EN1740 Computer Aided Visualization and Design

Spring 2012

4/17/2012 – Lecture B

Brian C. P. Burke

Last Time:

- Intro to GD&T
- Motion analysis with Pro/E

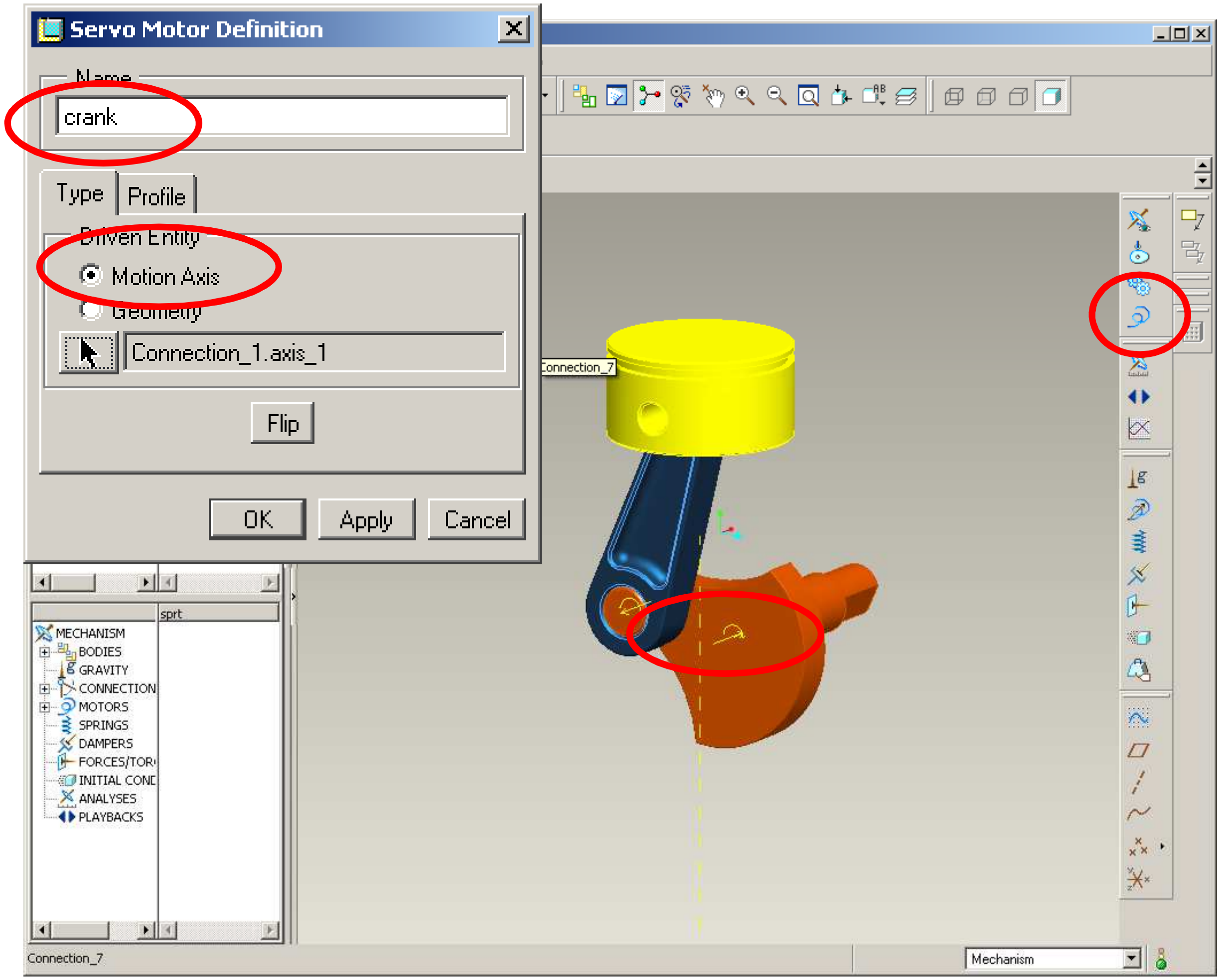
Tonight:

- Motion analysis with Pro/E

EXERCISE - Motion Analysis

How system rotates the assembly

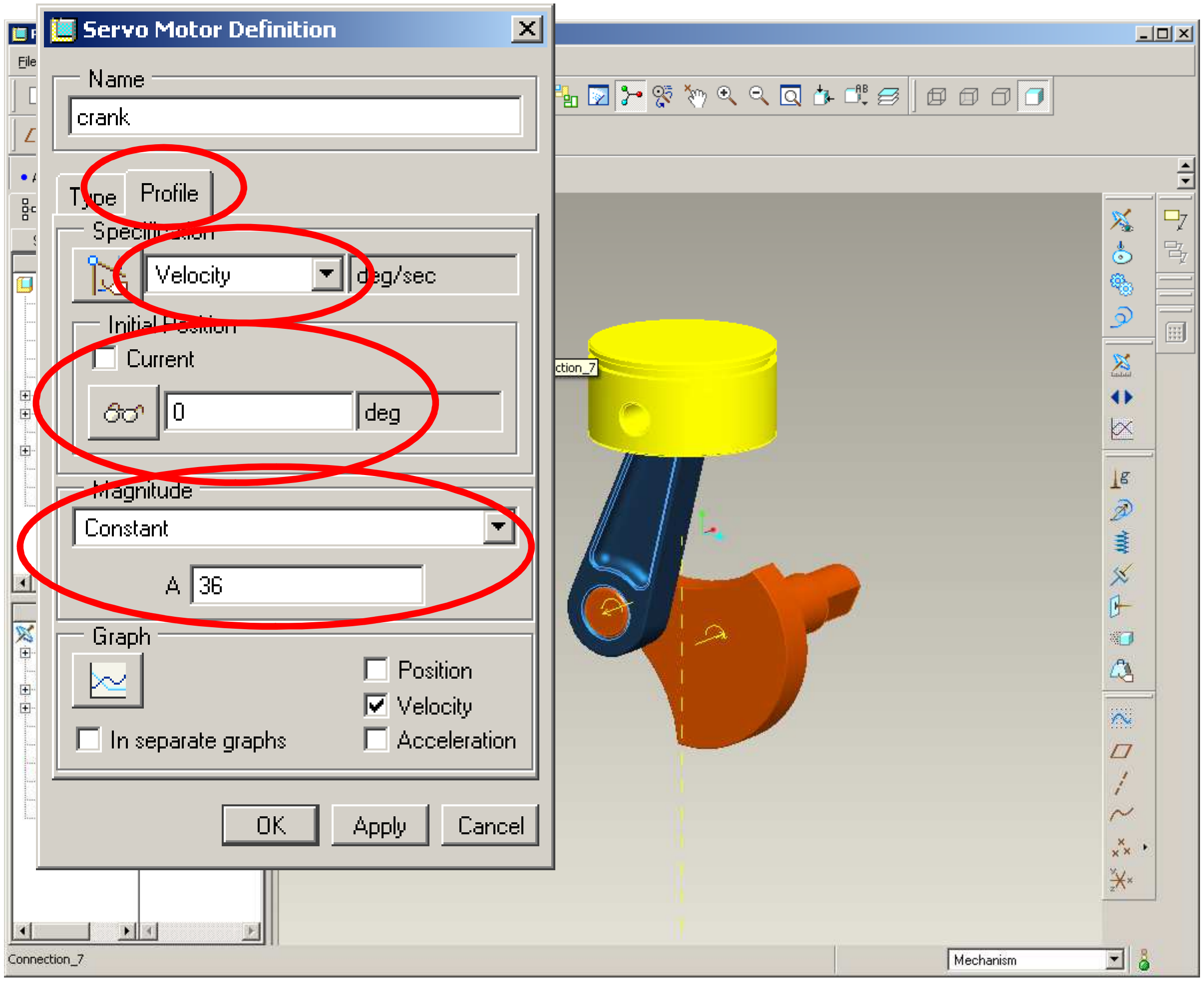
- Click Define Servo Motor
  - Name it crank
  - Select Motion Axis
  - Click axis on crank shaft (should come up as Connection_1.axis_1)



