Machinery Cable Tutorial

This is a model of a rudder system for a light aircraft. You will first perform an analysis with the initial model which uses ideal couplers to transmit motion through the pulley system. Then you will replace the couplers with a cable system modeled via Adams/Machinery Cable.

This chapter includes the following sections:

What You Will Create

During this tutorial, you will model a rudder system for a light aircraft. You will first perform an analysis with the initial model which uses ideal couplers to transmit motion through the pulley system. Then you will replace the couplers with a cable system modeled via Adams/Machinery Cable.

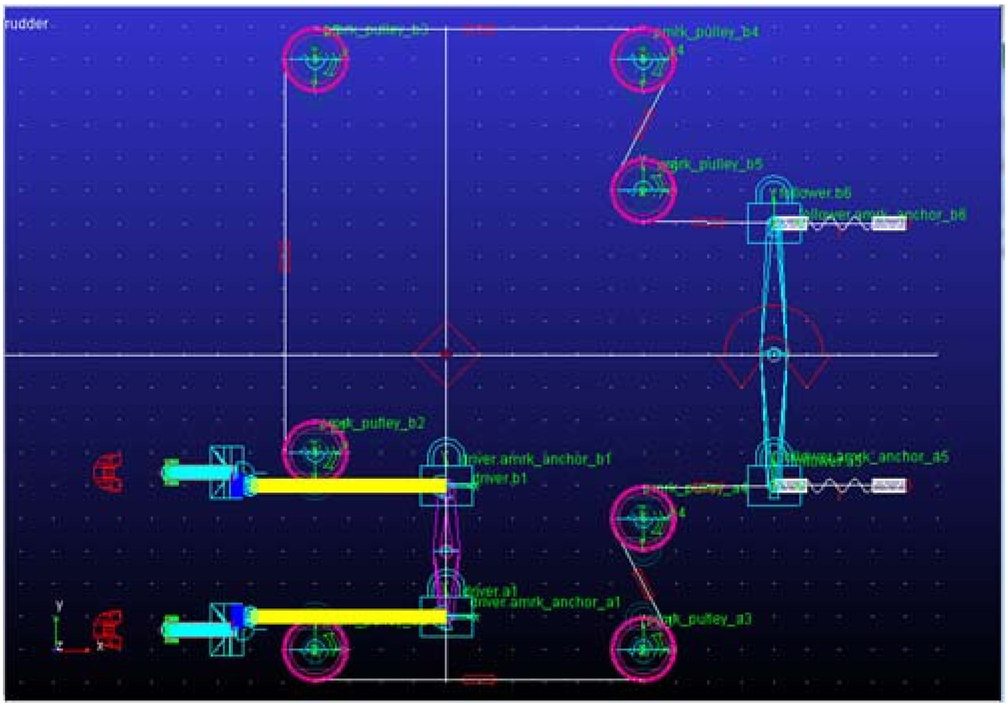
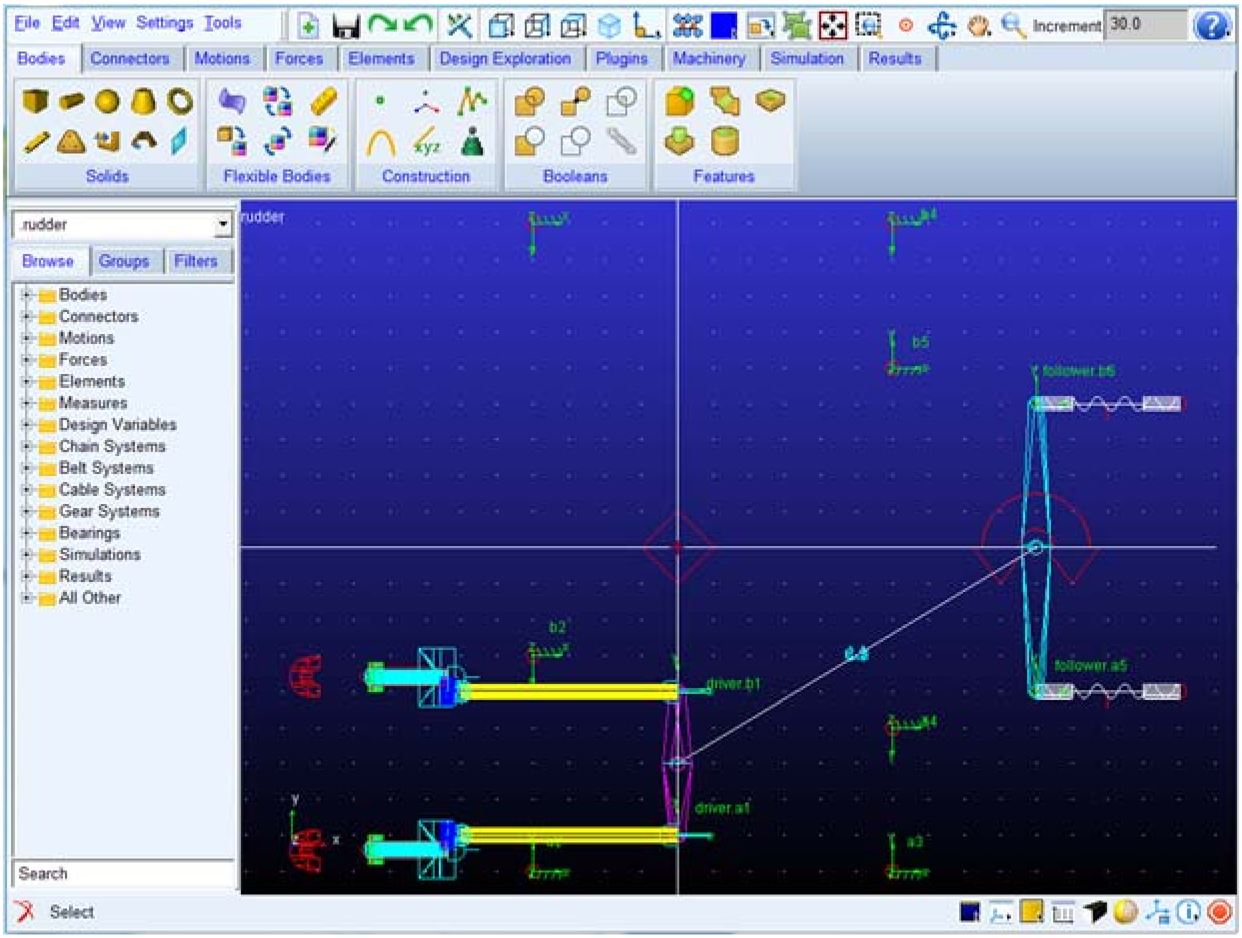


