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Ergonomic Manikin Manipulation using CATIA V5 DMU Kinematics

(Steps 5 - 11 the optimized solution)

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- In the previous example, we showed a simple solution to manipulate an Ergonomic Manikin using CATIA DMU Kinematics.
- In that example the angle of the feet do not follow the angle of the pedals.
- In this example we will optimize the pedals to maintain contact with the feet.

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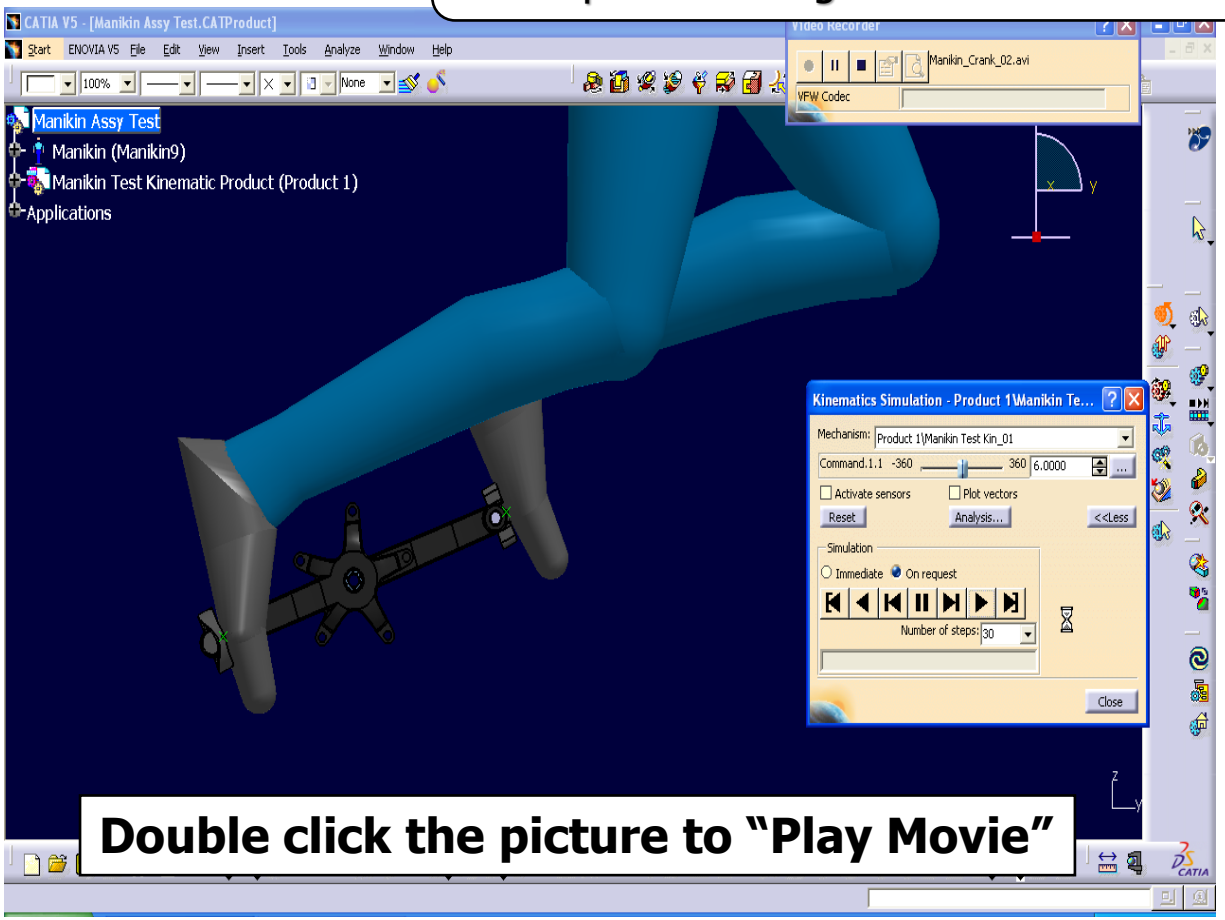
- Previous example:

The angle of the feet do not follow the angle of the pedals during rotation.



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- The rotation angle of the pedals is set to a 1:1 ratio of the crank rotation within the kinematic set.
- While the Manikin may be “attached” to the pedals, it is *driven* by the kinematic set and therefore not editable inside the Kinematic function.
- The main problem to solve in this example is to get the pedals to follow the feet.

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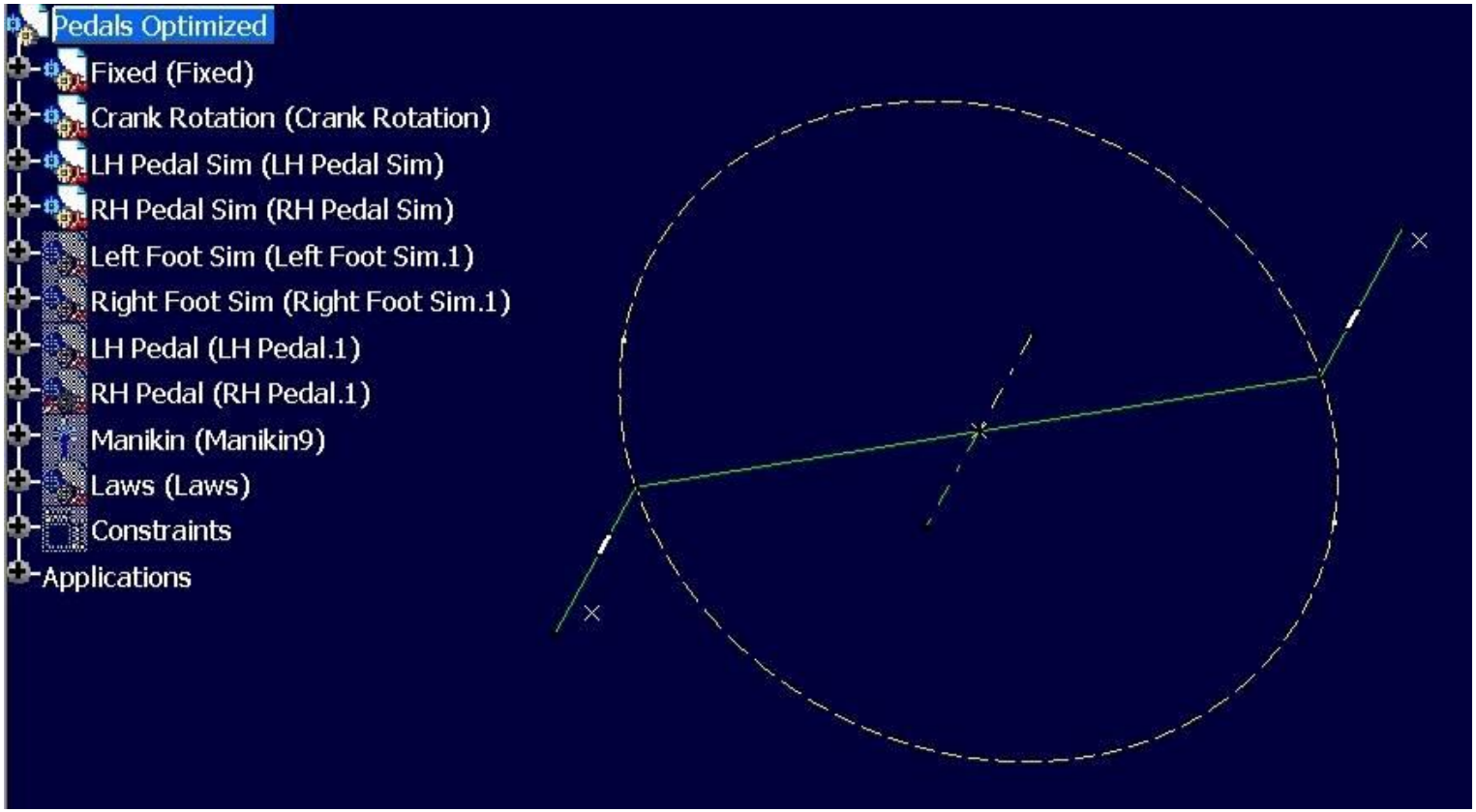
- Step 5: Create a Product for a “stick figure” kinematic mechanism.



