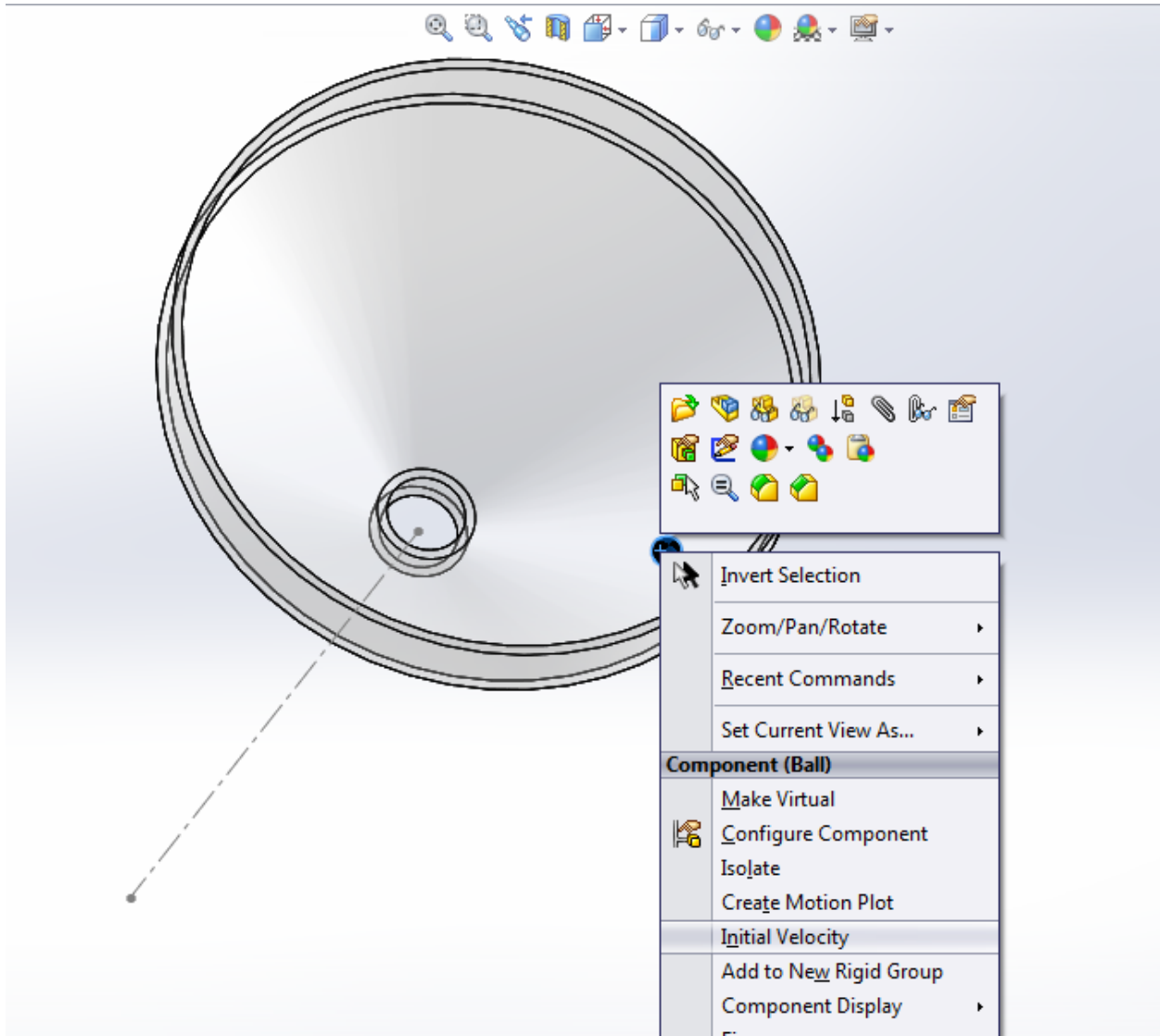
2. Add gravity in the Z direction
3. Select the ball and click on the contact constraint button