EXERCISE - Motion Analysis

How system rotate the assembly

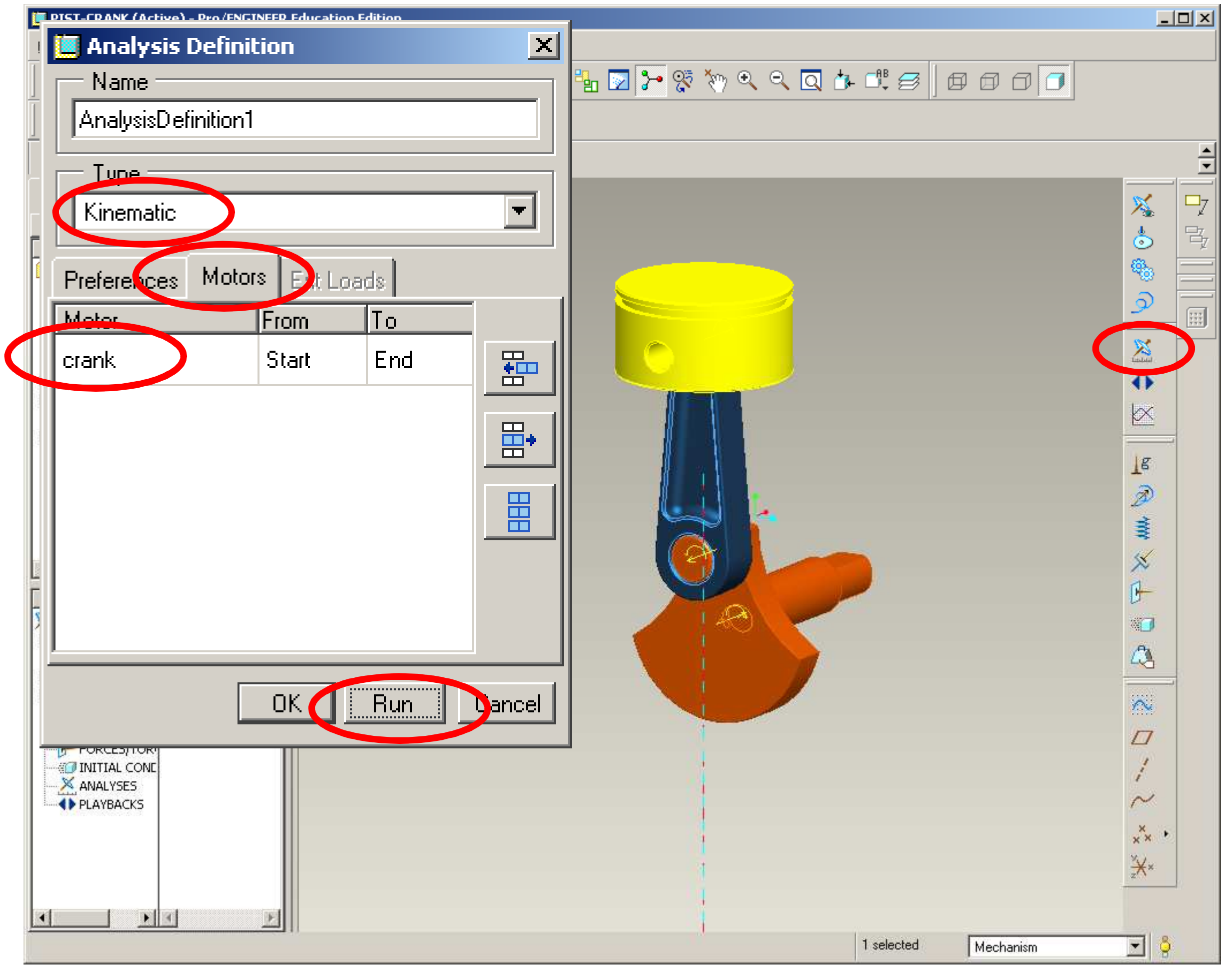
- Click Define Servo Motor
  - Click Profile tab
  - Select Velocity as Specification
  - Un-check Current and enter 0 as Initial Position
  - Select Constant as Magnitude
  - Enter 36 as a value
  - Click OK



EXERCISE - Motion Analysis

How system rotate the assembly

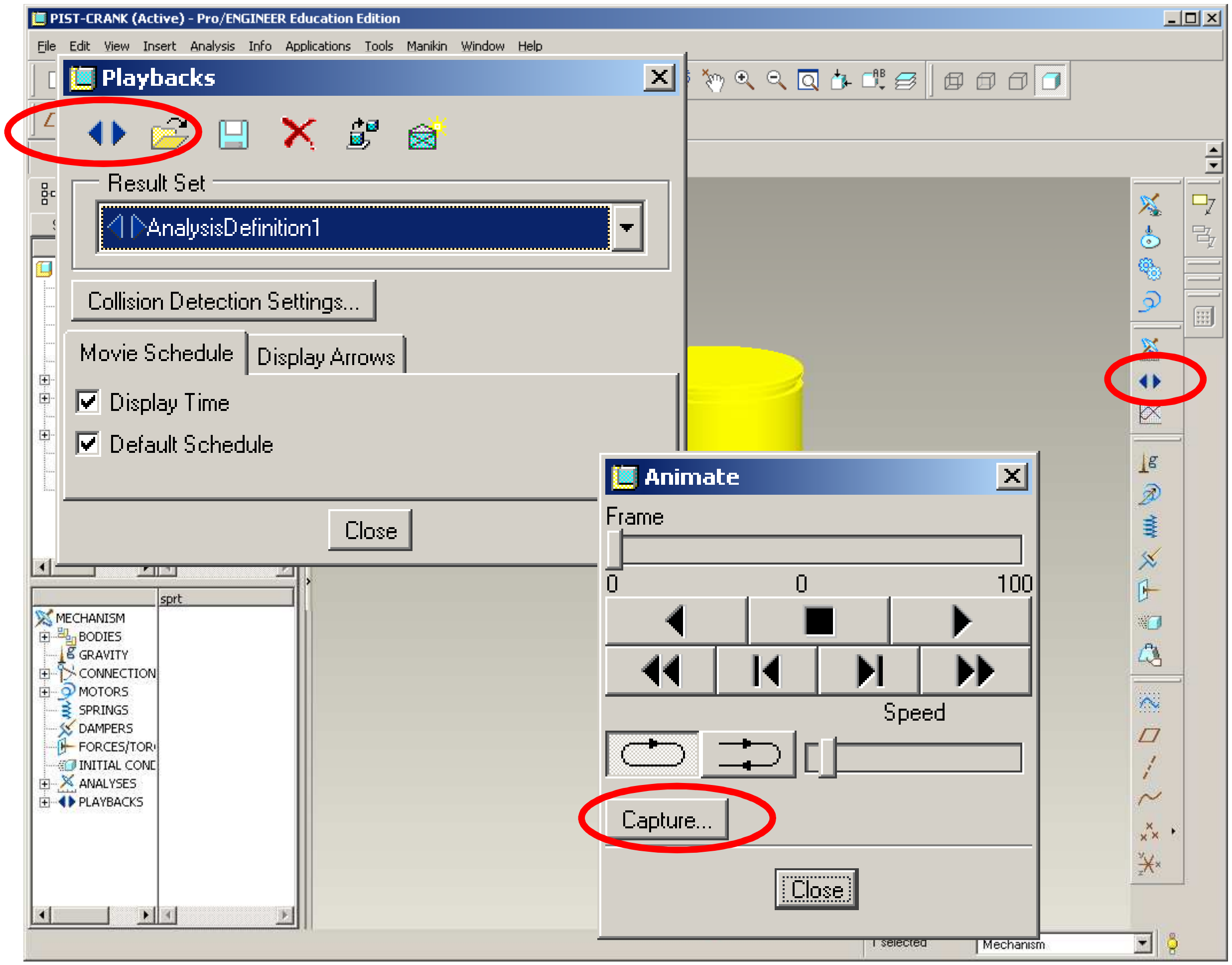
- Define a Mechanism Analysis
  - Click Mechanism Analysis icon
  - Make sure Type is set to Kinematic
  - Switch to Motor tab and make sure the crank motor is selected
  - Click Run
    - Stuff moves
  - Click OK