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- There will be four Parts to build the kinematic mechanism:
  - Fixed
  - Crank Rotation
  - LH Pedal Simulator
  - RH Pedal Simulator

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- Other Parts within the Product will be:
  - Manikin (Ergonomic Design & Analysis)
  - Left Foot Simulator
  - Right Foot Simulator
  - LH Pedal (3D Part)
  - RH Pedal (3D Part)
  - Laws

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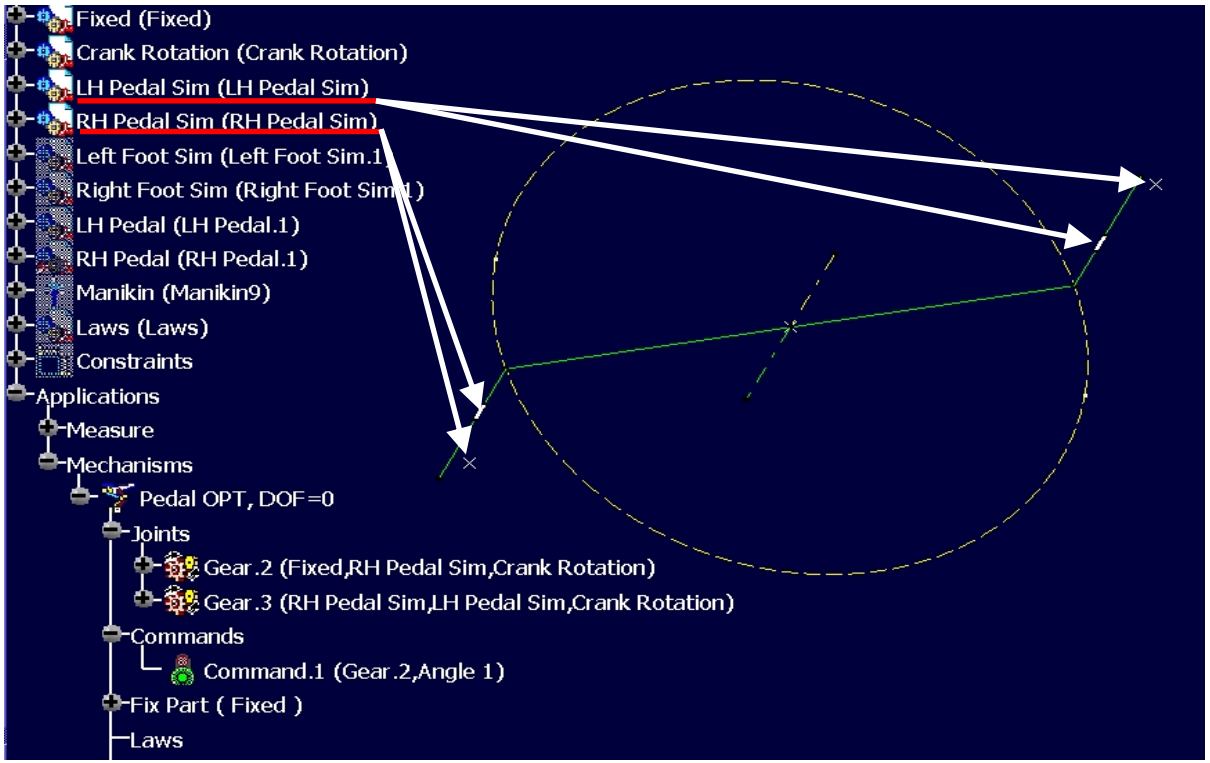
- The kinematic mechanism will start with the Fixed Part and two Gear Joints between the Fixed, Crank Rotation, and Pedal Sim Parts.



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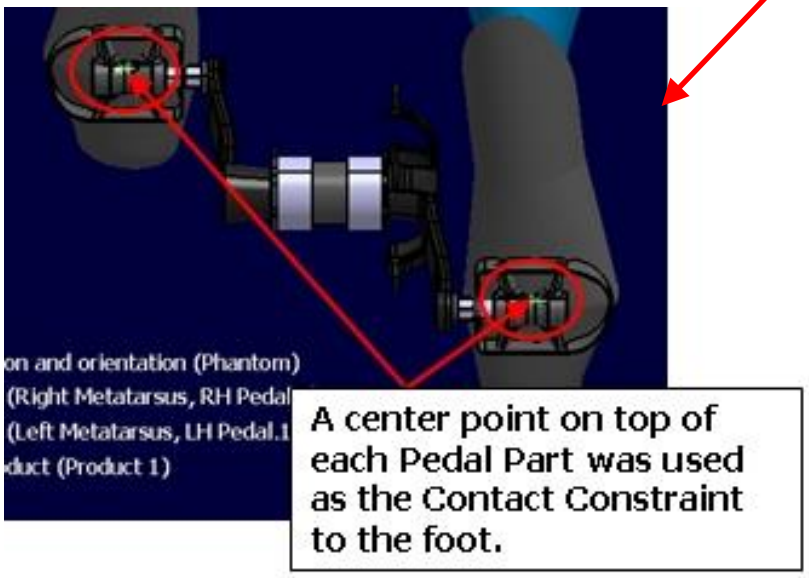
- The LH & RH Pedal Sim Parts consist of a centerline for the pedal pivot and a point.
- They will be used to “attach” the Manikin to the kinematic mechanism as in the previous example.