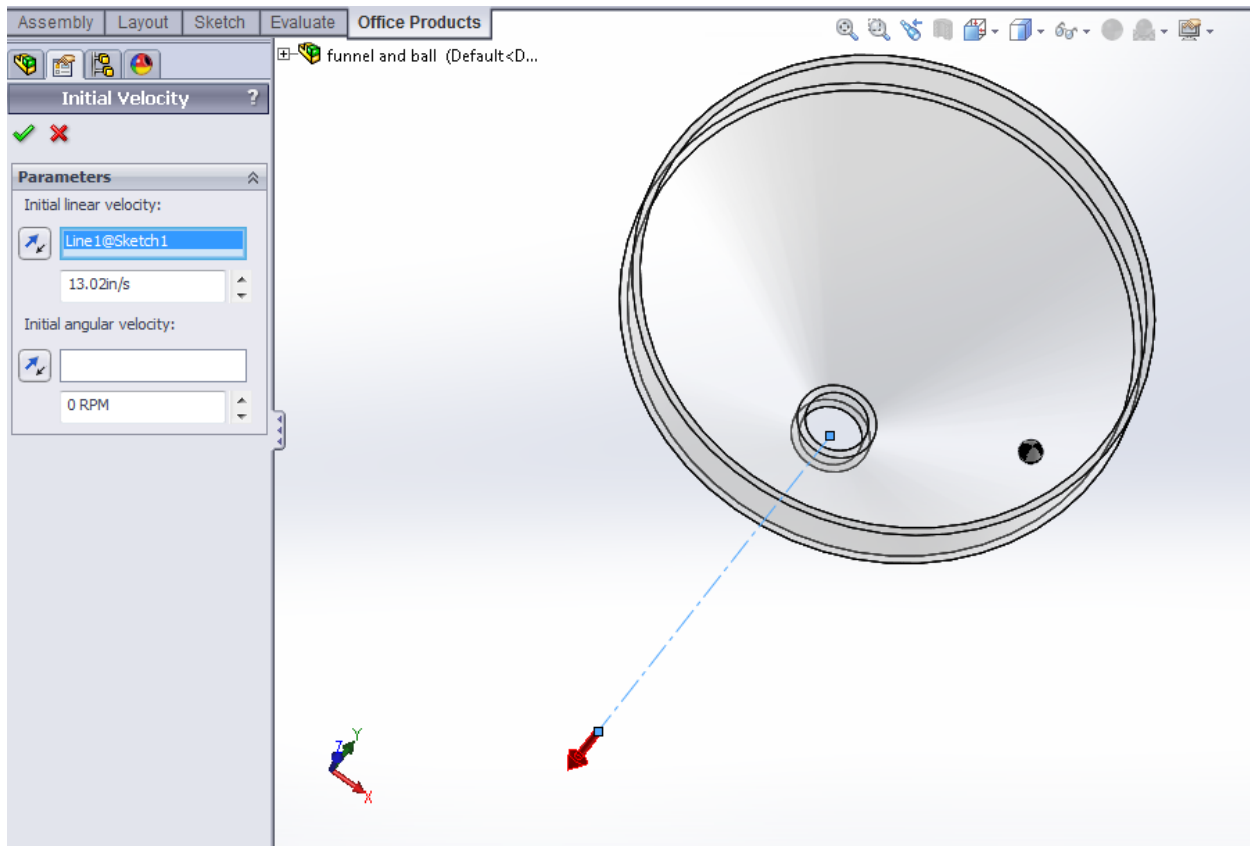
4. Select the funnel as the second object and set the first material to Steel (Dry) under the Material tab and click okay.



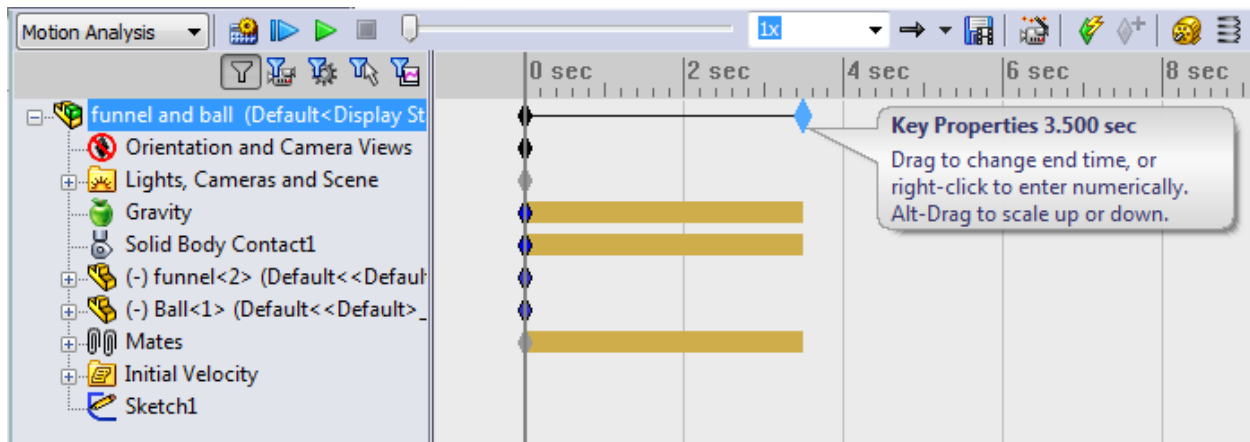
5. Right click the ball and select Initial Velocity