Figure 1 Rudder Model

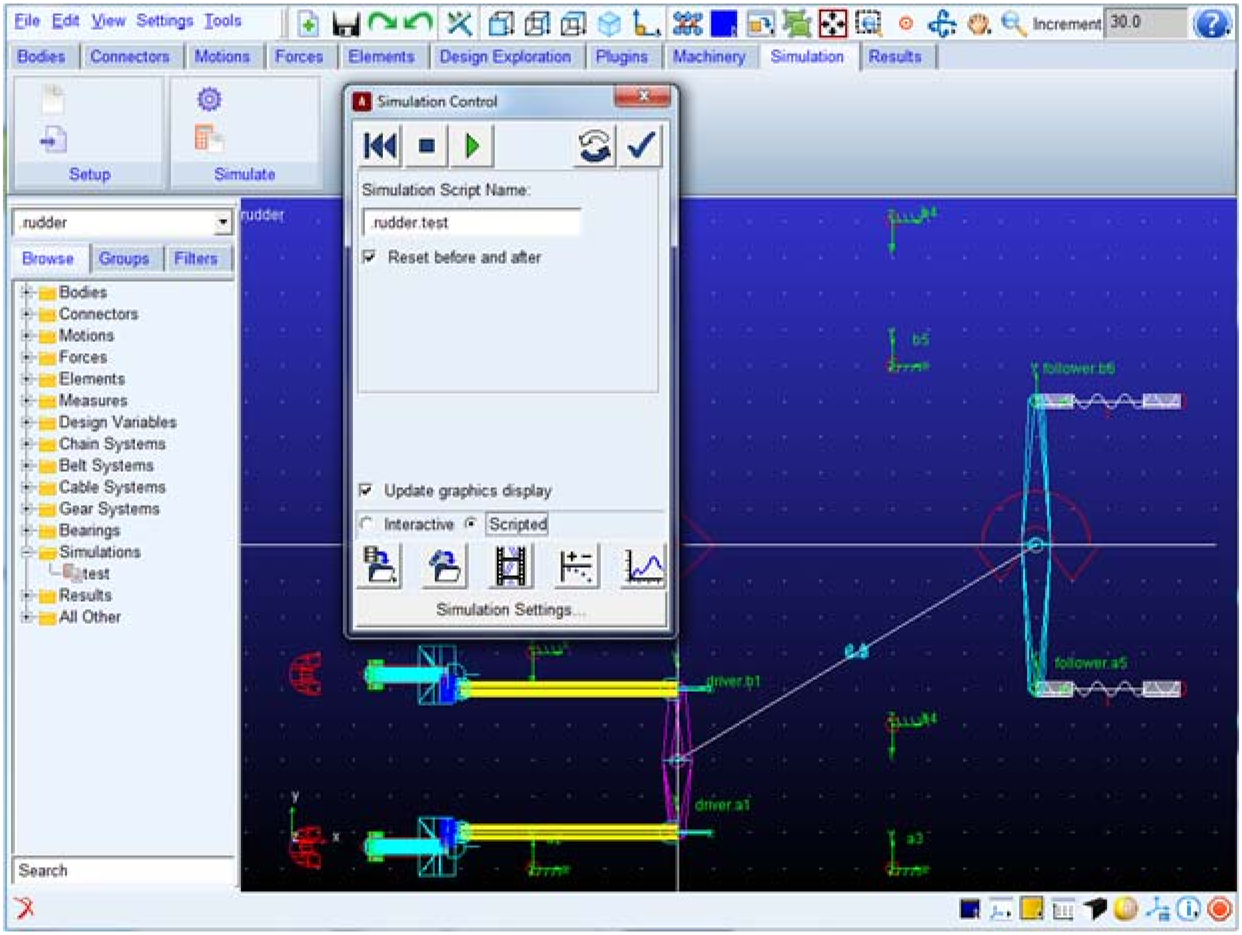
Creating Rudder Module

In this section, you will create a rudder system for a light aircraft.

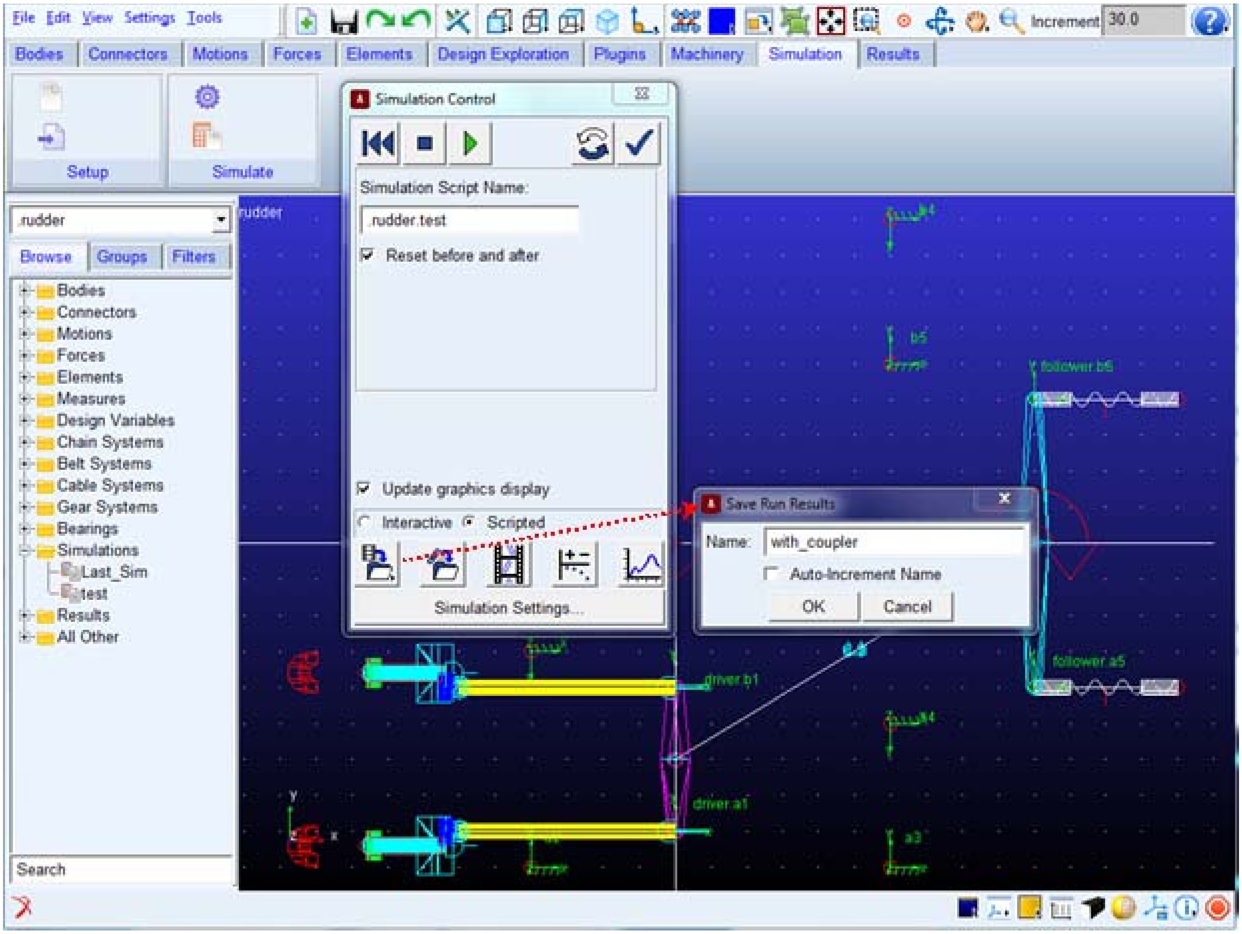
1. Copy **rudder.cmd** and *rudder.xmt_txt* from **<topdir>\amachinery\examples\cable** to your working directory
2. Open A/View and import existing model **rudder.cmd**.