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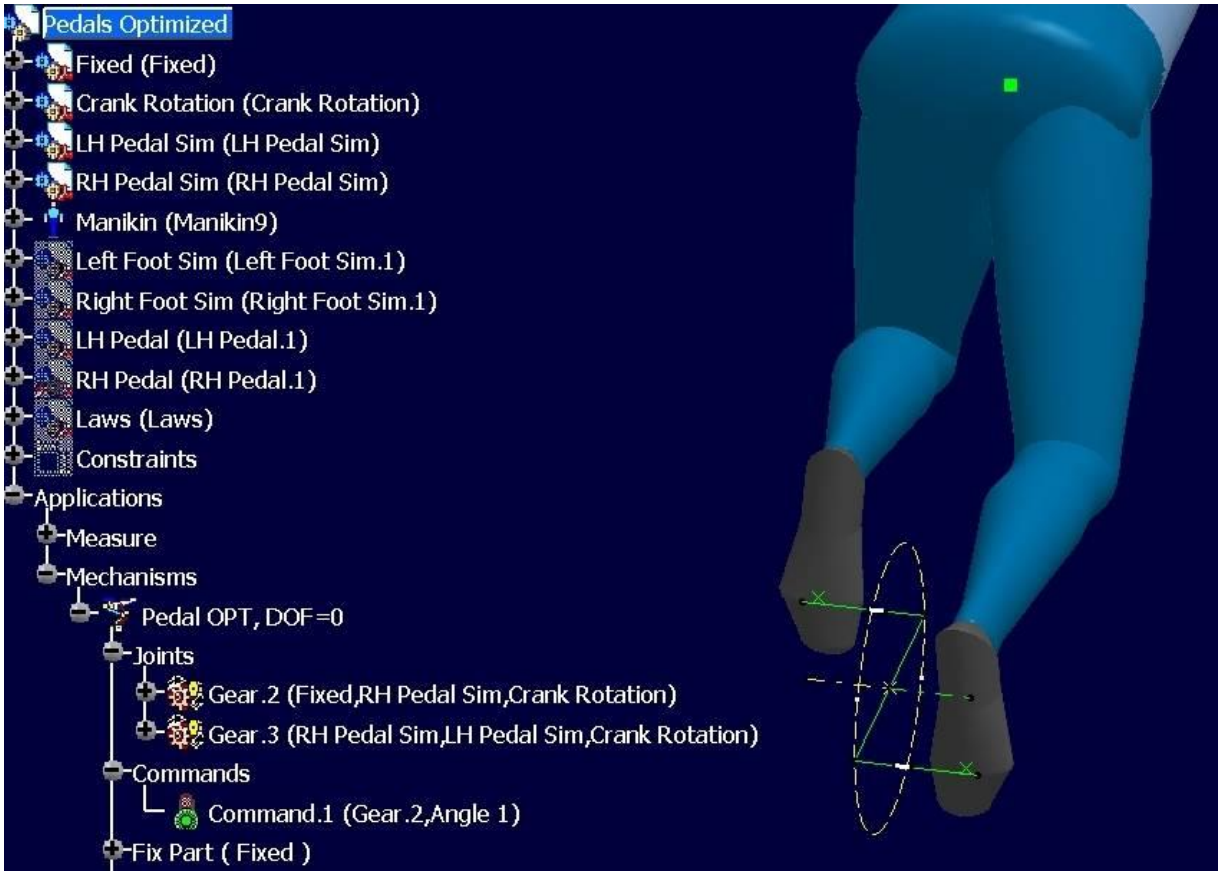
- Step 6: Load the Manikin from the previous example.



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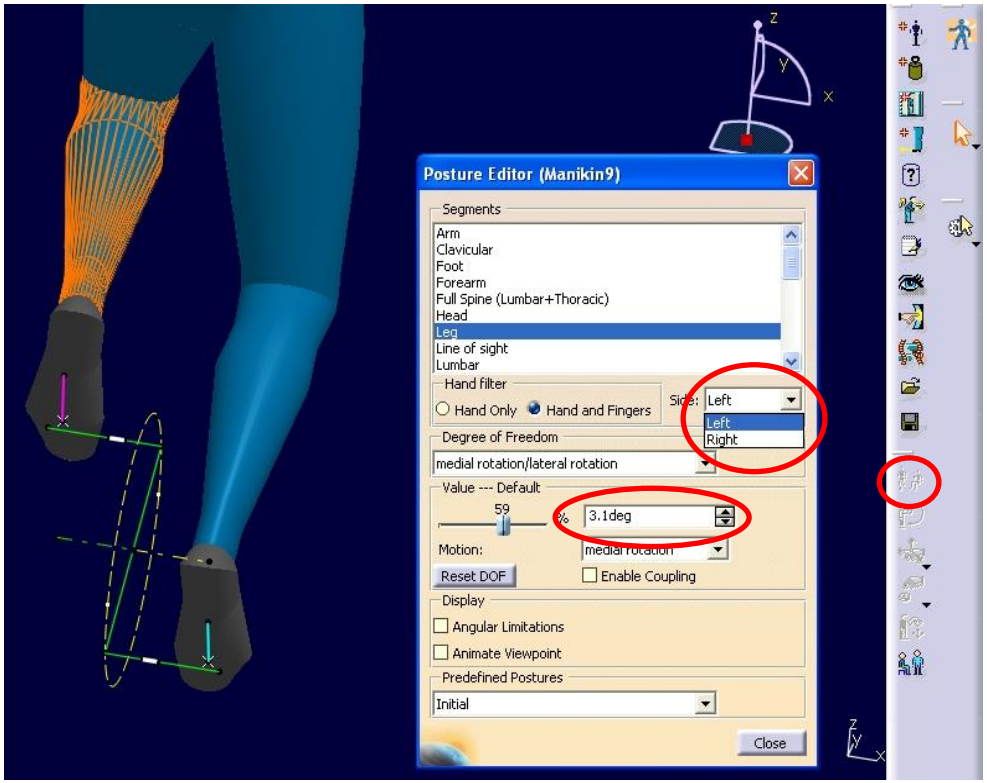
- Ensure the DOF values for the Feet, Legs, & Thighs are correct and symmetric before locking the DOF.



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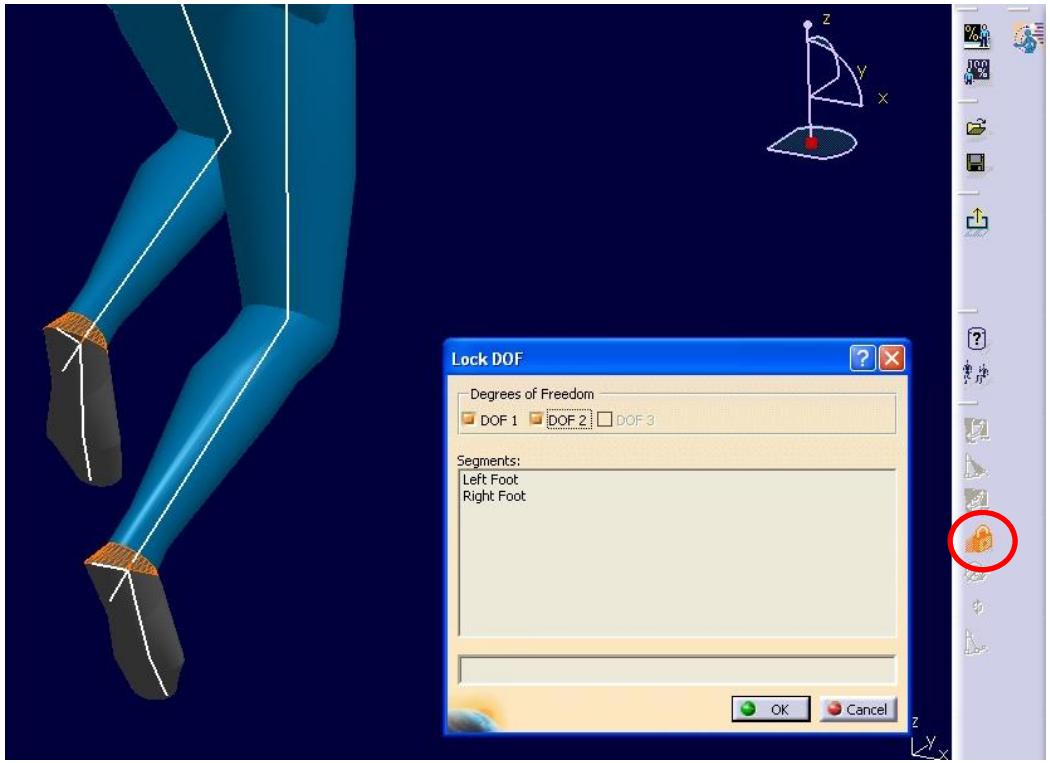
- Open Human Posture Analysis. Lock the Feet DOF 1 & 2, Leg DOF 3, & Thigh DOF 2.