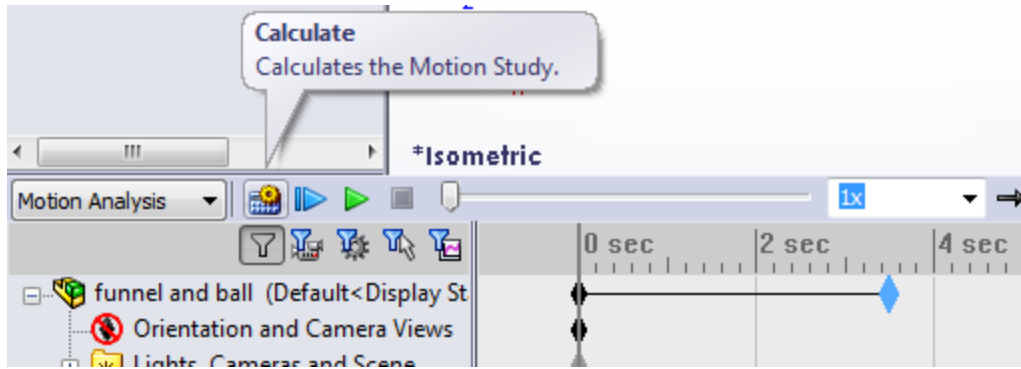
6. Select the line coming from the origin and enter a speed of 13.02 in/s and click okay.



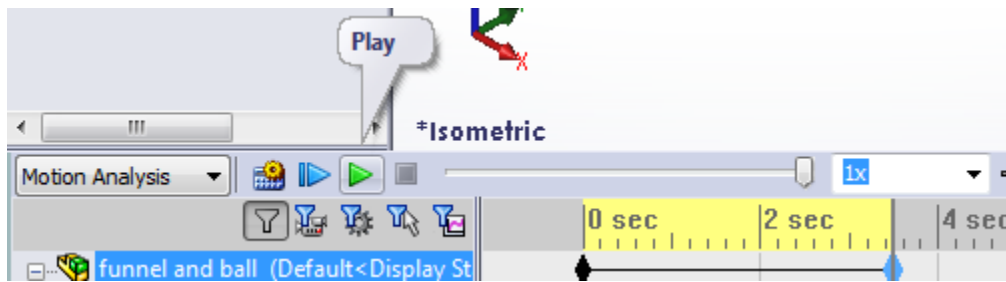
7. Drag the duration key on the timeline to 3.5 s.