EXERCISE - Motion Analysis

How system rotate the assembly

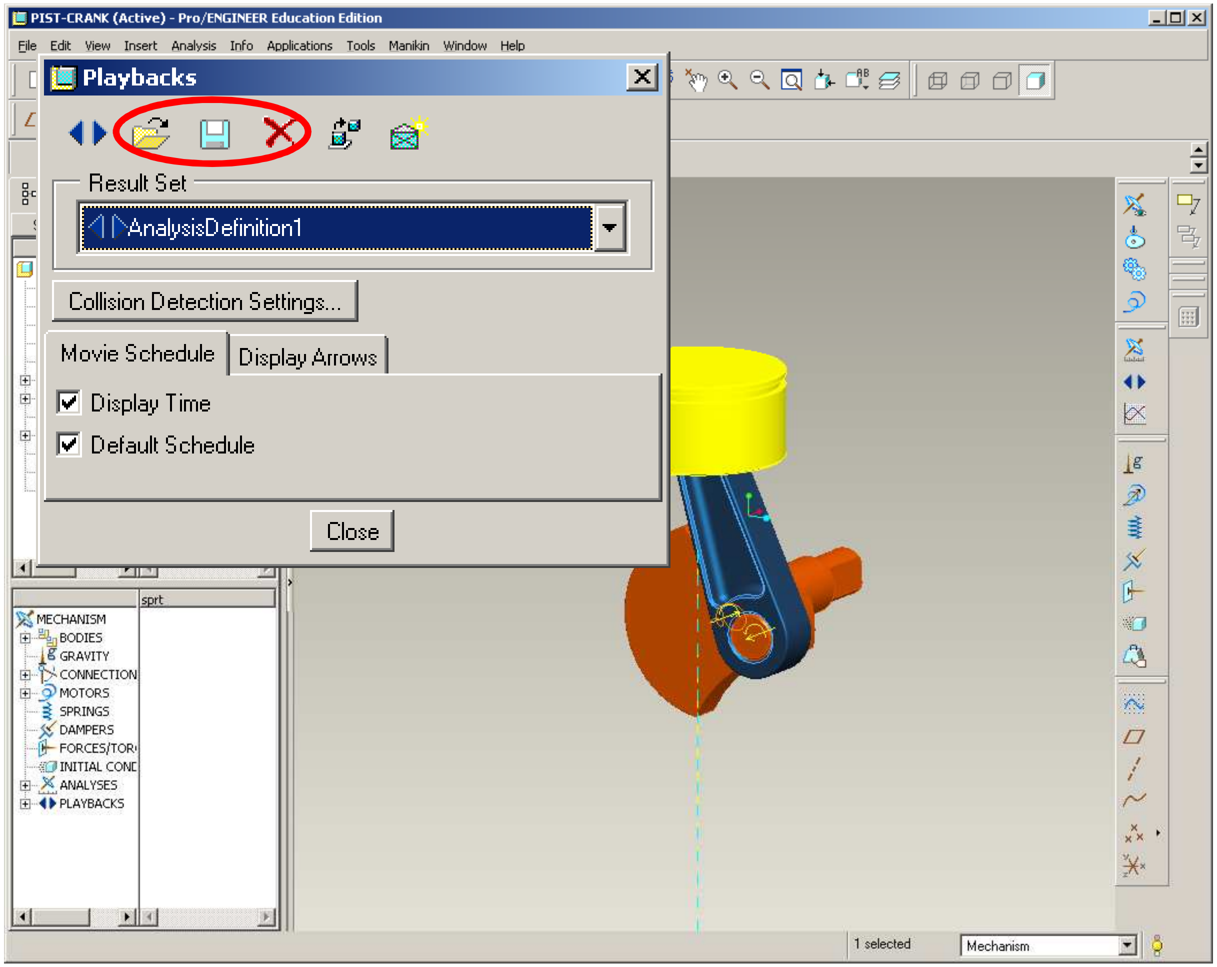
- Click Playbacks icon
- Note our results are present
- Click Playback button
    - Animation dialog appears
    - ***Click Capture button to export***



EXERCISE - Motion Analysis

How system rotate the assembly

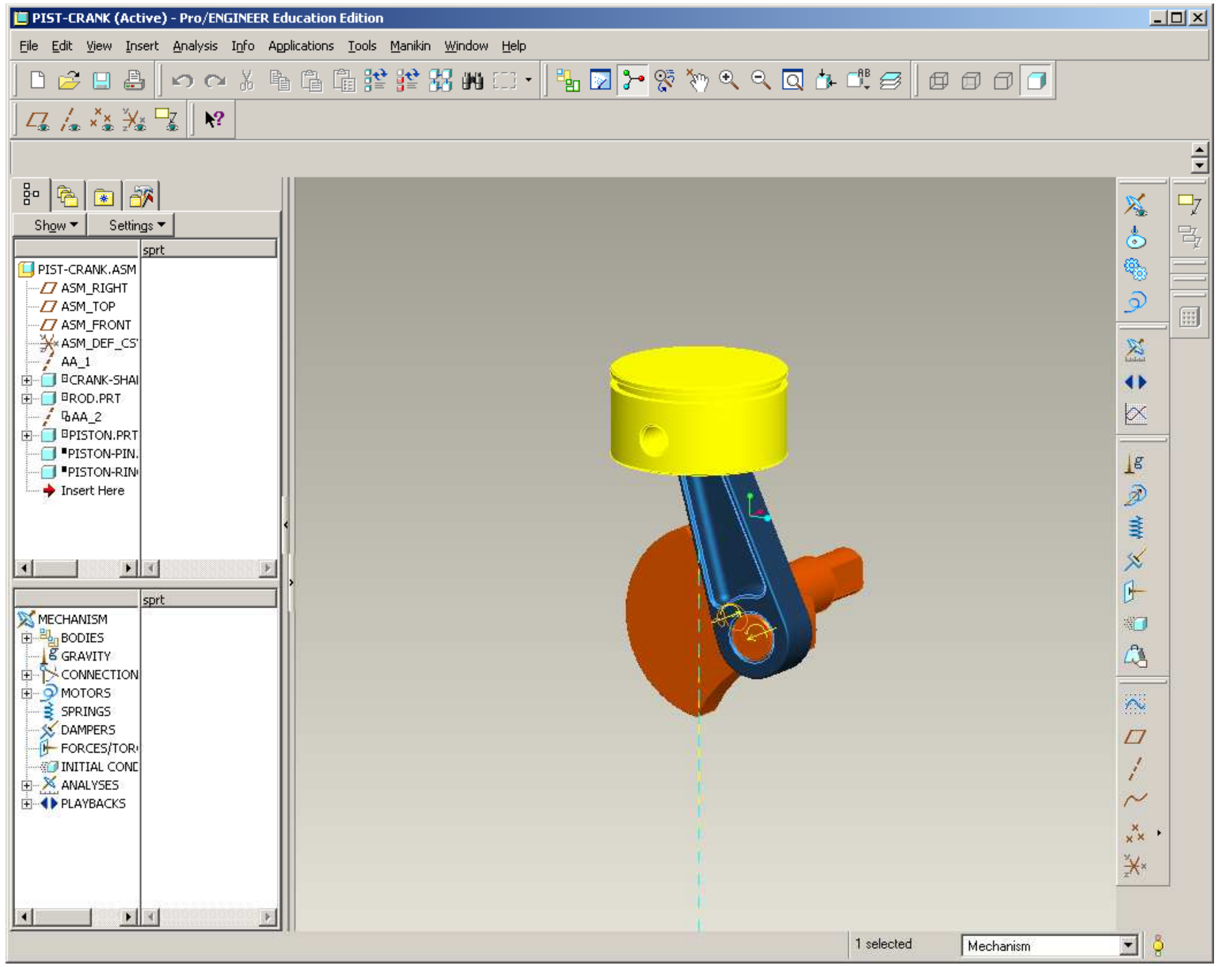
- Click Save Current Set to Disk so analysis will be there when we get back