You MUST LOCK the DOF each time you read the Product!

If you run the kinematic set without doing this, you may experience unwanted results!

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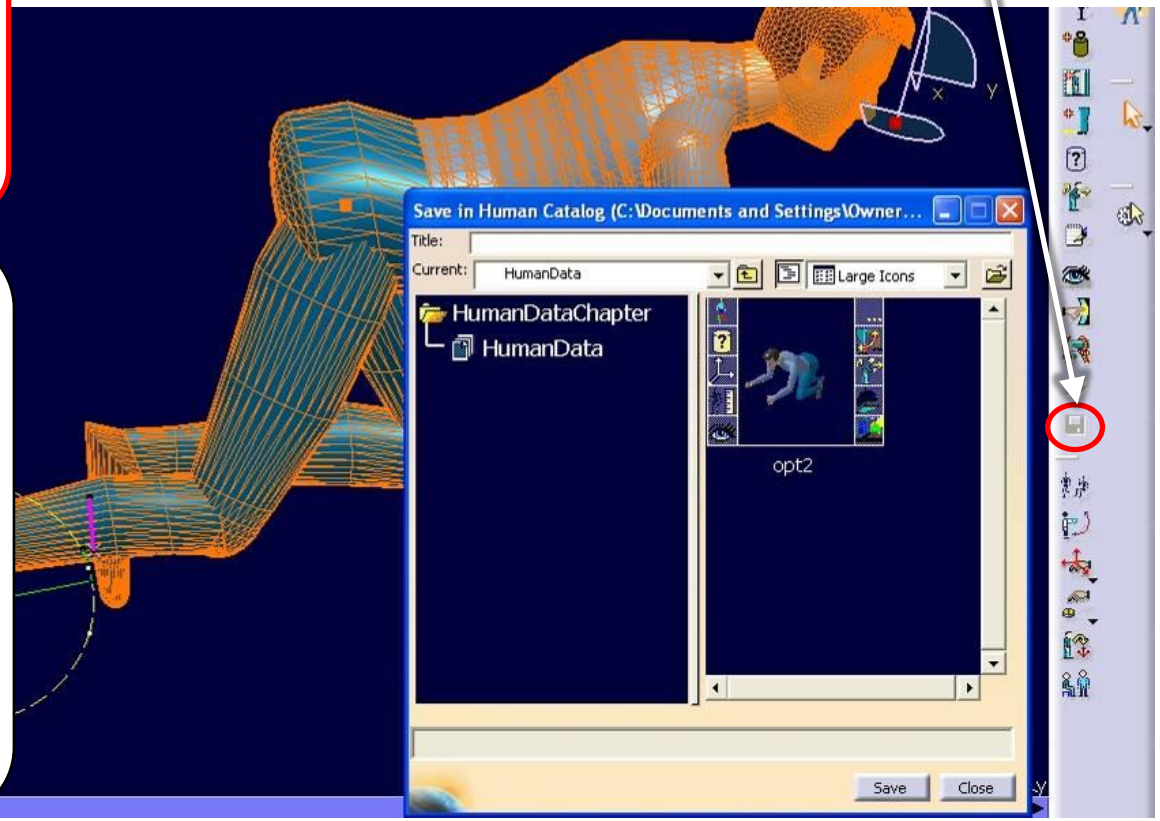
- A helpful tip at this point would be to Save a Manikin Profile in the desired position.

You MUST LOCK the DOF each time you read the Product!

If you save a Manikin profile after locking the DOFs, when that profile is loaded correctly, it maintains these locked DOFs



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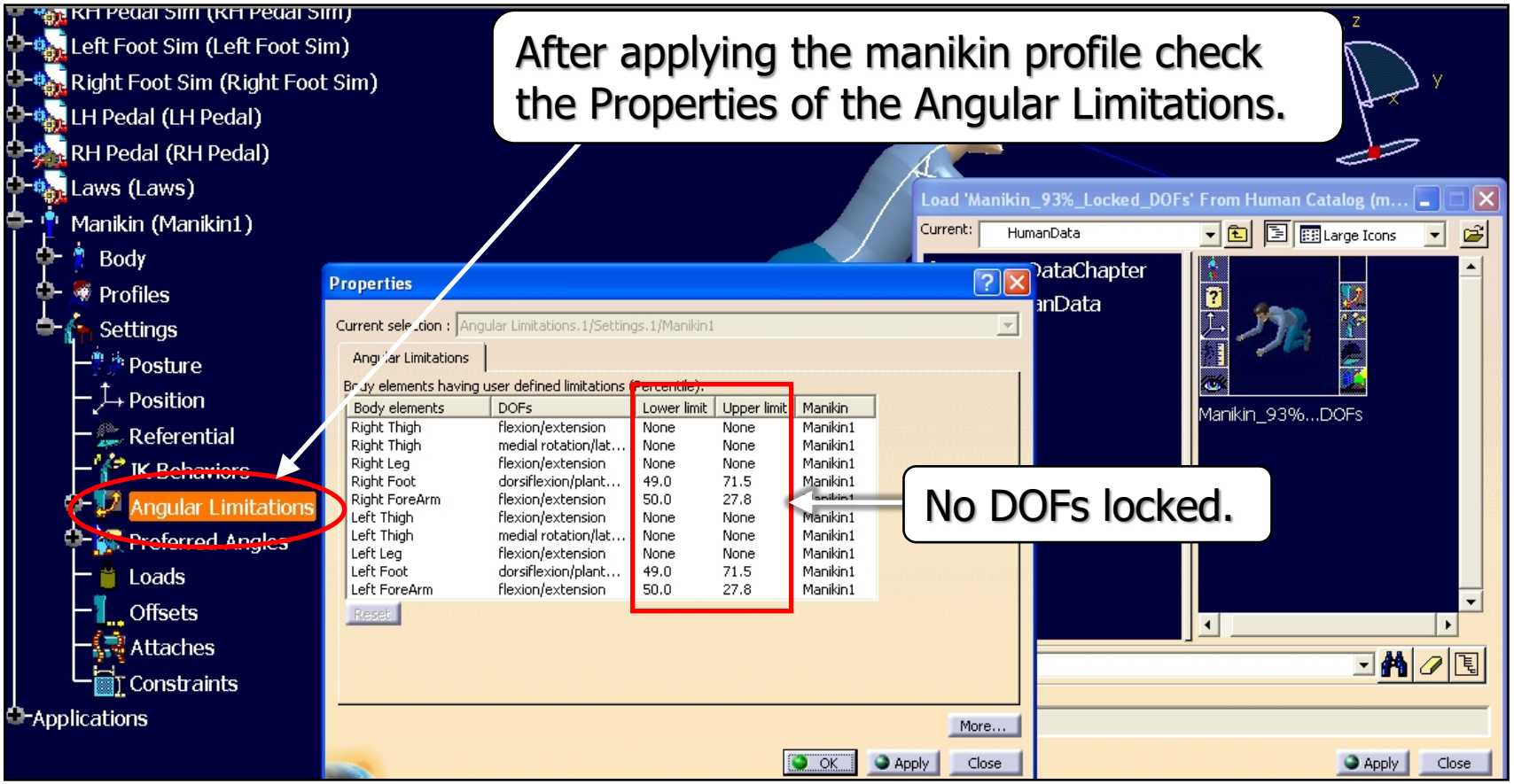
- More on Locked DOFs…