8. Click the calculate button and wait for it to simulate the path of the ball.

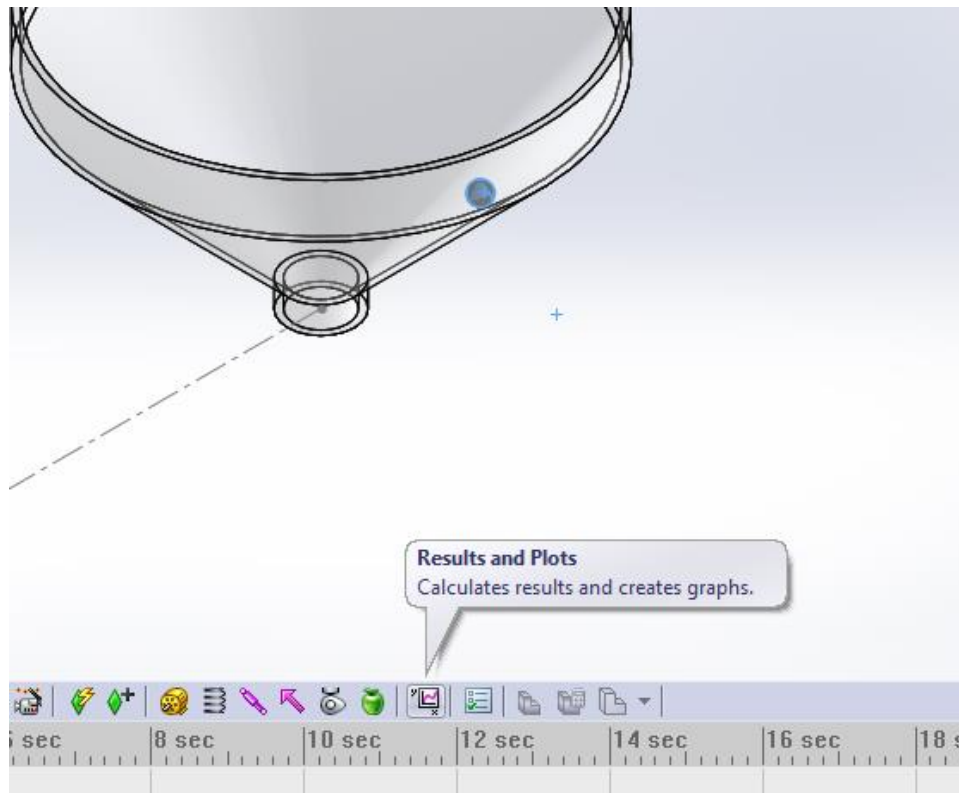


9. Clicking play will allow you to see the finished simulation

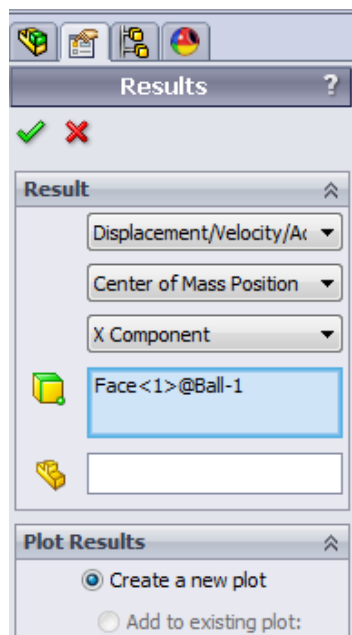


Creating results plots

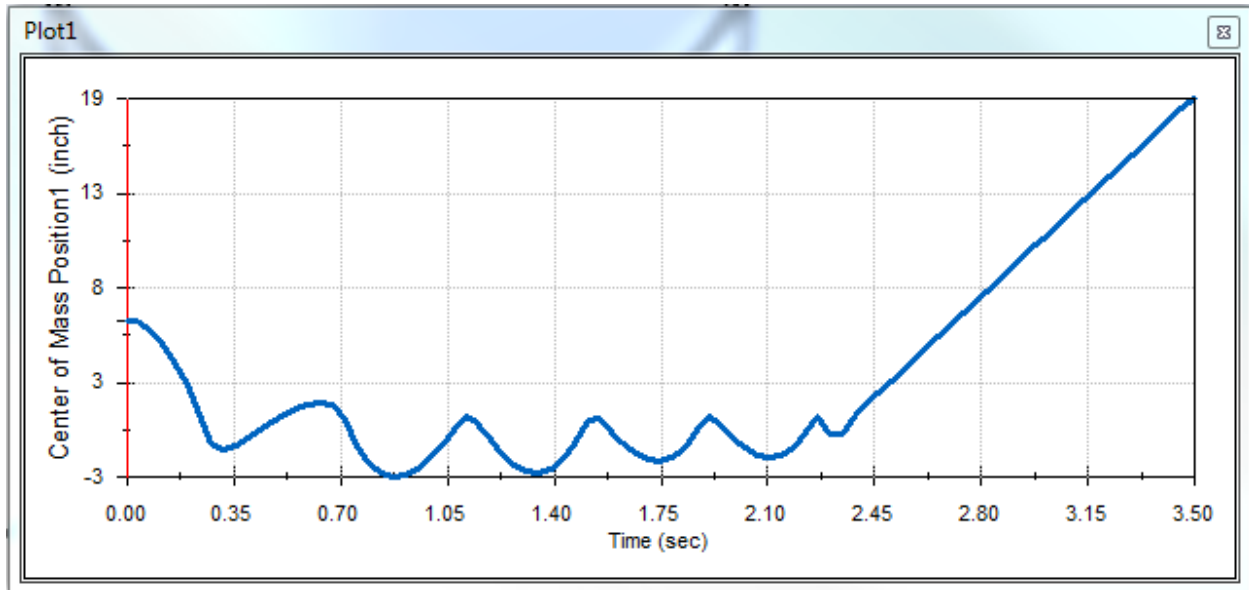
1. Select the ball and click the Results and Plots button



2. In the Results menu select Displacement/Velocity/Acceleration then Center of Mass Position then X Component and click ok.