Motion Analysis

Extended mechanism functionality

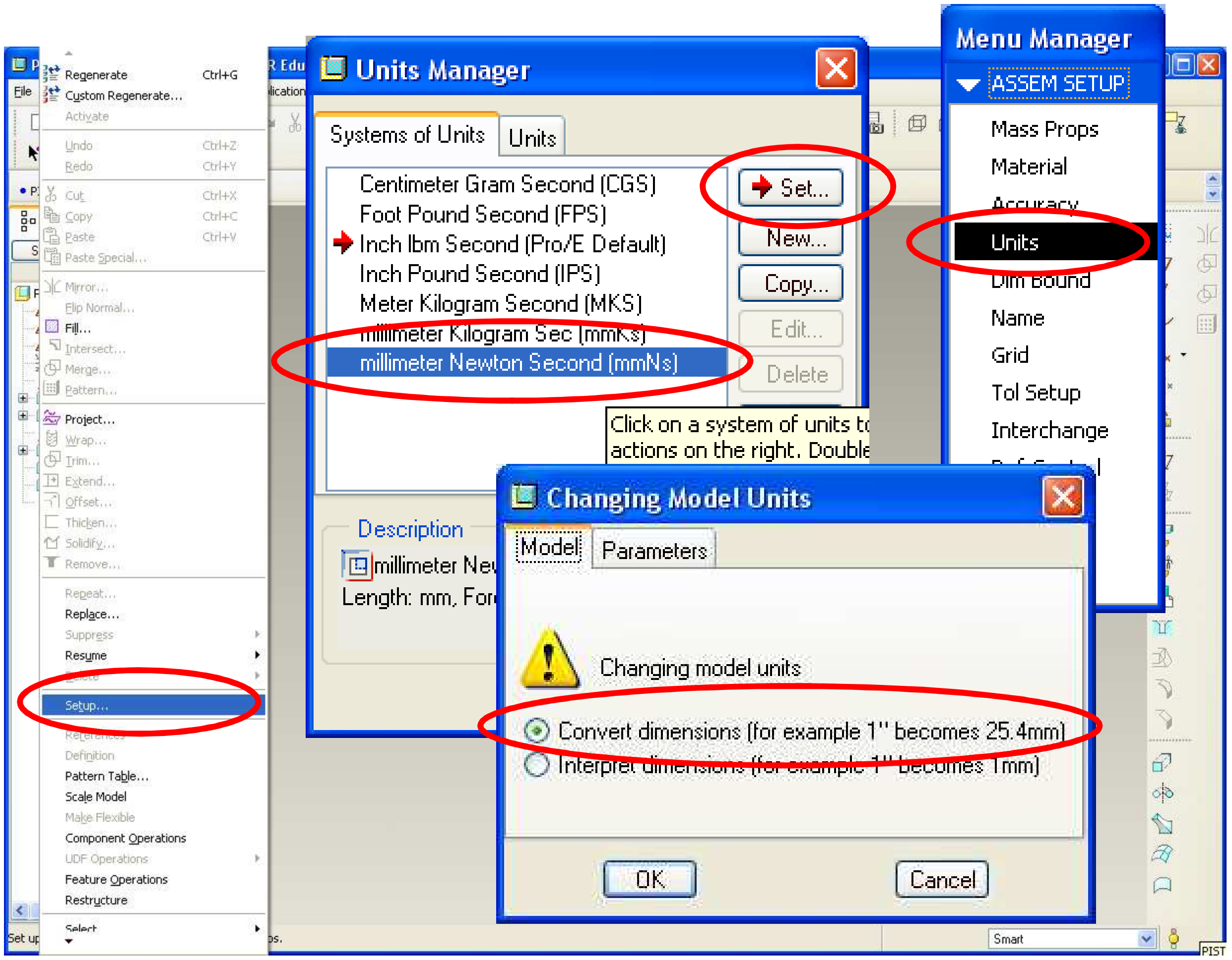
- Quantified motion analysis
- Mechanism components
    - Springs
    - Friction Forces
- Assumptions
    - All parts are steel
    - Rotation is 1000rpm



EXERCISE - Motion Analysis

Change the assembly units

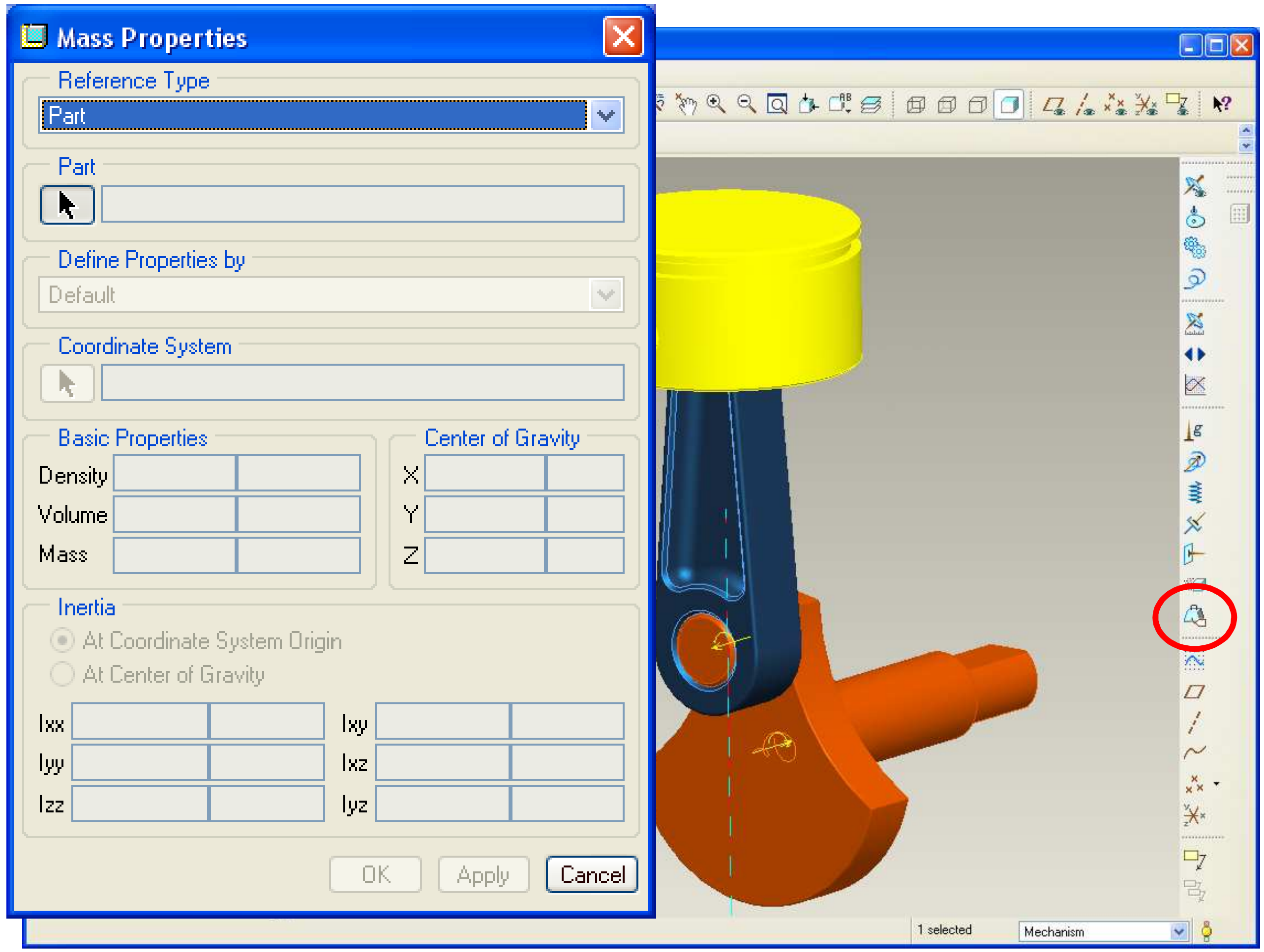
- The parts are currently in mm-N-sec and the assembly is in in-lb-sec
- Change the assembly units to match the part
    - Back to Standard Application
    - Edit > Setup > Units > mm-N-sec
    - Set
    - Check Convert dimensions
    - OK



EXERCISE - Motion Analysis

Assign density to each part

- Save the assembly
- Switch the application to Mechanism
- Select the Mass Properties icon