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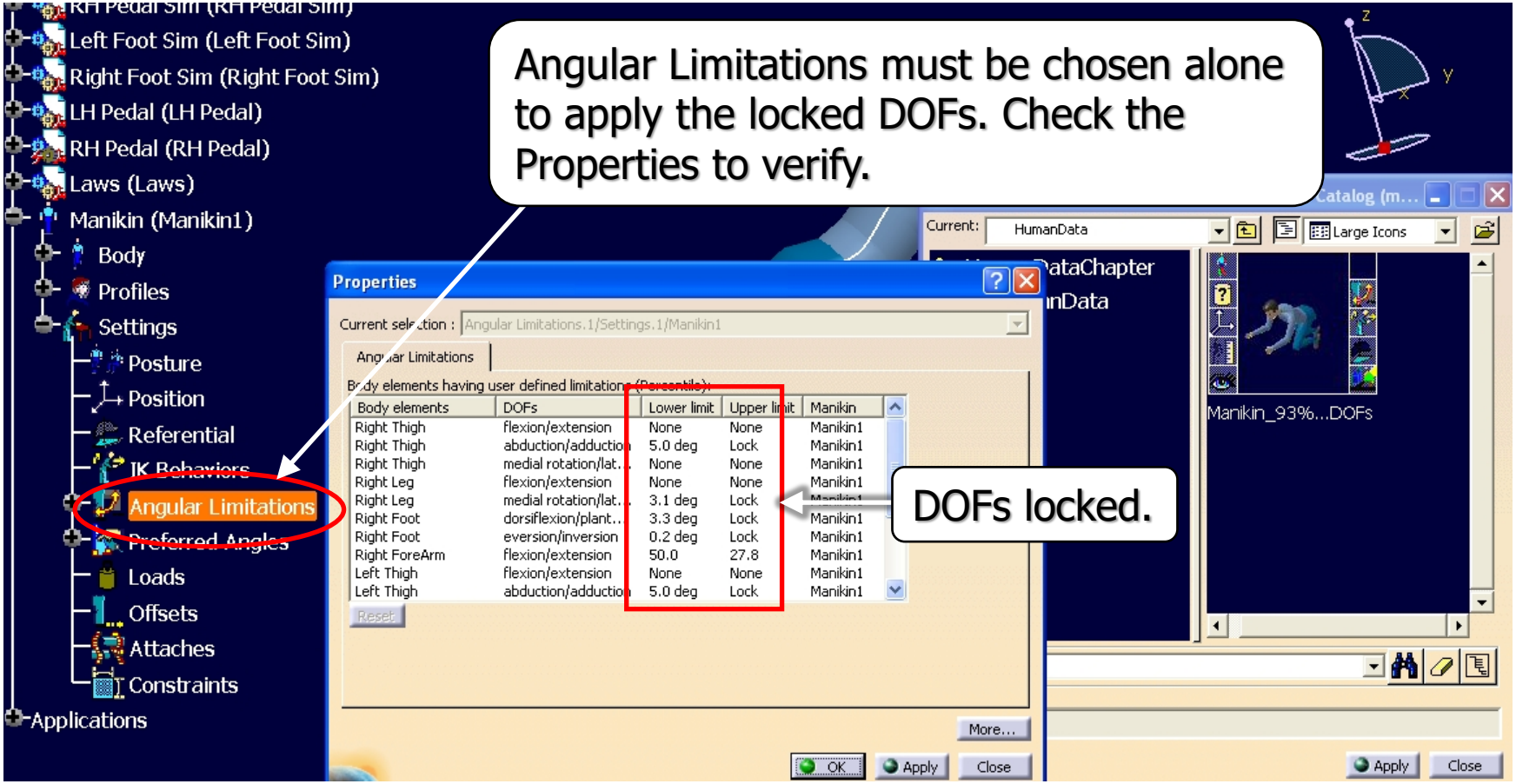
- More on Locked DOFs…



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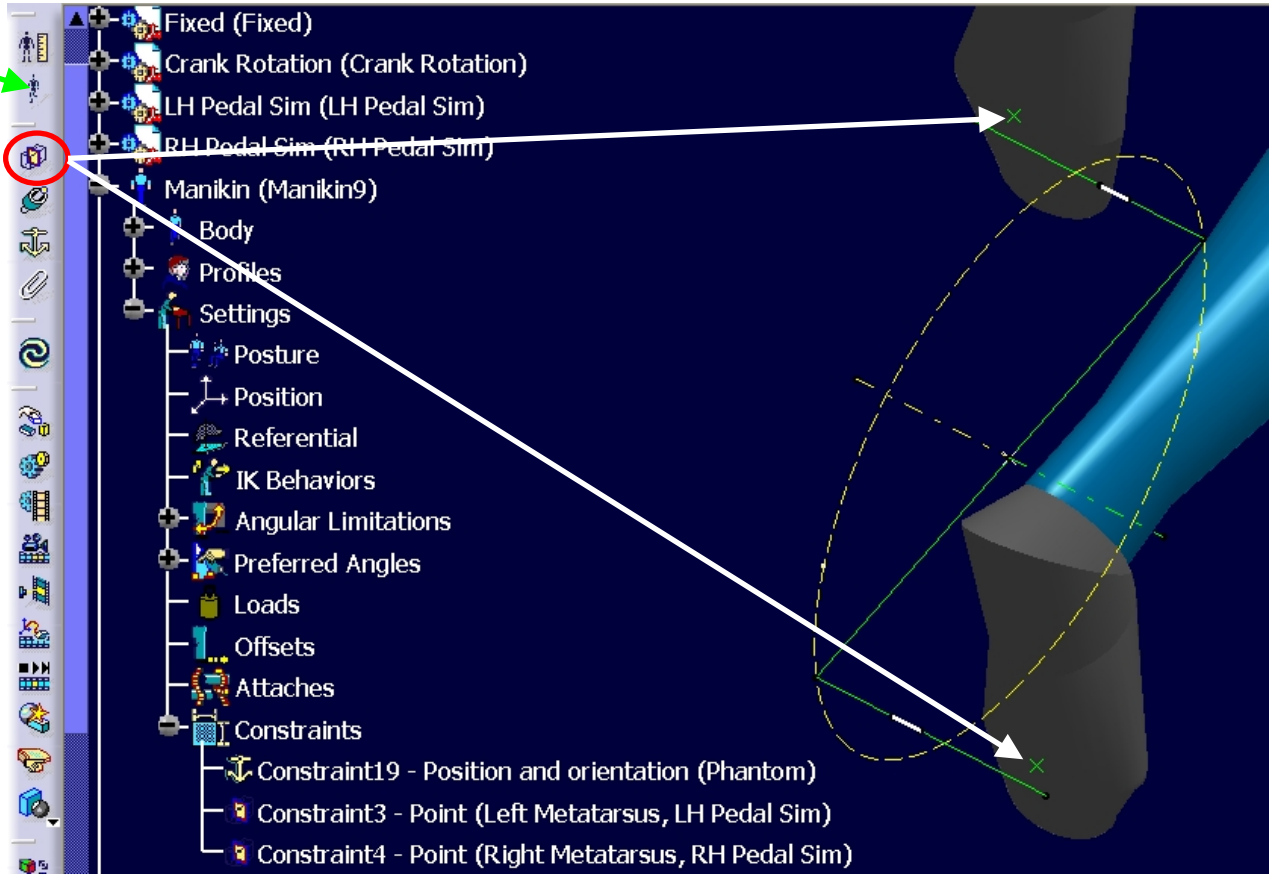
- Constrain the feet to the points in each Pedal Simulator Part (use Contact Constraint).