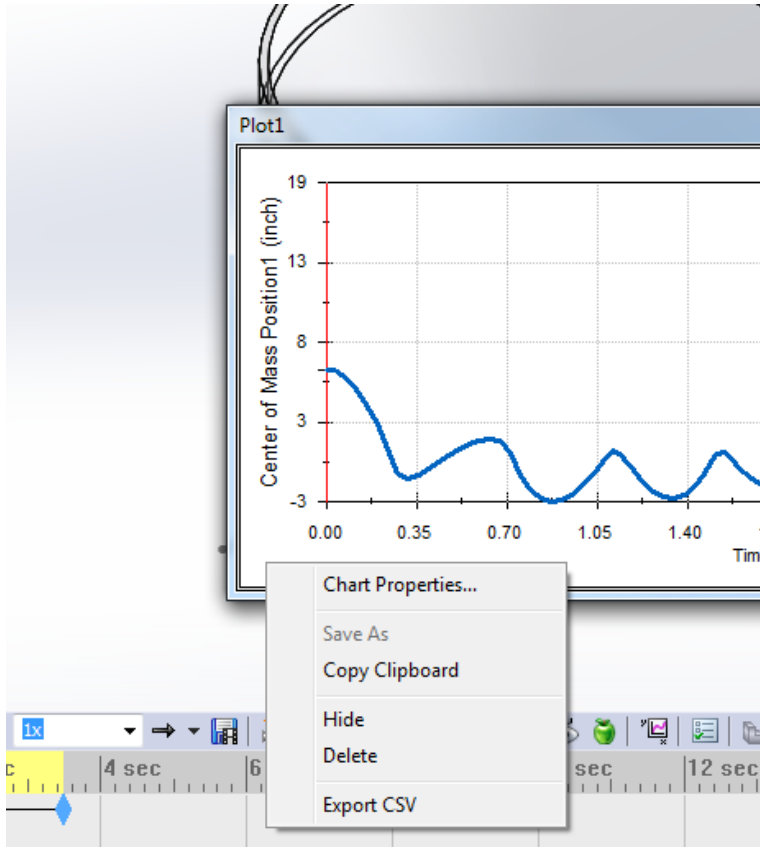


3. It should bring up a graph like this.

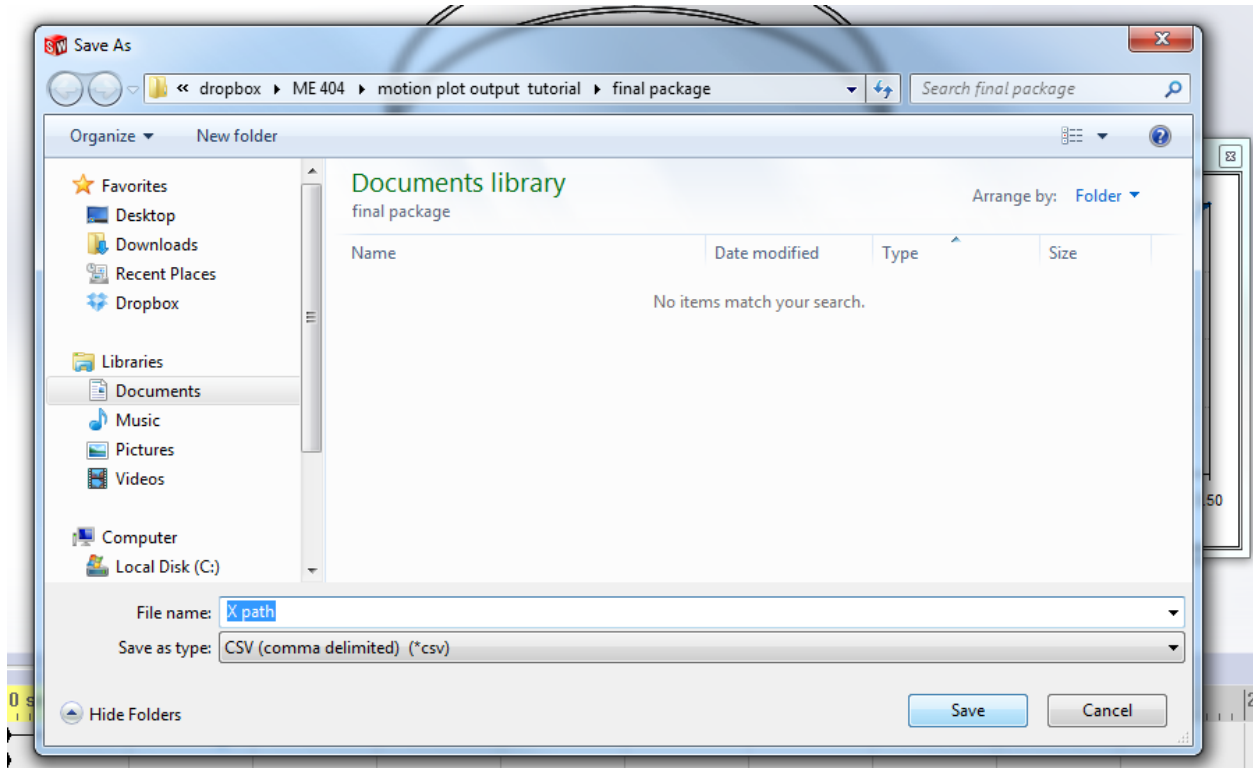


NOTE: Due to the nature of the simulation process the results can turn out slightly different than shown.