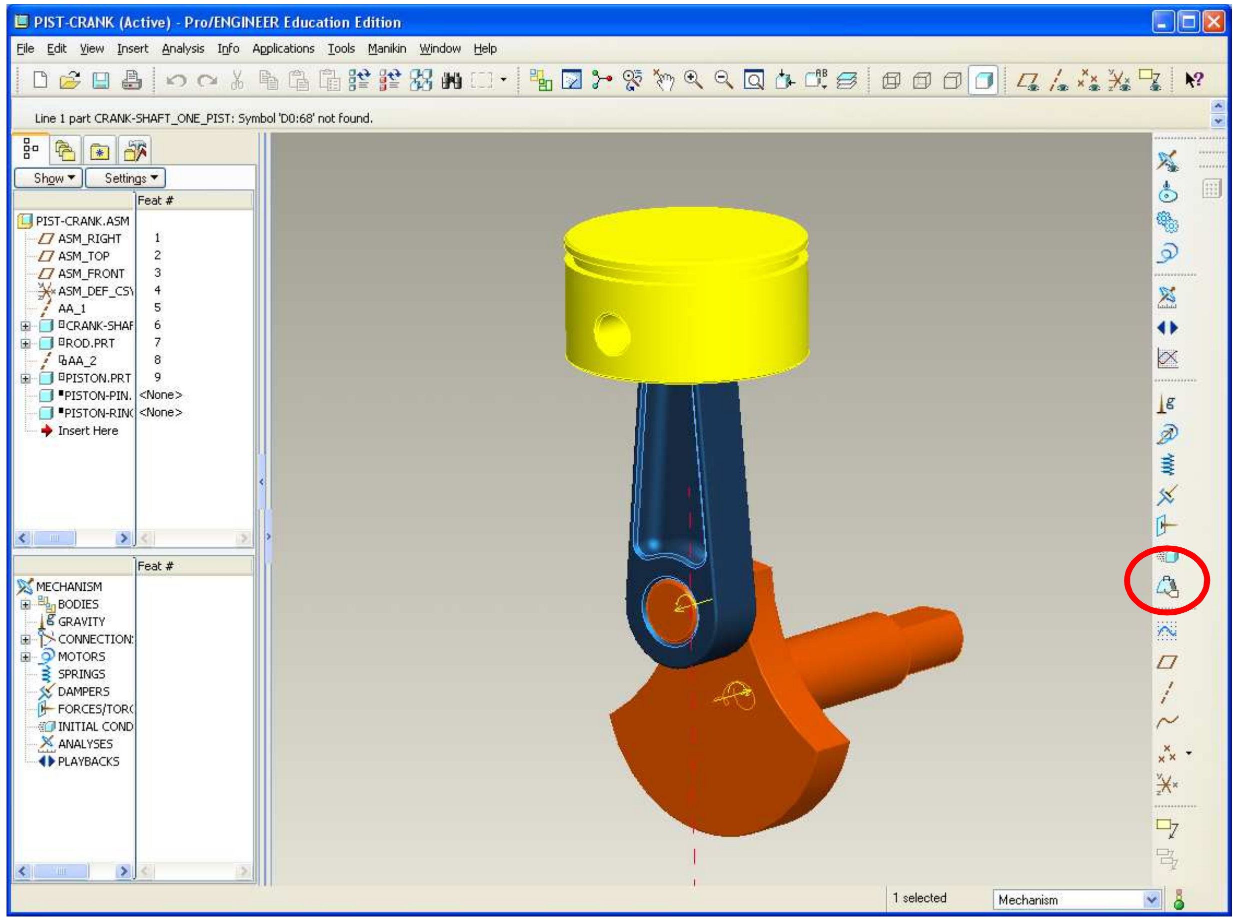


EXERCISE - Motion Analysis

Assign density to each part

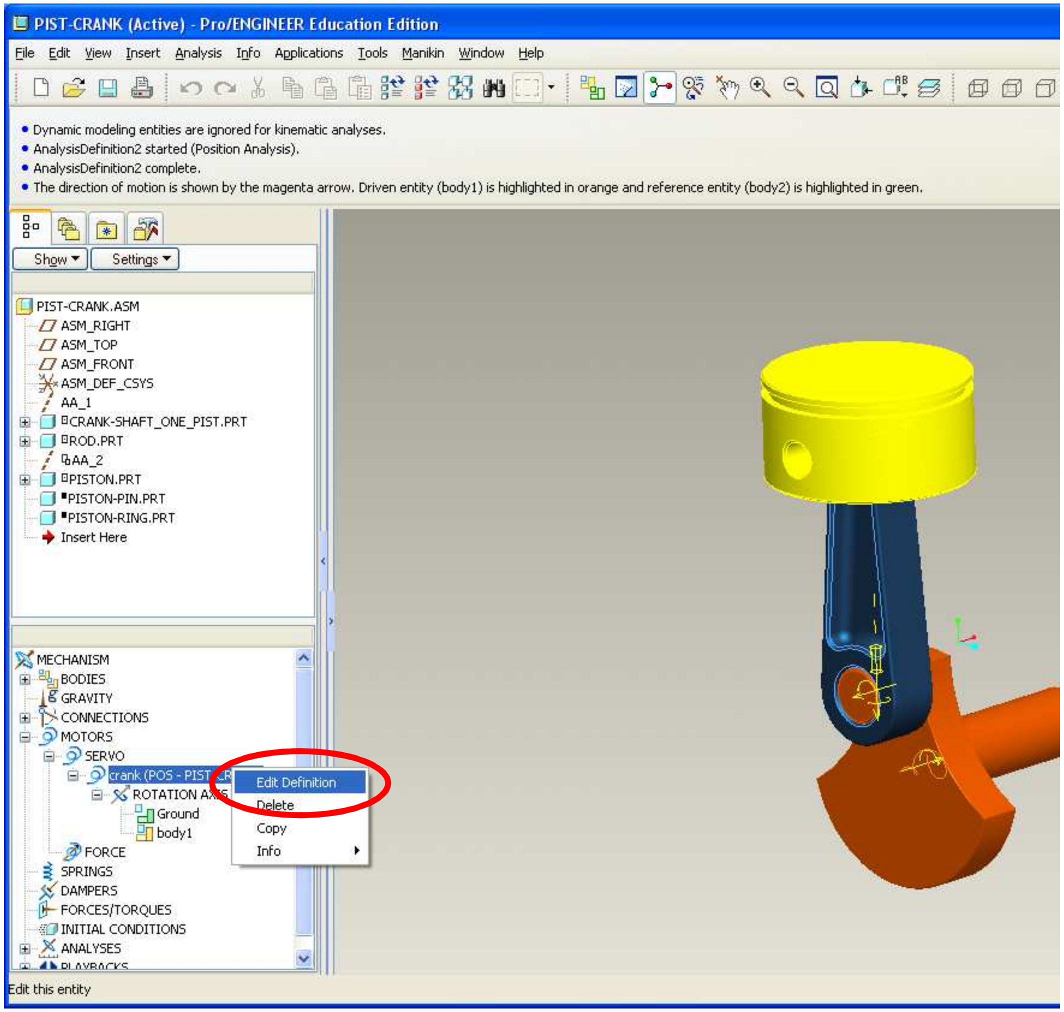
- Keep Reference Type as Part
- Select the PISTON part
- Change *Define Properties by* dialog to Density
- Enter

  7.827e-9 tonne/mm^3
- OK
- Repeat the process for the other 2 components



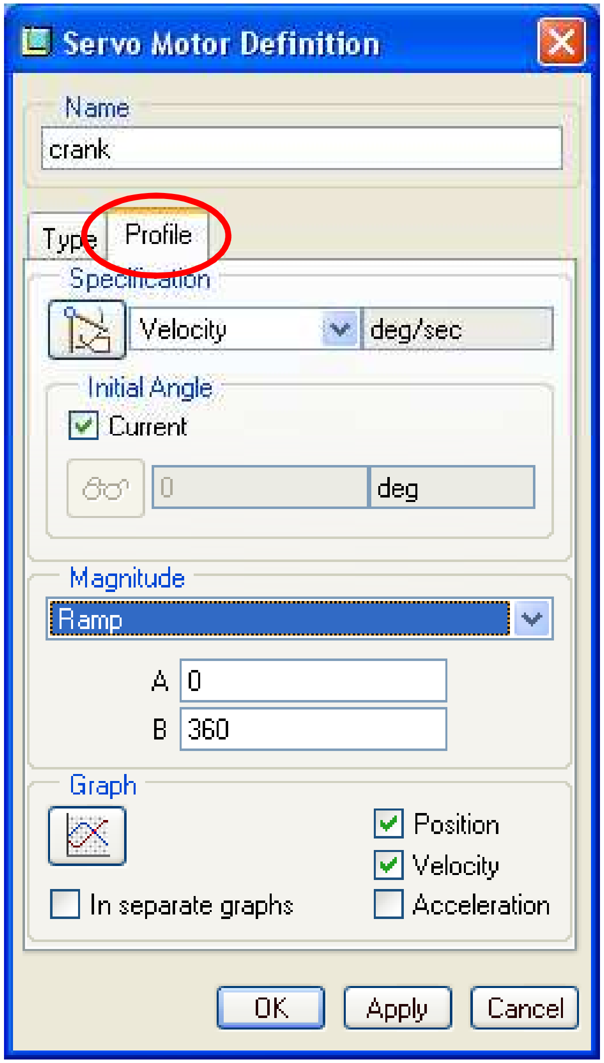
EXERCISE **- Motion Analysis**

- Go to mechanism model tree in the lower left
- Expand
    - Motors
    - Servo
- Open the *crank* motor we defined previously