Human Posture Analysis



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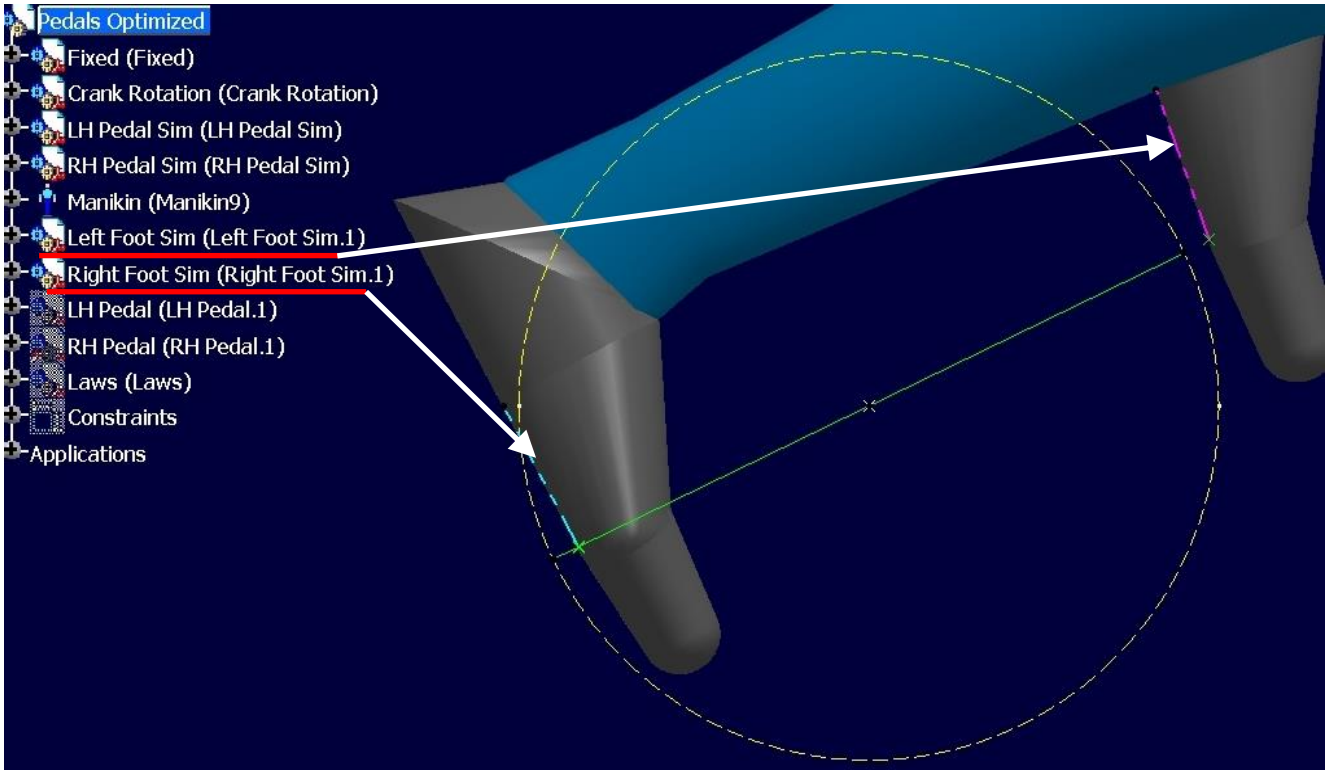
- Step 7: Create a line inside each Foot Simulator Part. This will be used later to measure the foot angle relative to the pedal.



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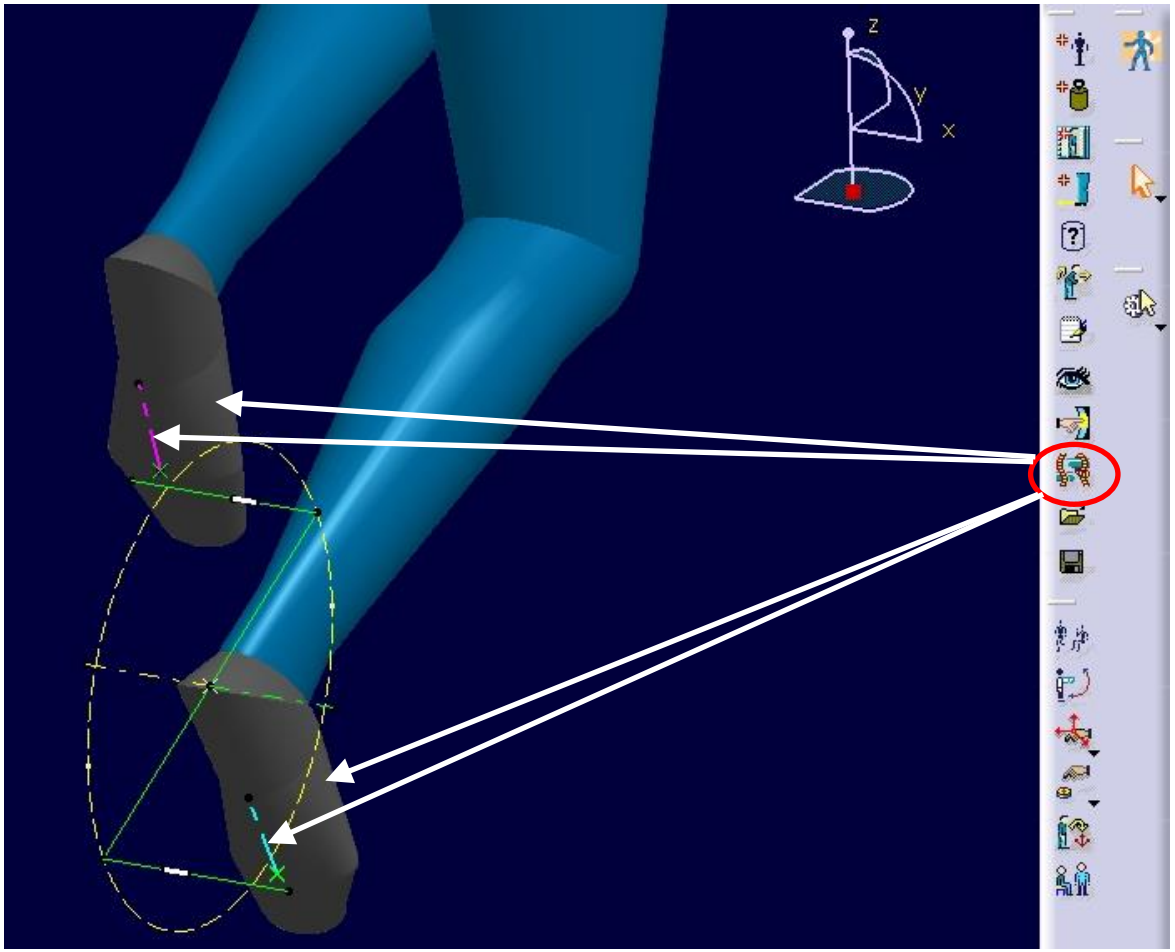
- Attach the Feet Simulator Parts to each foot.