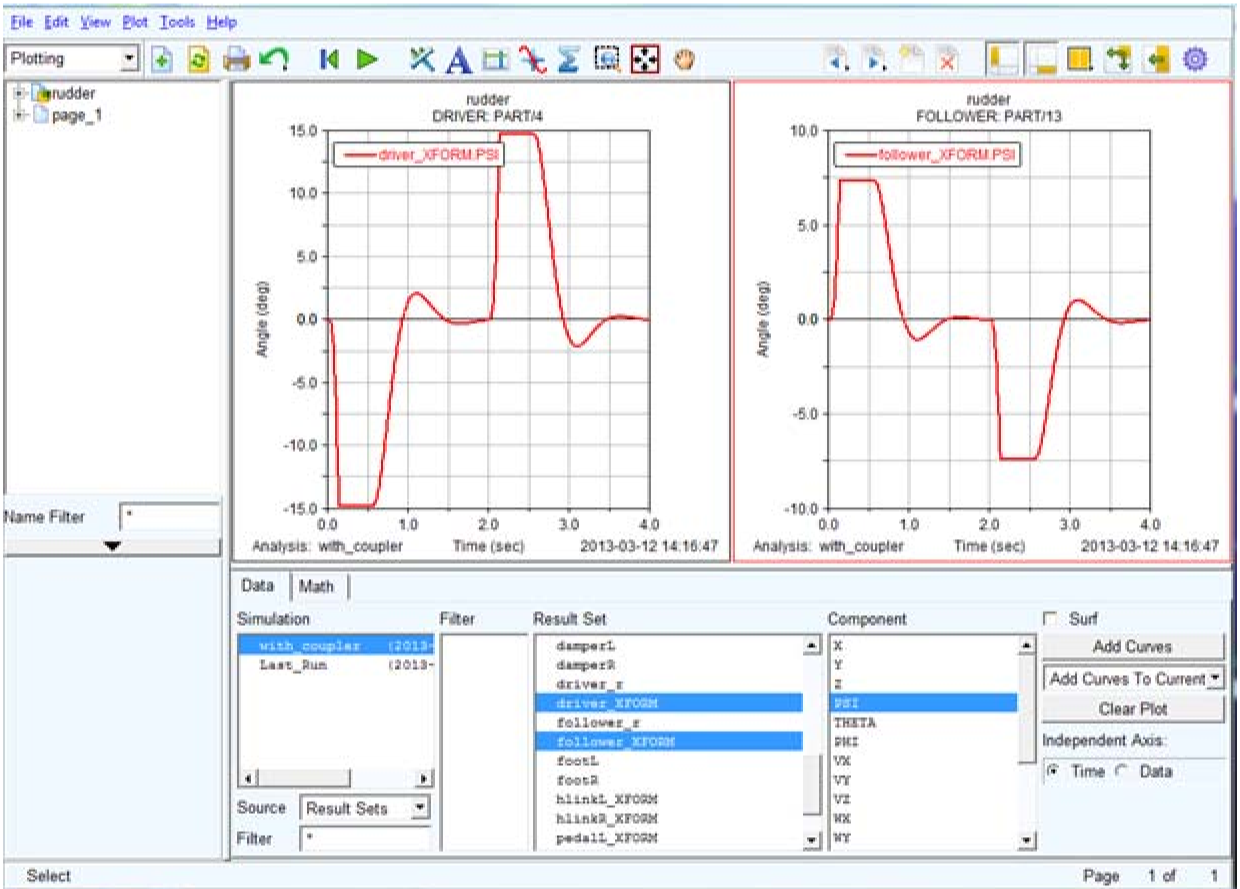
3. Run a scripted simulation using the simulation script **test**.



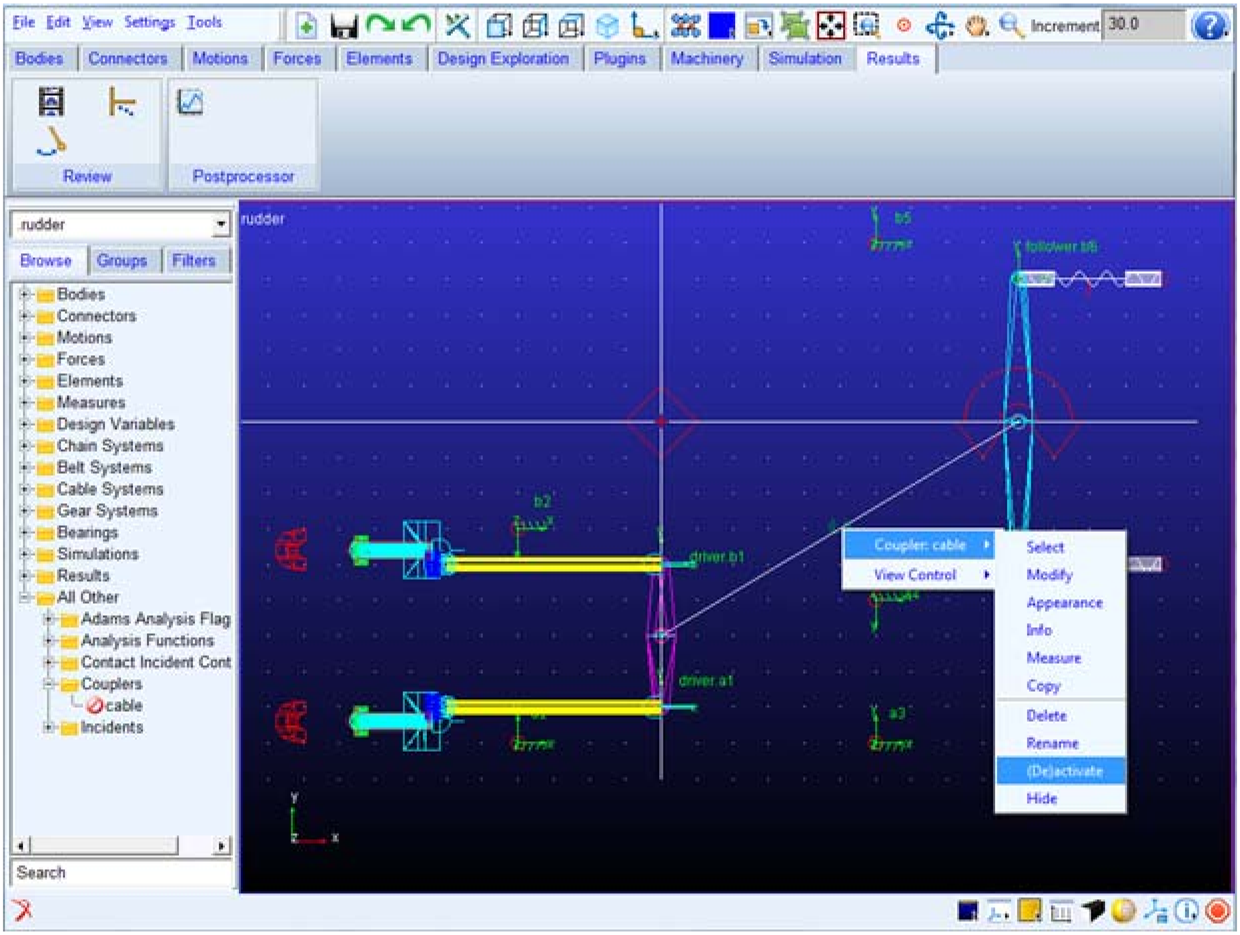
4. Save the analysis as **with_coupler**.

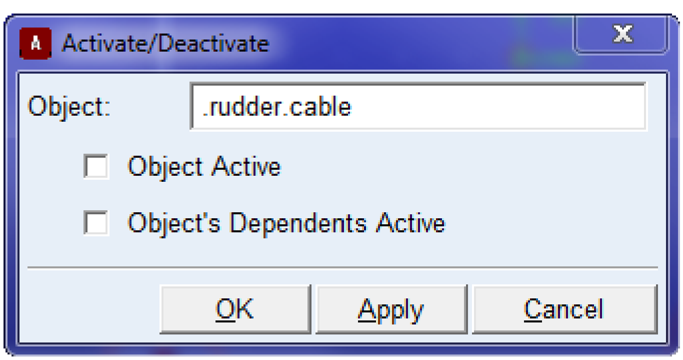


5. Go to Adams/PostProcessor and plot the angular rotation of the driver rudder and follower rudder:

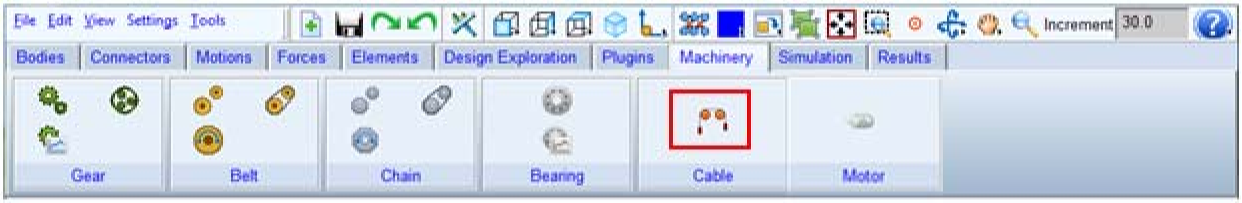


6. Return to Adams/View and deactivate the coupler named **cable** by right clicking the coupler either from the model browser or from the graphics window, selecting **(De)Activate** and, from the ensuing dialog, un-checking both options.