4. Right click on the plot and click Export CSV.



5. Save the file as X path.



6. Repeat for the Y and Z components of the path.

Using results in Outside Software

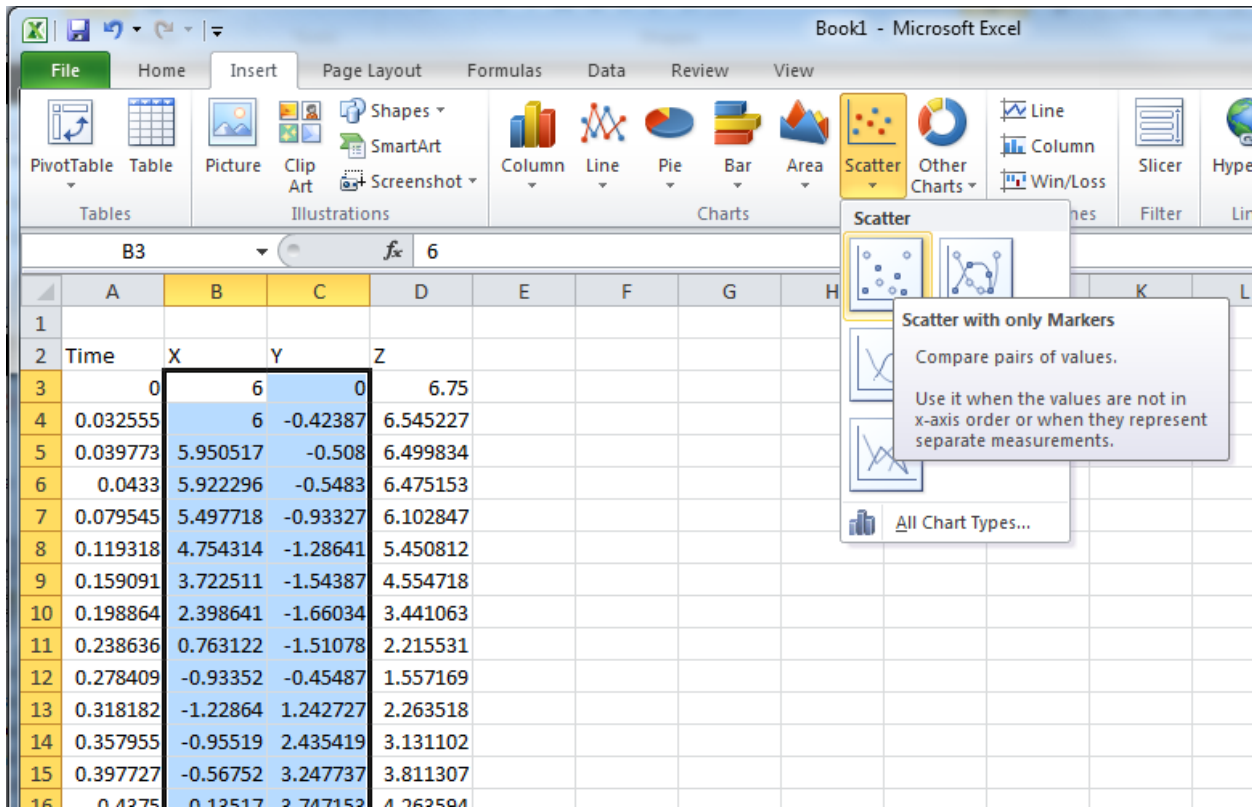
Excel

1. Open the three .CSV files in Excel
2. Start a new Excel file with columns for Time, X, Y, and Z.
3. Copy and Paste the values from the CSV file into the columns in the Excel file.