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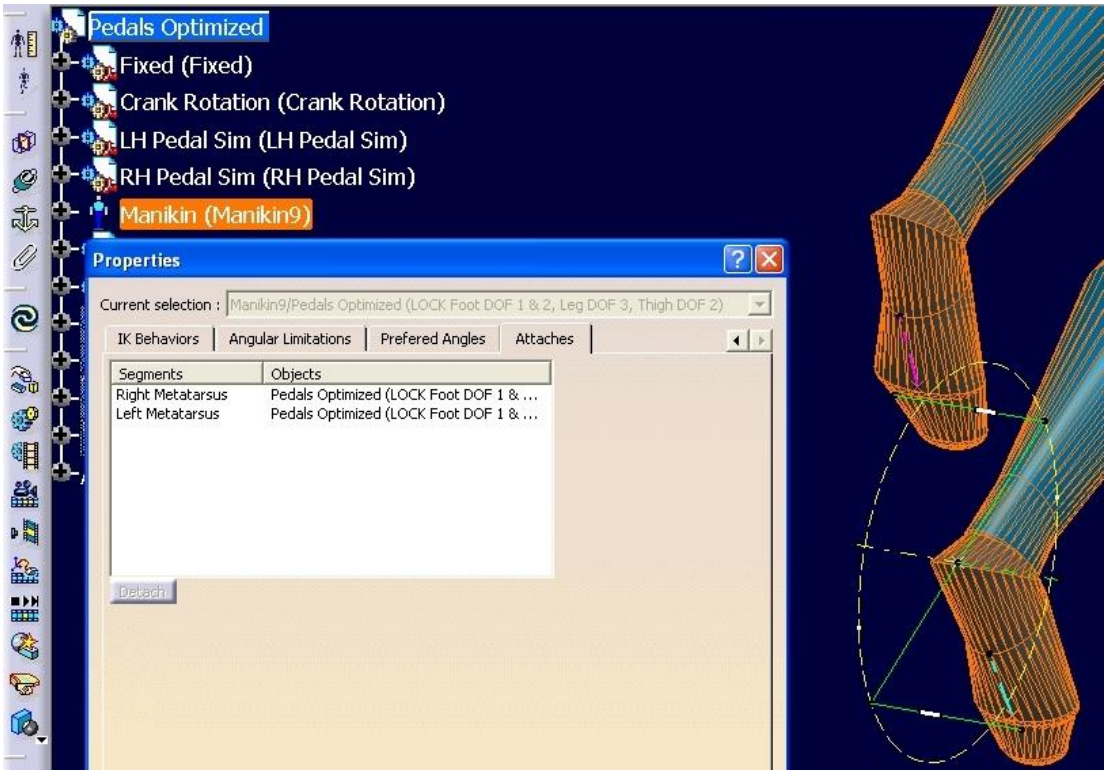
- Attaches to the Manikin can be verified by right-clicking the Part name from the tree, and open Properties.



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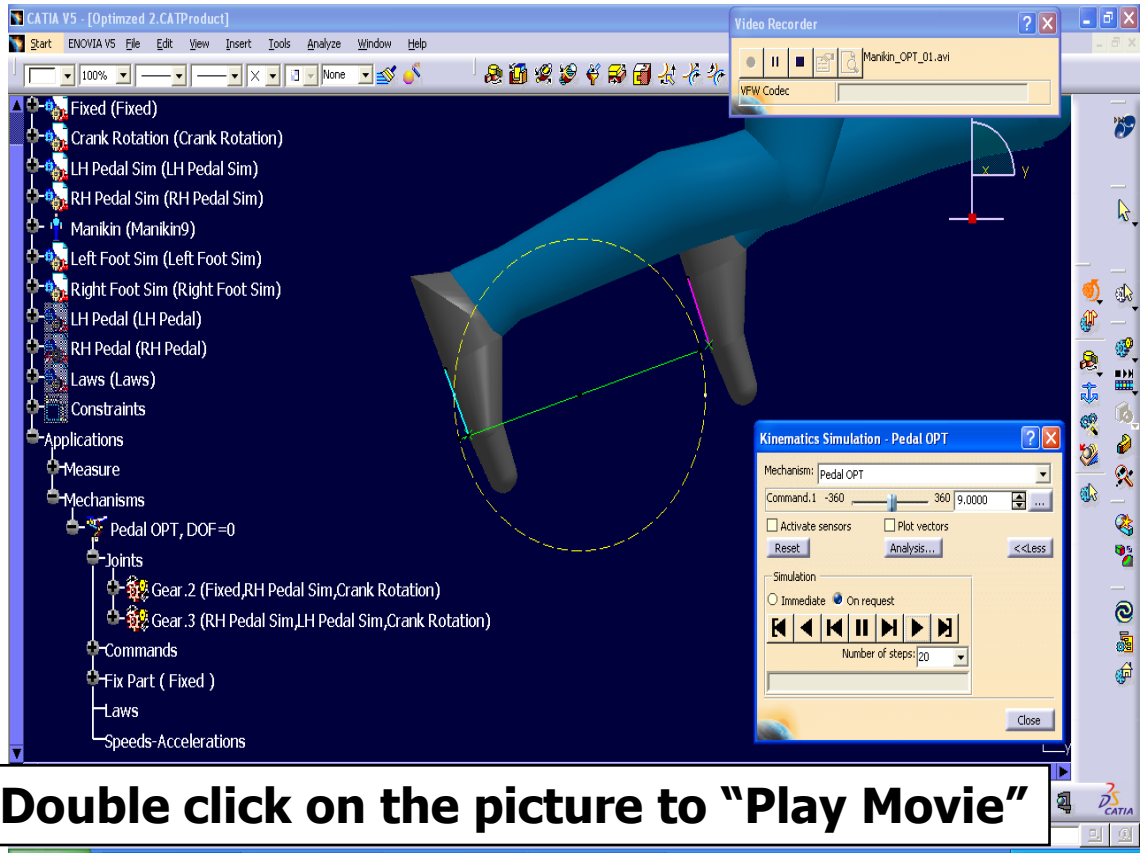
- Run a test using DMU Kinematics.