7. From the **Machinery** tab in the Adams/View ribbon click on the Create Cable System icon within the **Cable** container to launch the Cable System Creation wizard.



8. On the Anchor Layout page, name the cable system and specify that you want four anchors.
9. Specify the name, location and connection part for each of the four anchors as follows:
   a. 1

      i. Name = anchor_a1

      ii. Location: pick location of marker .rudder.driver.a1 (the position coordinates of the marker will be read into the field)

      iii. Connection Part = pick "driver"

   b. 2

      i. Name = anchor_a5

      ii. Location: pick location of marker .rudder.driver.a5

      iii. Connection Part = pick "follower"

   c. 3

      i. Name = anchor_b1

      ii. Location: pick location of marker .rudder.follower.b1

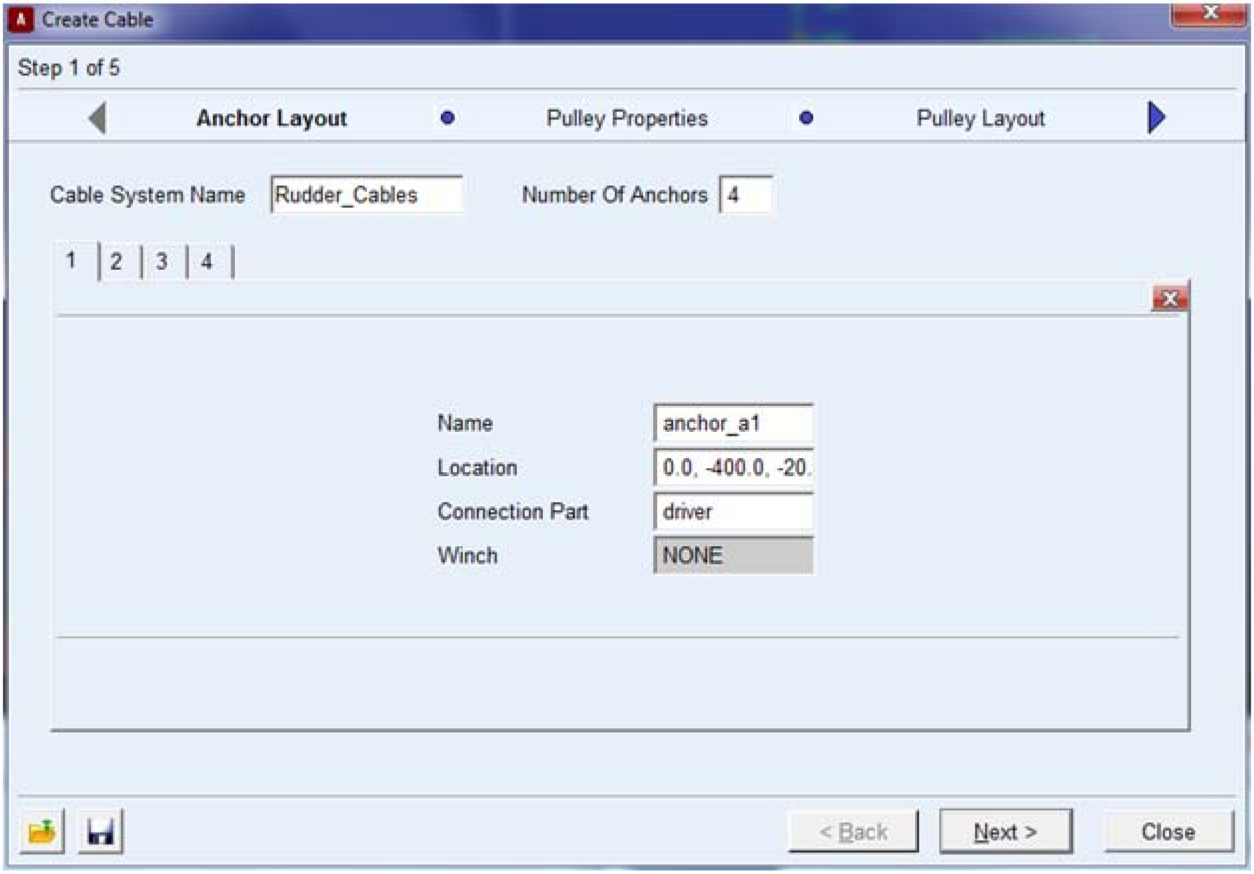
      iii. Connection Part = pick "driver"