EXERCISE - Motion Analysis

- Click the Profile tab



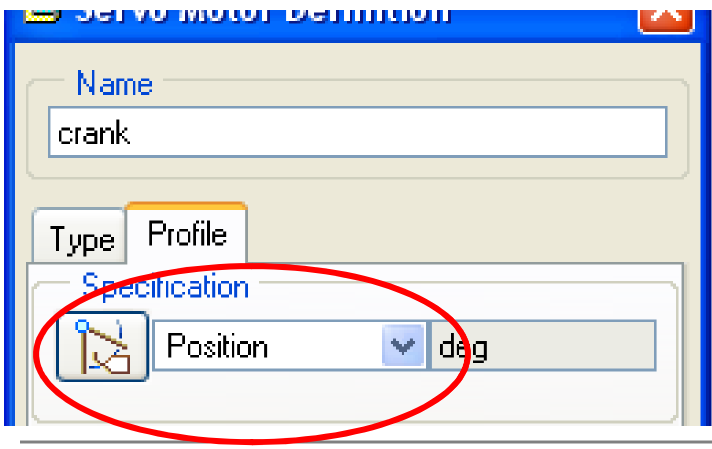
EXERCISE - Motion Analysis

• There are a number of ways to define the motion of the servo motor

• Input variable x is time

• Output variable is q, selected by user in Specification box

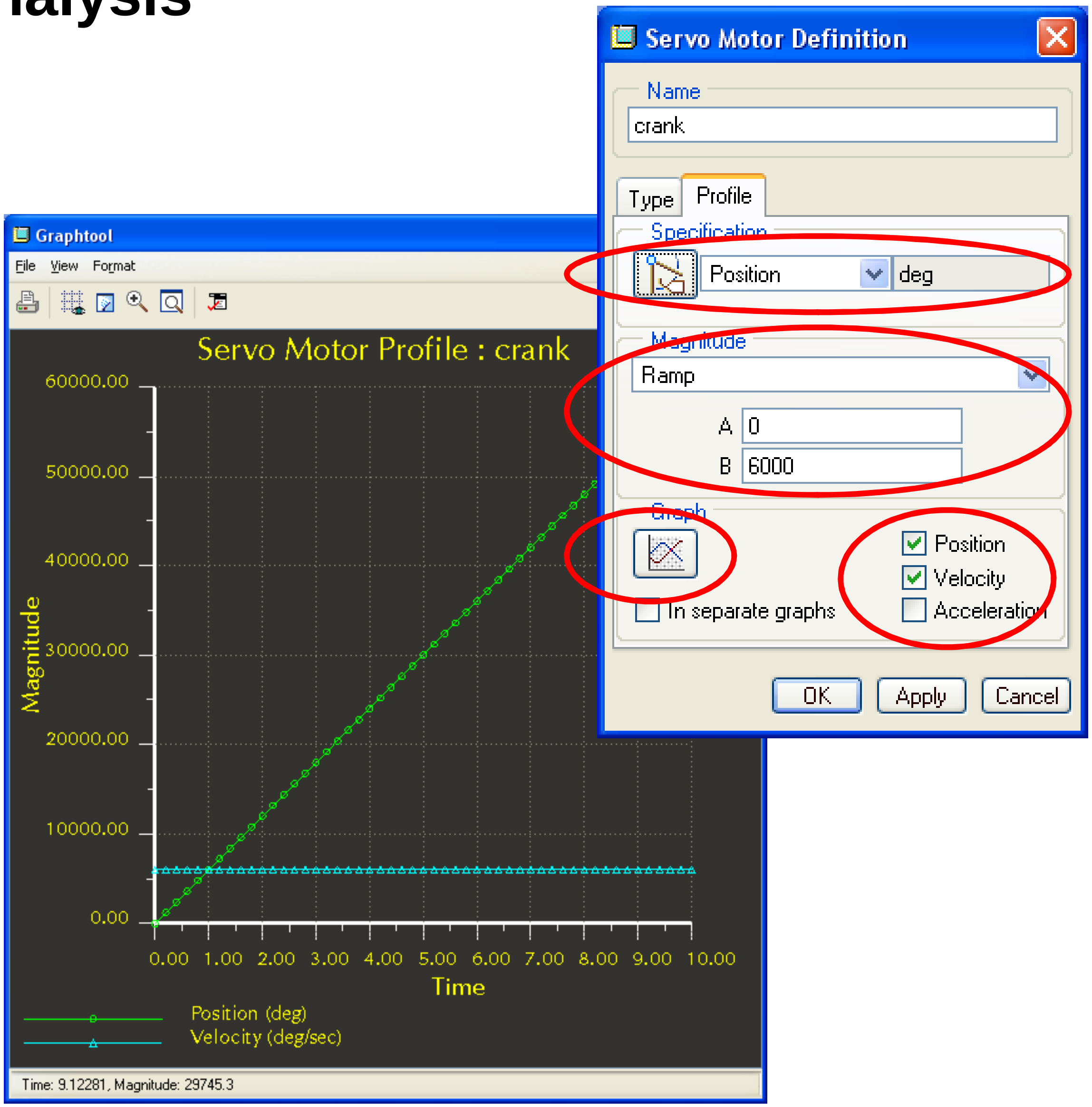
• Coefficients are defined by user to specify motion according to the definitions shown right



Magnitude Type	Description	Required Settings
Constant	Use for constant motion.	q = A where A = Constant
Ramp	Use for a constant motion or a profile that changes linearly over time.	q = A + B*x where A = Constant B = Slope
Cosine	Use to assign a cosine wave value to the motor profile.	q = A*cos(360*x/T + B) + C where A = Amplitude B = Phase C = Offset T = Period
SCCA	Use to simulate a cam profile output. SCCA can only be used when **Acceleration** is chosen as the motion type.	
Cycloidal	Use to simulate a cam profile output.	q = L*x/T – L*sin (2*Pi*x/T)/2*Pi where L = Total rise T = Period
Parabolic	Use to simulate a trajectory for a motor.	$q = A*x + 1/2\ B(x^2)$ where A = Linear coefficient B = Quadratic coefficient
Polynomial	Use for generic motor profiles.	$q = A + B*x + C*x^2 + D*x^3$ where A = Constant term coefficient

