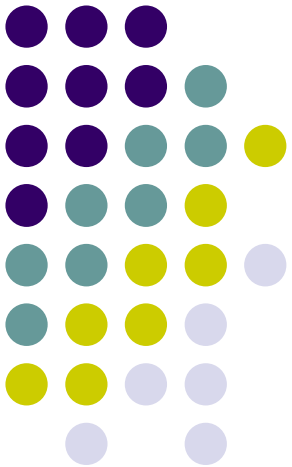
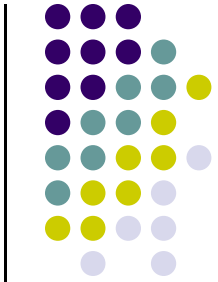
ADAMS Assignment 1

ME451:Kinematics and Dynamics of Machine Systems

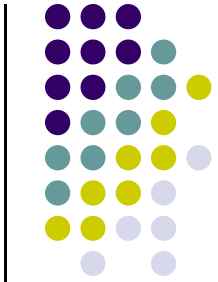


Turning in Your Assignment



- Place all files in a directory called "lastName_ADAMS_01"
- zip that directory
- Drop the resulting file "lastName_ADAMS_01.zip" in the appropriate Dropbox Folder (ADAMS_01) at Learn@UW

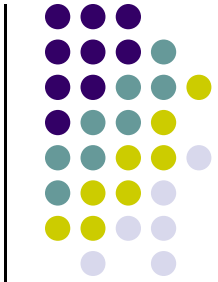
Problem Definition



1. Using ADAMS, find the displacement, velocity, and acceleration of a ball (mass = 1 kg) after 3 seconds, when the ball falls freely under gravity. (Assume no aerodynamic drag forces)

2. Compare the ADAMS results with the analytical solution. Show all the calculations.

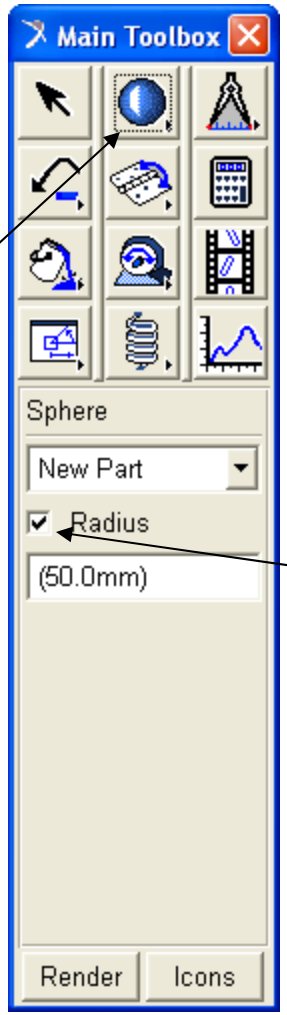
ADAMS Startup



- Start ADAMS/View.
- In the Welcome dialog box
  - Under the heading, **How would you like to proceed,** select **Create a new model**.
  - Set some working directory where all the ADAMS related files will be saved.
    - E.g. I:\ME451\AdamsDir
  - Name the model **falling_ball**.
  - Verify that **Gravity** is set to **Earth Normal (-Global Y)**.
  - Verify that **Units** are set to **MMKS - mm, Kg, N, s, deg**.
- Select **OK**.

ADAMS Toolbox

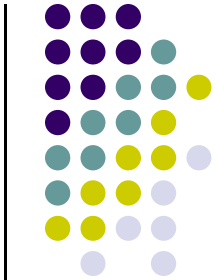
- To create a ball:
  - Use the **Sphere** tool to create a ball part with a 50 mm radius and its center at the global origin. You'll also rename the part and set its mass to 1 kg.
  - To view the coordinates as you create the sphere so you know its size, from the **View** menu, select **Coordinate Window**.
  - From the Main Toolbox, right-click the **Rigid Body** tool stack, and then select the **Sphere** tool
  - Follow the Status bar instructions and pick the center of the sphere at the global origin, then drag the cursor until you create a sphere with a **50 mm** radius or check the radius box and type in 50mm for the radius



Check the radius and type 50.0

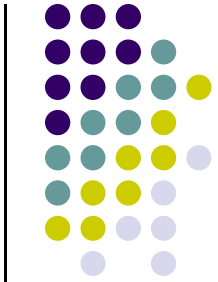
Then click on the sphere tool

Modify the body



- To rename the ball:
  - Right-click the sphere, point to **Part:PART_"number"**, and then select **Rename**.
  - In the **New Name** text box, enter **.falling_ball.Ball**, and then select **OK**.
- To set the mass to 1 kg:
  - Right-click the sphere, point to **Part:Ball**, and then select **Modify**.
  - In the **Define Mass by** text box, select **User Input**.
  - If an alert box opens, select **Close**.
  - In the **Mass** text box, enter **1.0**.
  - Select **OK**.

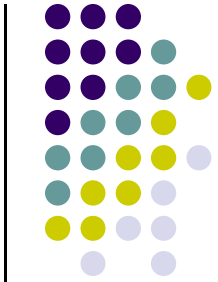
Create measurements



- Create measures for the falling stone
  - To calculate the vertical displacement, velocity, and acceleration of the ball's cm marker in the Y direction, you'll create three object (part) measures. You'll set Y as the component to measure.