   d. 4

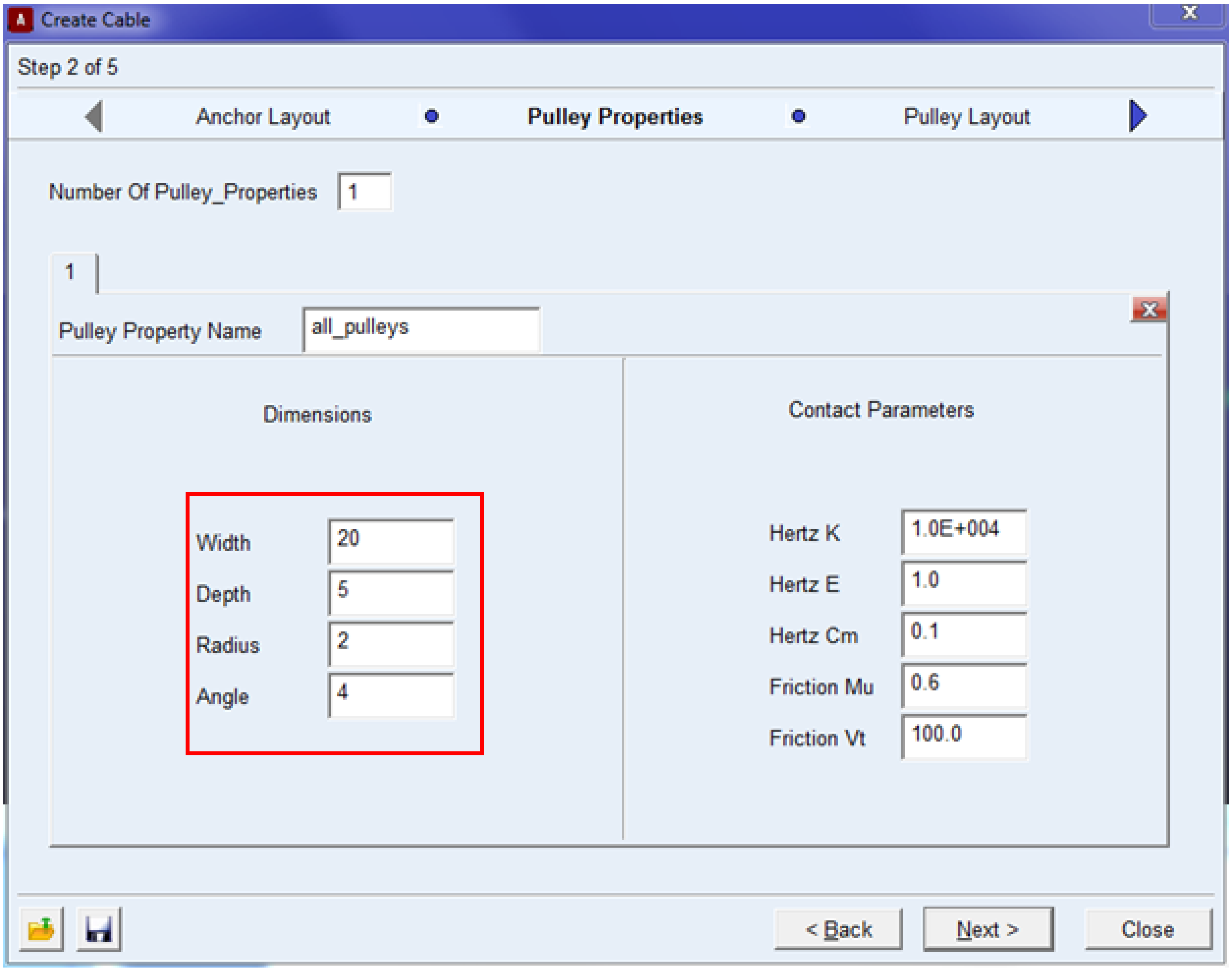
      i. Name = anchor_b6

      ii. Location: pick location of marker .rudder.driver.b6

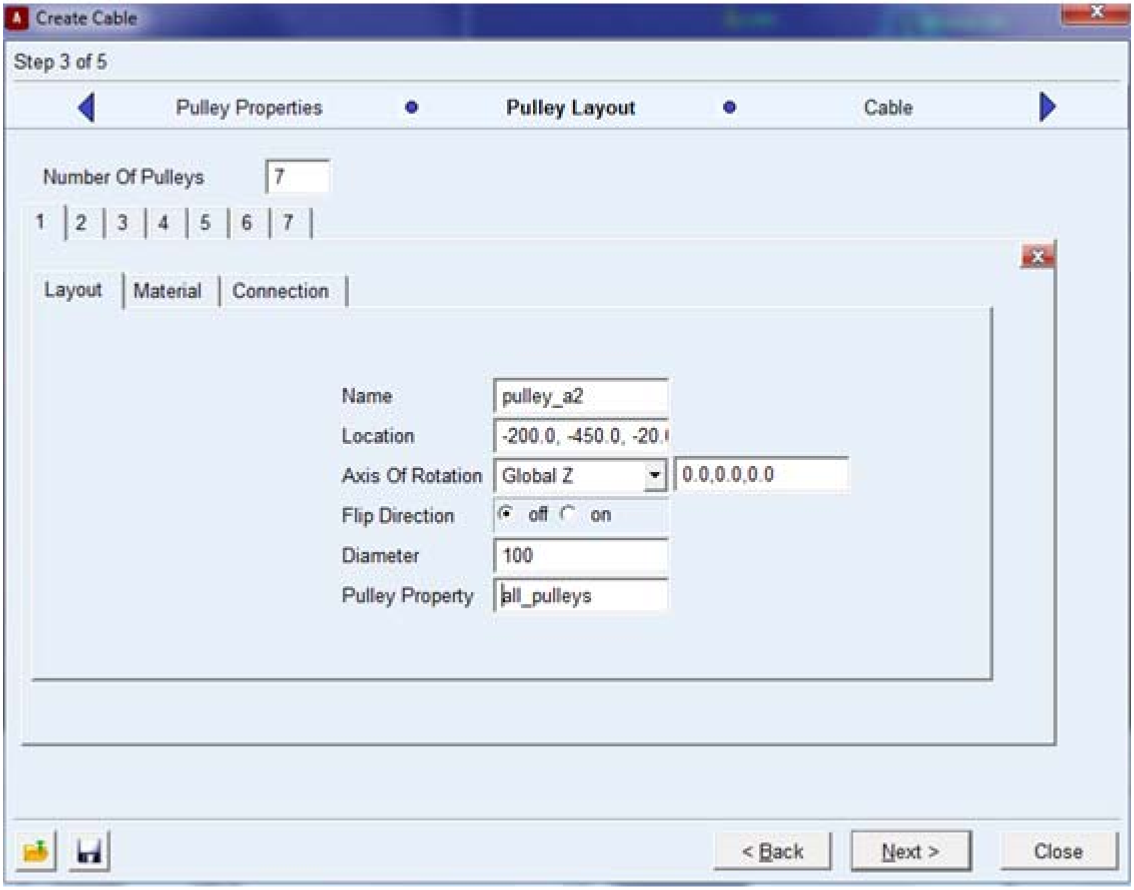
      iii. Connection Part = pick "follower"



10. Click **Next** and proceed to create a pulley property set as shown below. The pulley property set is convenient way to store pulley cross-sectional dimensions and contact parameters which you'd like to use for multiple pulleys in the cable system.



11. Click **Next** and proceed to create 7 pulleys at the location of the markers a2, a3, a4, b2, b3, b4, and b5, respectively.
    a. Accept the defaults on the Material and Connection tabs for each pulley
    b. See the image below for the specification of the first pulley's layout tab:



c. The others will differ in name and location. For example, the next pulley will be located at marker "a3" so name the pulley "pulley_a3" and for the Location entry right-click the Location field, select Pick and pick the marker "a3" from the graphics window.

d. They will also differ in "Flip Direction" which determines the direction in which we intend the pulley to rotate Set "Flip Direction" as follows:

i. 1, pulley_a2; Flip Direction = Off (default)

ii. 2, pulley_a3; Flip Direction = Off (default)