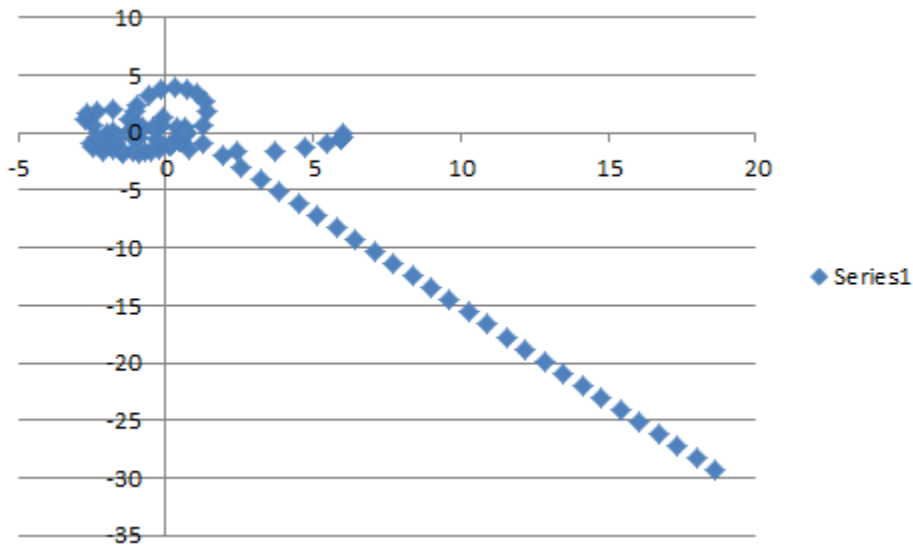
	A	B	C	D	E
1	Plot1				
2	Time (sec) Center of Mass Position1 (inch)				
3	0	6			
4	0.032555	6			
5	0.039773	5.950517			
6	0.0433	5.922296			
7	0.079545	5.497718			
8	0.119318	4.754314			
9	0.159091	3.722511			
10	0.198864	2.398641			
11	0.238636	0.763122			
12	0.278409	-0.93352			
13	0.318182	-1.22864			

	A	B	C	D	E
1					
2	Time	X	Y	Z	
3	0	6	0	6.75	
4	0.032555	6	-0.42387	6.545227	
5	0.039773	5.950517	-0.508	6.499834	
6	0.0433	5.922296	-0.5483	6.475153	
7	0.079545	5.497718	-0.93327	6.102847	
8	0.119318	4.754314	-1.28641	5.450812	
9	0.159091	3.722511	-1.54387	4.554718	
10	0.198864	2.398641	-1.66034	3.441063	
11	0.238636	0.763122	-1.51078	2.215531	
12	0.278409	-0.93352	-0.45487	1.557169	
13	0.318182	-1.22864	1.242727	2.263518	
14	0.357955	-0.95519	2.435419	3.131102	

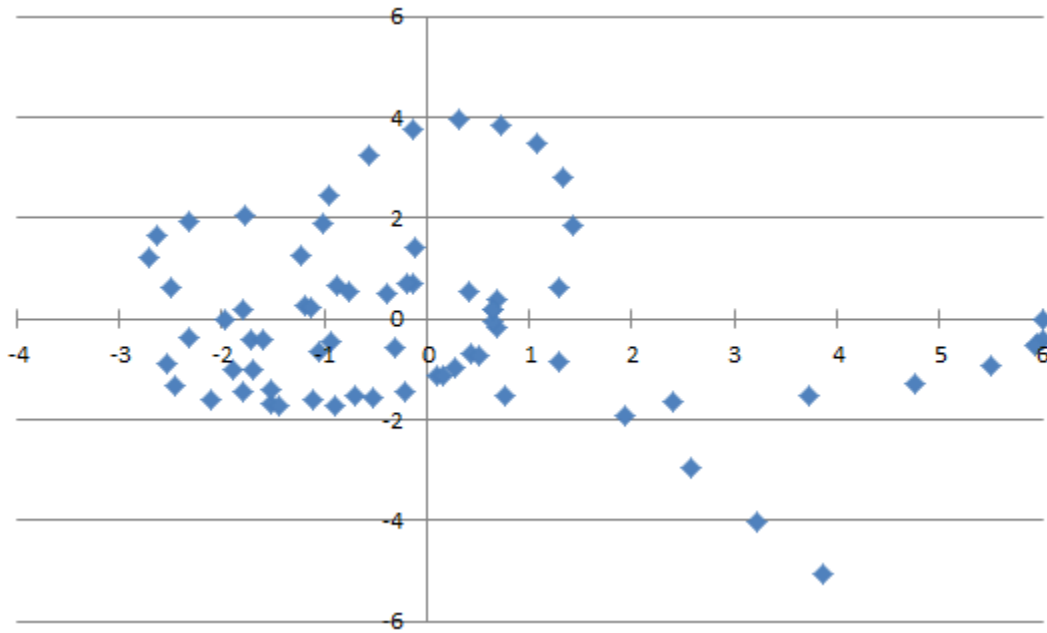
4. Select the X and Y columns and make a scatterplot.