- To calculate the displacement of the stone in the Y direction:
  - Right-click the sphere, point to **Part:Ball**, and then select **Measure**.
  - In the **Measure Name** text box, enter **displacement**.
  - Set **Characteristic** to **CM position**.
  - Set **Component** to **Y**.
  - Select **Create Strip Chart**.
  - Select **OK**.
  - A measure stripchart appears. It is empty because you need to run a simulation before ADAMS/View has the necessary information for the stripchart.

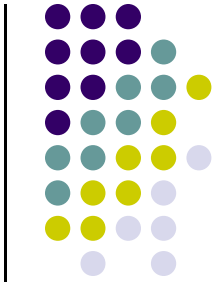
Measures, con't



- To calculate the velocity of the ball in the Y direction:
  - Right-click the sphere, point to **Part:Ball**, and then select **Measure**.
  - In the **Measure Name** text box, enter **velocity**.
  - Set **Characteristic** to **CM velocity**.
  - Set **Component** to **Y**.
  - Select **Create strip chart**.
  - Select **OK.**

- To calculate the acceleration of the ball in the Y direction:
  - Follow the instructions above but set **Measure Name** to **acceleration**, and **Characteristic** to **CM acceleration**.

Verify the model



- Verify the model
  - Now you'll verify the model. When you verify the model, ADAMS/View checks for error conditions, such as misaligned joints, unconstrained parts, or massless parts in dynamic systems and alerts you to other possible problems in the model.
- To verify the model:
  - In the bottom right corner of the Status bar, right-click the **Information** tool stack  , and then select the **Verify** tool  .
  - In the Information window, check that the model has verified successfully.
  - Close the Information window.

View Control

- Set up and run a simulation
  - Now you'll zoom out the display so that the falling ball is clearly visible while it simulates. You'll then simulate it for 3 seconds with 150 steps.
- To zoom out:
  - Select the **Select** tool  to display the view control options in the toolbox.
  - Select the **Zoom** tool  , and then click and drag the mouse to zoom out until the entire working grid is visible.
  - Select the **Translate** tool  , and then drag the working grid to the top of the screen.

Run the simulation

- To run a simulation for 3 seconds:
  - In the Main Toolbox, select the **Simulation** tool 
  - In the **End Time** text box, enter **3.0** and in the **Steps** text box, enter **150.**
  - Select the **Play** tool 
  - As the stone falls, ADAMS/View plots the corresponding data on the displacement, velocity, and acceleration graphs.
  - When the simulation ends, reset the model to the input, or design configuration by selecting the **Reset** tool.
  - Animate the simulation to replay the simulation without simulating again.

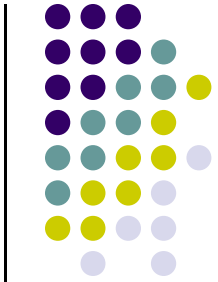
Review results

- To find the values of displacement, velocity, and acceleration:
  - Now you'll use ADAMS/PostProcessor to find the stone's displacement, velocity, and acceleration after 3 seconds.

- To run ADAMS/PostProcessor:
  - Right-click the blank area inside the stripchart **.falling_ball.displacement**, point to **Plot:scht1**, and then select **Transfer to Full Plot**.
  - ADAMS/PostProcessor replaces the ADAMS/View window.

- To find the value of the stone's displacement:
  - In ADAMS/PostProcessor, from the main toolbar, select the **Plot Tracking** tool  .
  - Because you want to know the final conditions after 3 seconds, move the cursor over the end point of the plot.
  - In the area below the menu bar, the value of X is displayed as 3. Note the value of Y; this is your answer.
  - Compare this value of Y with your analytical solution.

Results con't

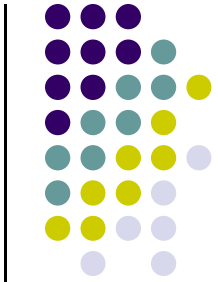


- To find the value of the ball's velocity after 3 seconds:
  - Check the **Surf** box below the plot.
  - This lets you view a selected measure without using the Add Curves button.
  - Set **Source** to **Measures**.
  - From the **Measure** list, select **velocity**.
  - Because you want to know the final conditions after 3 seconds, move the cursor over the end point of the plot.
  - In the area below the menu bar, the value of X is displayed as 3. Note the value of Y; this is your answer.
  - Compare this value of Y with your analytical solution.

Results con't

- To find the value of ball's acceleration after 3 seconds:
  - Set **Source** to **Measures**.
  - From the **Measure** list, select **acceleration**.
  - To display the acceleration plot, select **Surf**.
  - Because you want to know the final conditions after 3 seconds, move the cursor over the end point of the plot.
  - In the area below the menu bar, the value of X will be displayed as 3. Note the value of Y; this is your answer.
  - Compare this value of Y with your analytical solution.
  - To return to ADAM/View and close all three plots, select the **ADAMS/View** tool 

What to turn in



- To save your work:
  - From Adams/View (not the postprocessor), select **File->Save database as…**, and then select **OK**.

- Turn in:
  1. 3 Plots: vertical displacement, velocity & acceleration (screenshots are fine)
  2. Analytical calculations to verify the ADAMS plots