iii. 3, pulley_a4; Flip Direction = On

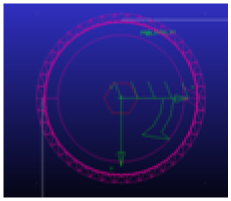
iv. 4, pully_b2; Flip Direction = On

v. 5, pully_b3; Flip Direction = On

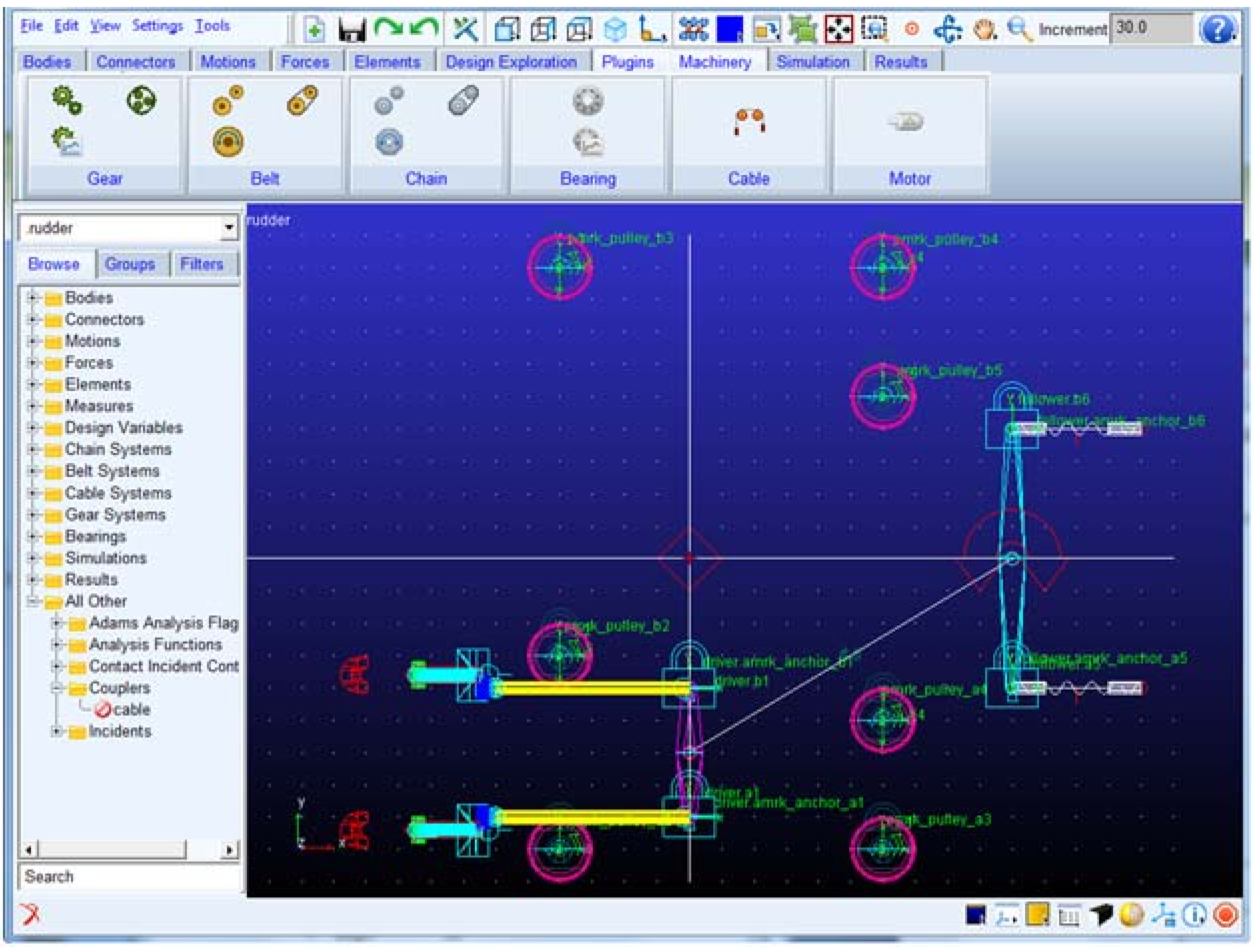
vi. 6, pully_b4; Flip Direction = On

vii. 7, pully_b5; Flip Direction = Off (default)

e. **Note:** Once the pulleys are created initially this direction of rotation is shown visually on the screen at each pulley by a green arrow icon:



12. Pulley geometry will now be visible in your model:



13. Click **Next** and proceed to create 2 cables:

a. First Cable:

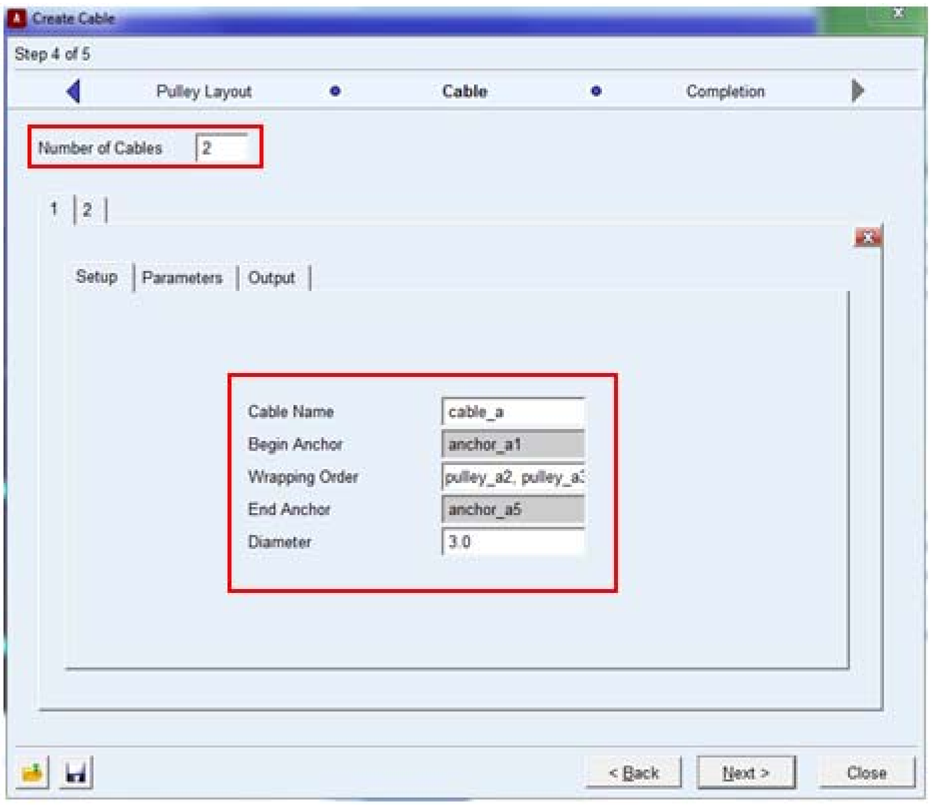
i. Layout: Start Anchor = anchor_a1; Wrapping Order = pulley_a2, pulley_a3, pulley_a4; End Anchor = anchor_a5 (these can be graphically selected or selected via right-mouse Browse or Guesses)