5. It will create a plot the looks like this.



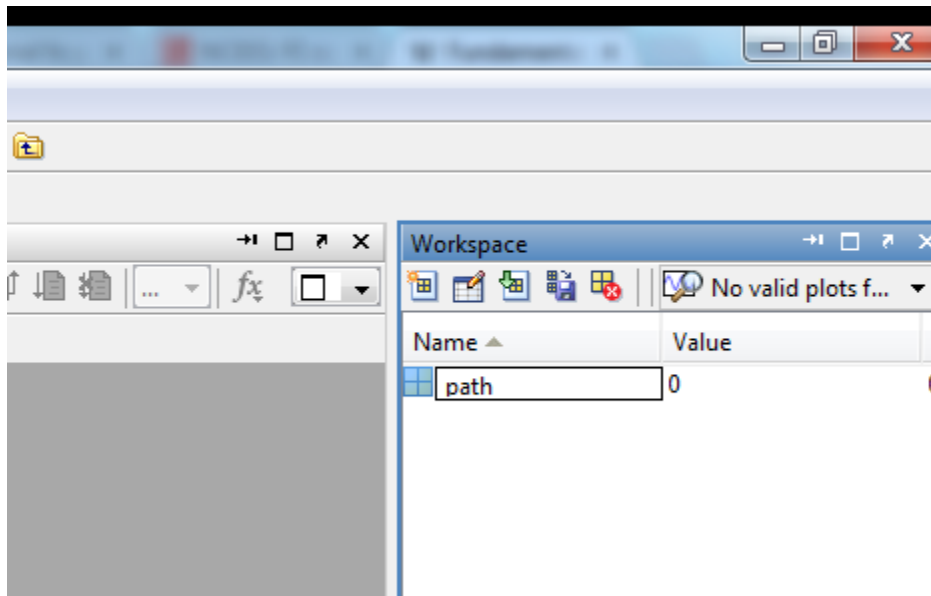
6. Its Axis can be adjusted to make it look better like so.



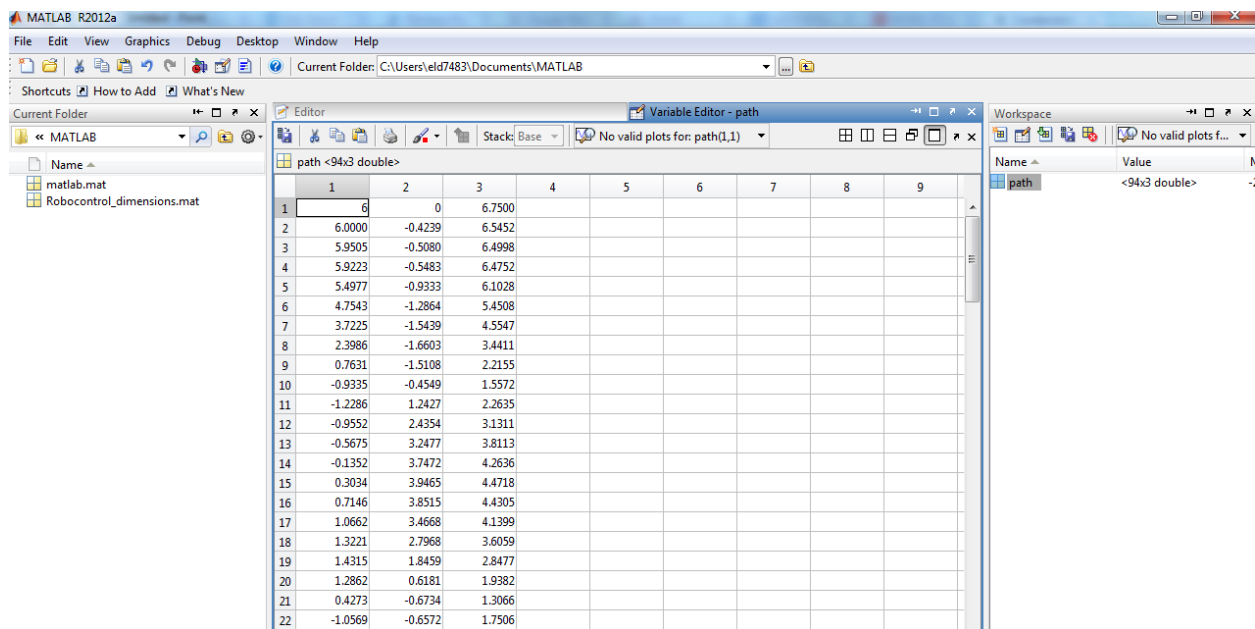
Various plots and calculation can be done in excel using the data.

MATLAB

1. Open MATLAB
2. Create a new variable named path



3. Open the variable and copy and paste the x,y, and z data into the variable from Excel.



4. In MATLAB enter the following commands to plot the path in 3d.

`plot3(path(:,1), path(:,2), path(:,3))`

this plots the points in 3d

`axis([-6,6,-6,6,-3,5])`

this sets the axis limits x min x max y min y max z min z max

5. It should result in a plot such as this.