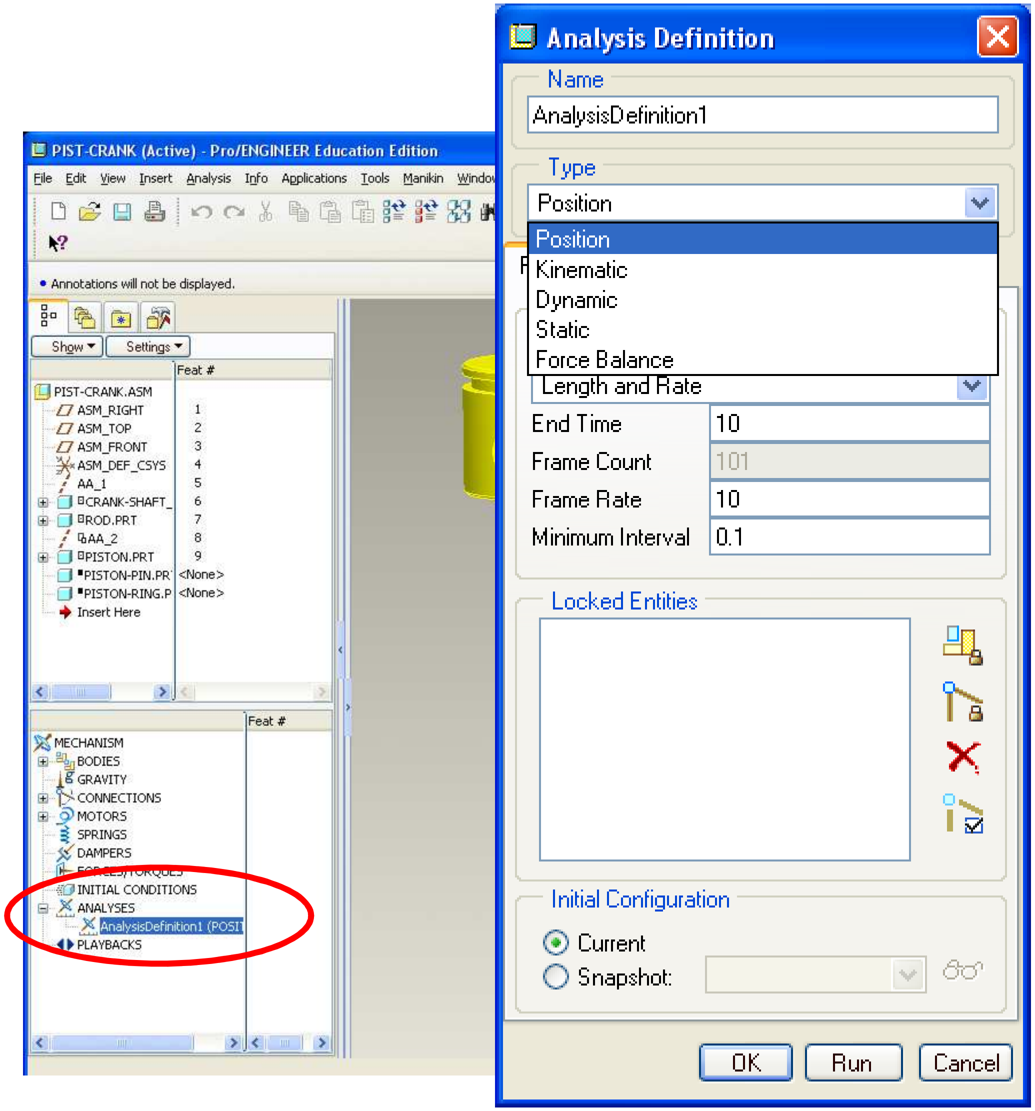
EXERCISE - Motion Analysis

- Redefine the *crank* motor to be
- Specify Position
- Use a Ramp Magnitude
  - A=0 (initial angular pos.)
  - B=6000
- Select Position and Velocity to graph
- Click graph icon



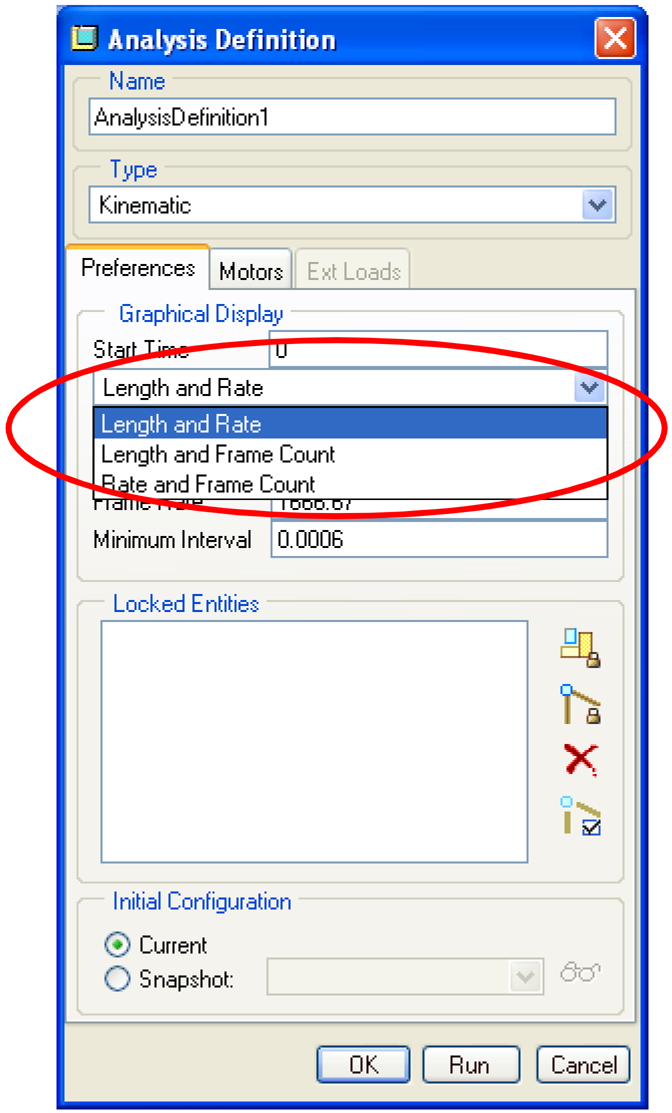
EXERCISE - Motion Analysis

- Back to the mechanism model tree in the lower left
- Expand Analyses
- RMB on the Analysis we had defined last time



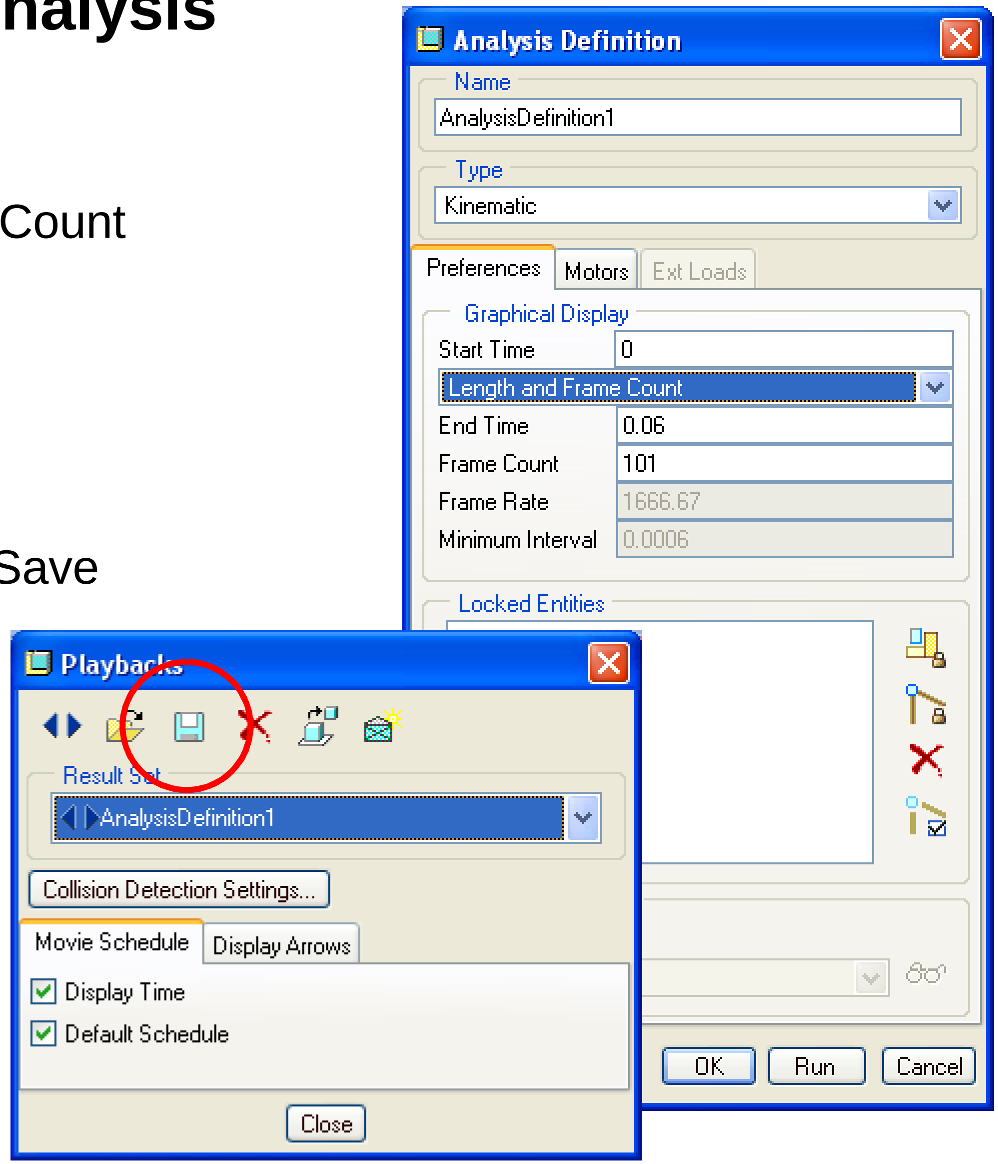
EXERCISE - Motion Analysis

- Drop down Analysis Type
- Note Type differences
    - Kinematic – No mass or force
    - Dynamic – Includes mass and force, non-zero acceleration
    - Static – zero acceleration
- **Set type to Kinematic**
- Note duration definitions
    - Length and Rate – Set speed
    - Length and Frame Count – Set number
    - Rate and Frame Count – Calculate rate