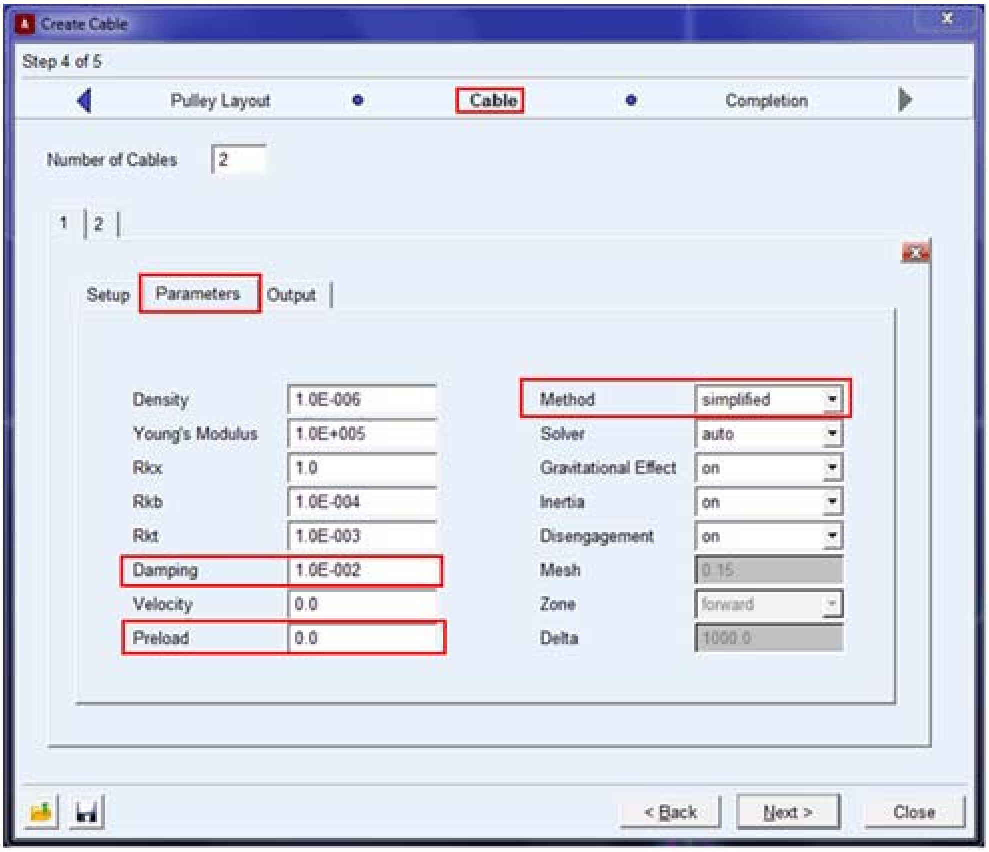
ii. Layout: Diameter = 3mm

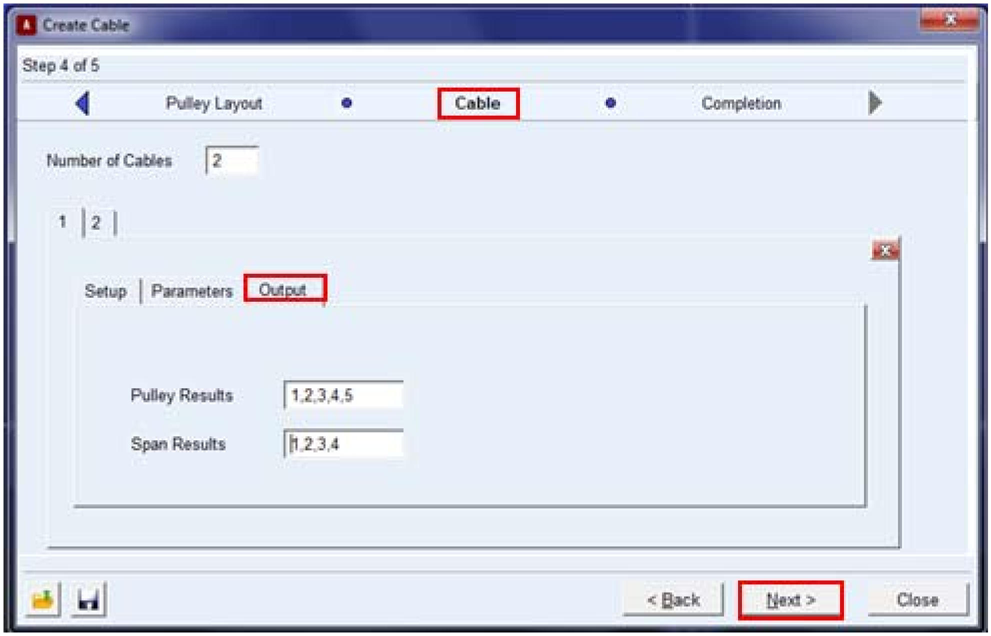
iii. Parameters: Damping = 1.0E-2 N*s/mm, Preload = 100N, Formulation = simplified

iv. Output: Pulley Results = 1,2,3,4,5; Span Results =1,2,3,4 (this will generate requests on each of the 5 anchors and pulleys and at the midpoint of each of the 4 spans)

v. Rest of the entries can be kept as default values




Create Cable
Step 4 of 5
Pulley Layout
Cable
Completion
Number of Cables
2
1
2
Setup
Parameters
Output
Density
1.0E-006
Young's Modulus
1.0E+005
Rkx
1.0
Rkb
1.0E-004
Rkt
1.0E-003
Damping
1.0E-002
Velocity
0.0
Preload
0.0
Method
simplified
Solver
auto
Gravitational Effect
on
Inertia
on
Disengagement
on
Mesh
0.15
Zone
forward
Delta
1000.0
< Back
Next >
Close



b. Second Cable:

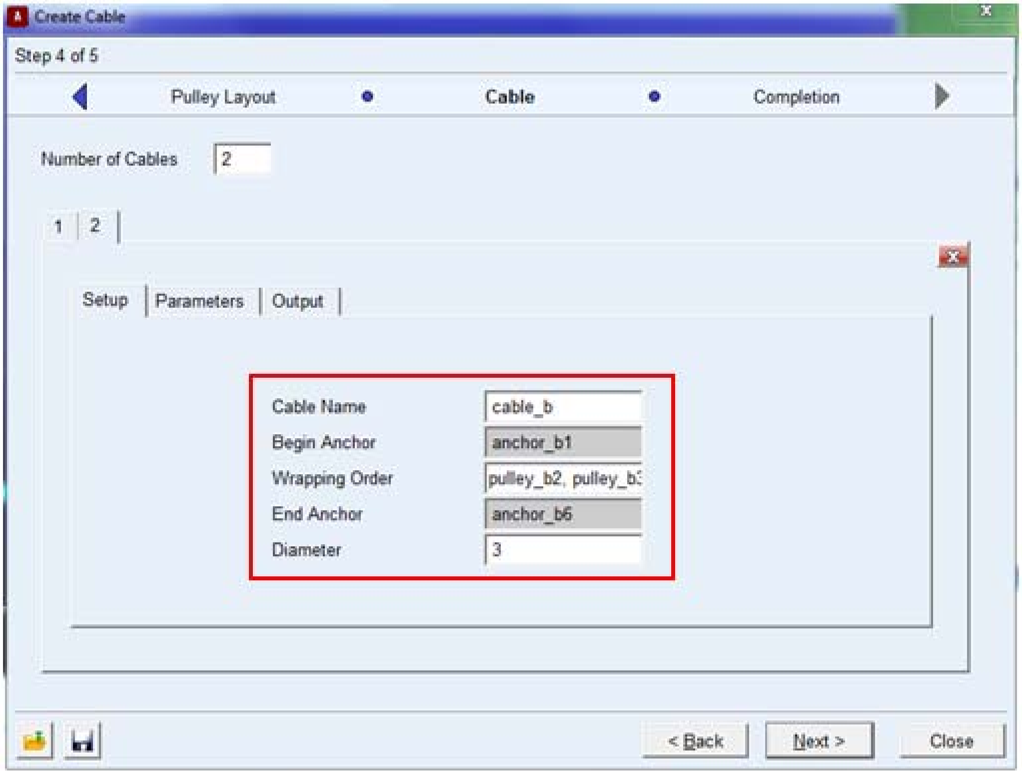
i. Layout: Start Anchor = anchor_b1; Wrapping Order = pulley_b2, pulley_b3, pulley_b4, pulley_b5; End Anchor = anchor_b6

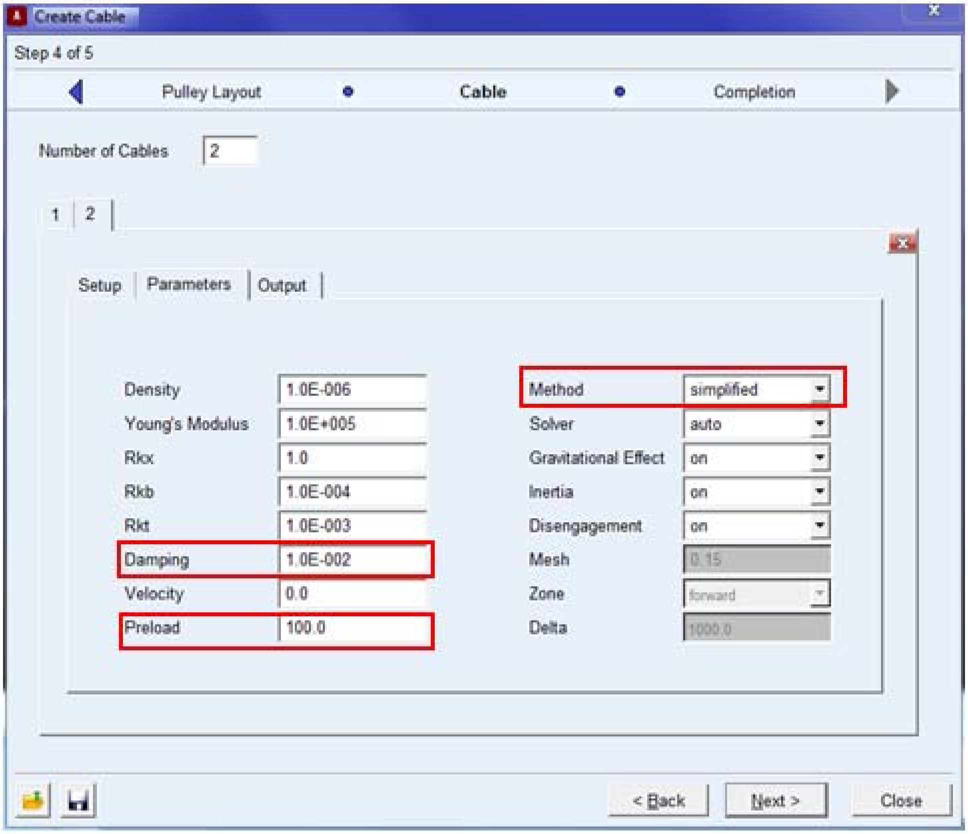
ii. Layout: Diameter = 3mm

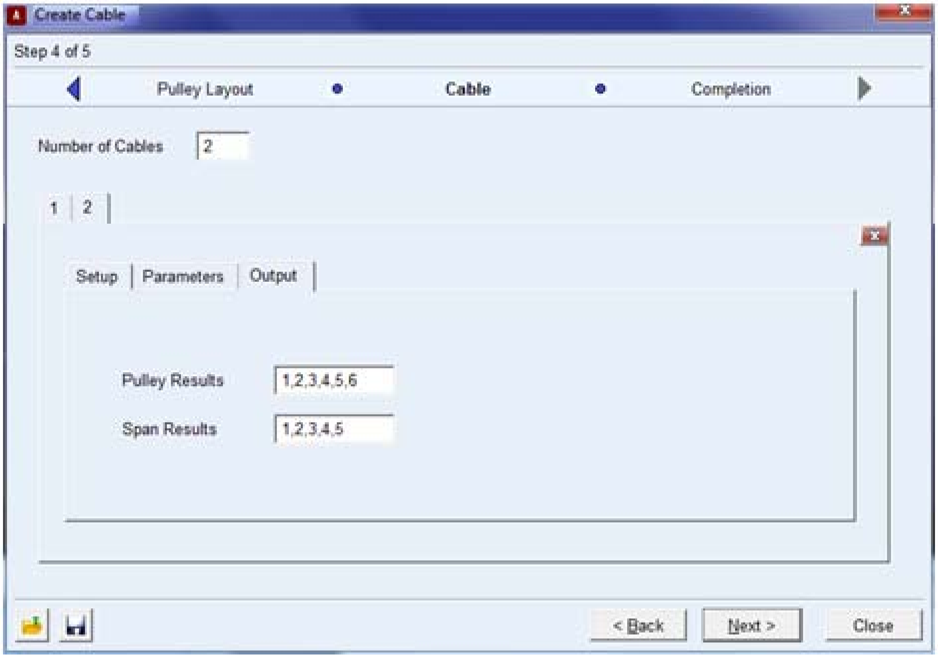
iii. Parameters: Damping = 1.0E-2 N*s/mm, Preload = 100N, Formulation = simplified

iv. Output: Pulley Results = 1,2,3,4,5,6; Span Results = 1,2,3,4,5

v. Rest of the entries can be kept as default values

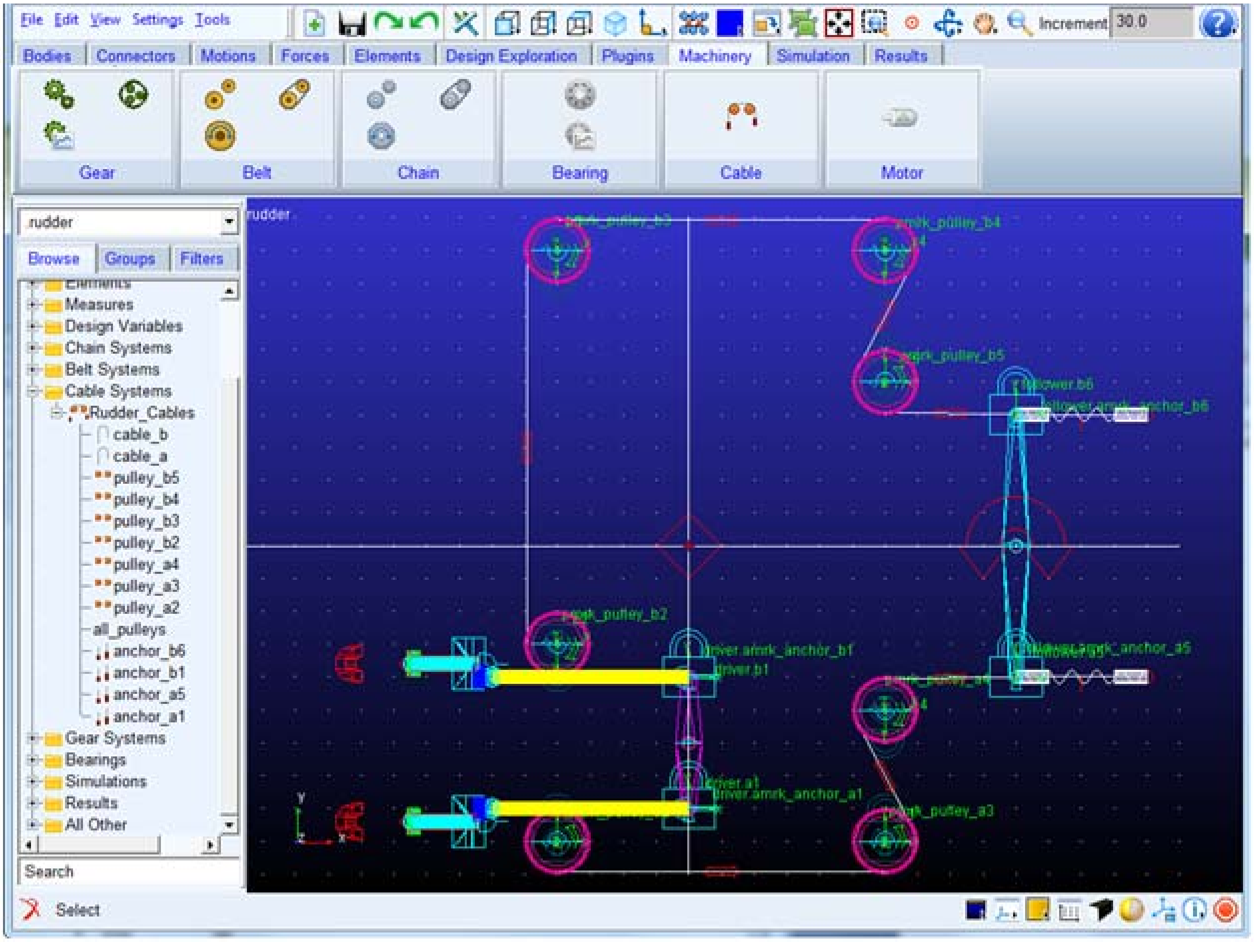

Create Cable
Step 4 of 5
Pulley Layout
Cable
Completion
Number of Cables
2
1
2
Setup
Parameters
Output
Cable Name
cable_b
Begin Anchor
anchor_b1
Wrapping Order
pulley_b2, pulley_b3
End Anchor
anchor_b6
Diameter
3
< Back
Next >
Close


Create Cable
Step 4 of 5
Pulley Layout
Cable
Completion
Number of Cables
2
1
2
Setup
Parameters
Output
Density
1.0E-006
Young's Modulus
1.0E+005
Rkx
1.0
Rkb
1.0E-004
Rkt
1.0E-003
Damping
1.0E-002
Velocity
0.0
Preload
100.0
Method
simplified
Solver
auto
Gravitational Effect
on
Inertia
on
Disengagement
on
Mesh
0.15
Zone
forward
Delta
1000.0
< Back
Next >
Close



14. Click **Next** and the cables are created.

15. Click **Finish** to exit the wizard.



16. Now that a cable system is in place (replacing the simple coupler used initially), re-run the simulation using the simulation script **test**.
17. Save the analysis as **with_cables**.

Adams/PostProcessor Results

Go to Adams/PostProcessor and plot the angular rotation of the driver rudder and follower rudder again on top of the original curves and zoom in see differences in the rudder travel.