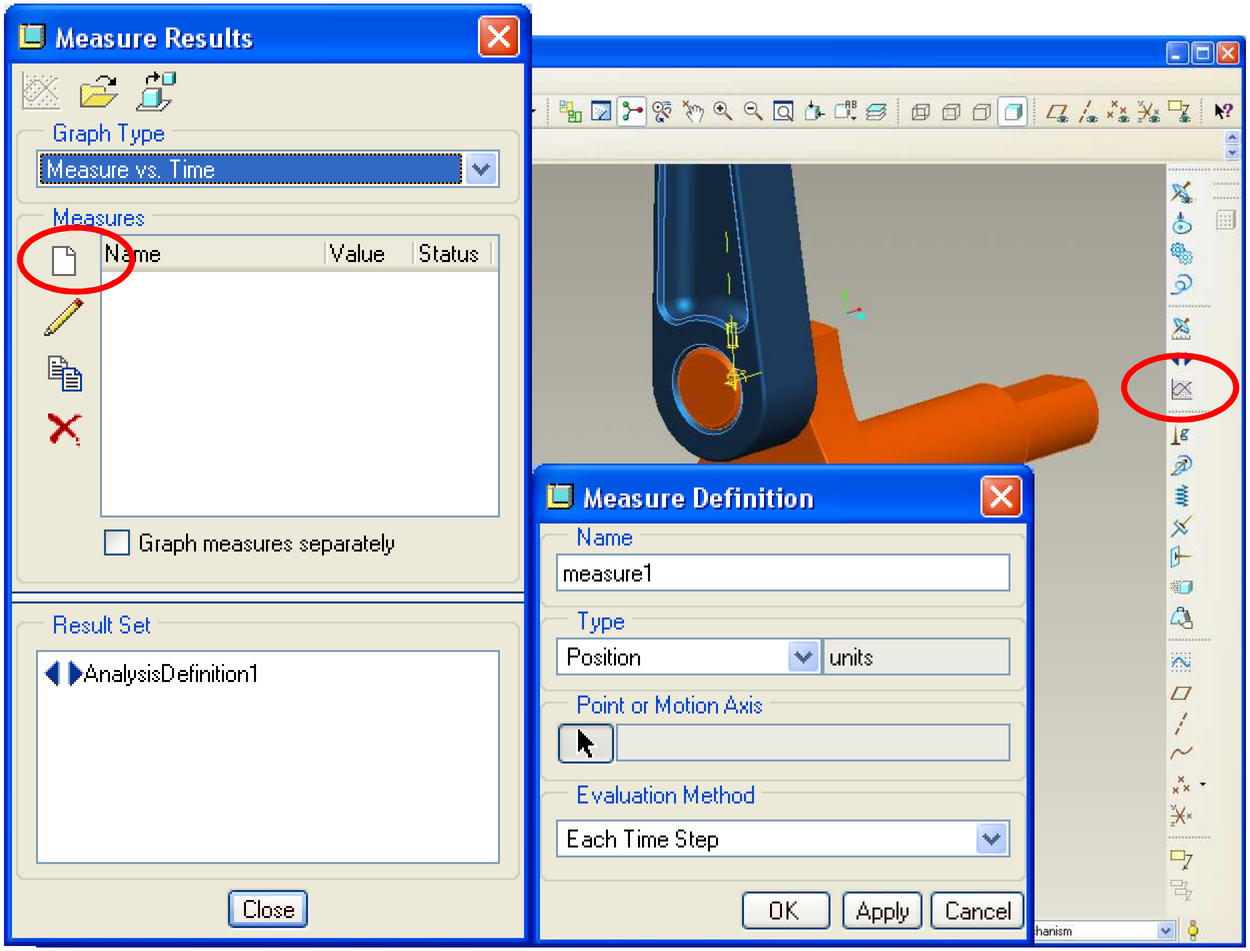
EXERCISE - Motion Analysis

- Set the Length and Frame Count
  - Set End Time to .06
  - Frame Count 101
- Click Run
- Go over to Playbacks and Save Analysis



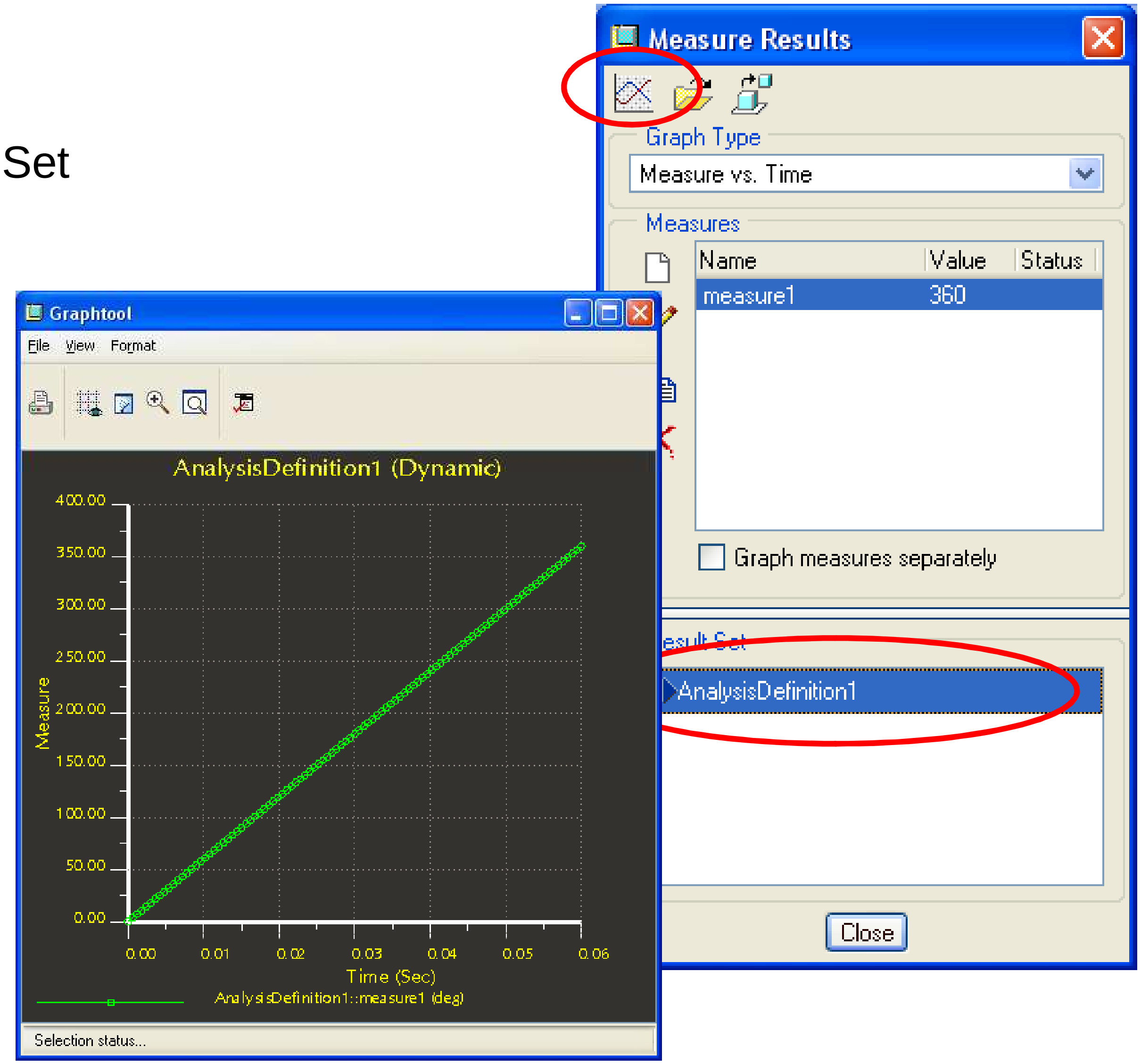
EXERCISE - Motion Analysis

- Click the Measures tool
- Click Create New Measure tool
- From Measure Definition
- Select Position as Type
- Click on the Servo motor icon on the crankshaft
- Click OK



EXERCISE **- Motion Analysis**

- Double Click on the Results Set
- Click the Graph icon



EXERCISE - Motion Analysis

Reset position

- In Mechanism Tree expand Motors to find Rotation Axis
- RMB > Edit Definition
- Set Current Position to 0.0
- Done