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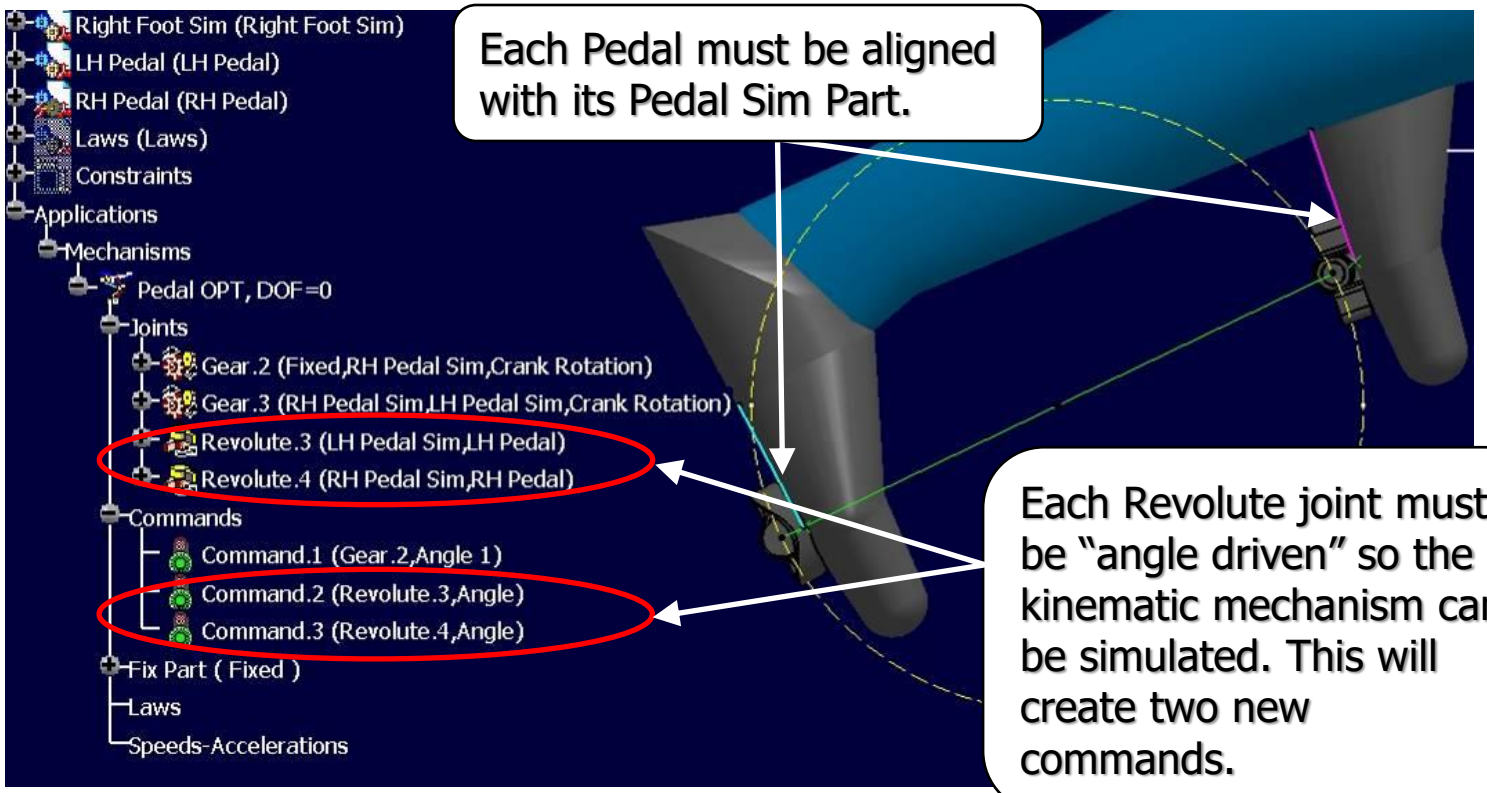
- Step 8: Load in the 3D Pedals. Create two Revolute joints between each Pedal and Pedal Simulator Parts.



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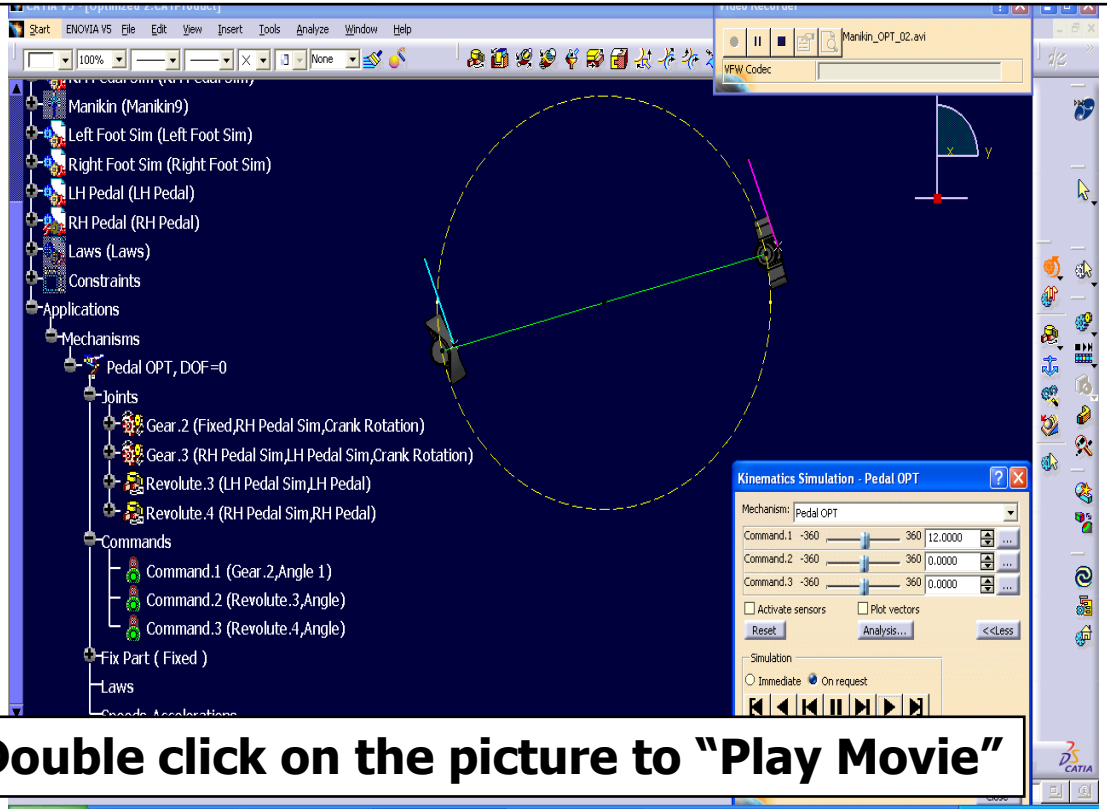
- Run a test using DMU Kinematics.

Run the simulation with a value only for Command 1. Notice the angular deviation between the Pedal an Pedal Sim Parts.



Double click on the picture to "Play Movie"

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- The Pedal Sim Parts are “attached” to the Manikin.
- The Manikin is constrained to the kinematic mechanism.
- This means the angular deviation due to the kinematic simulation occurs outside the kinematic mechanism.
- To correct this, we must measure the angular deviation and apply the measurement back into the kinematic mechanism.

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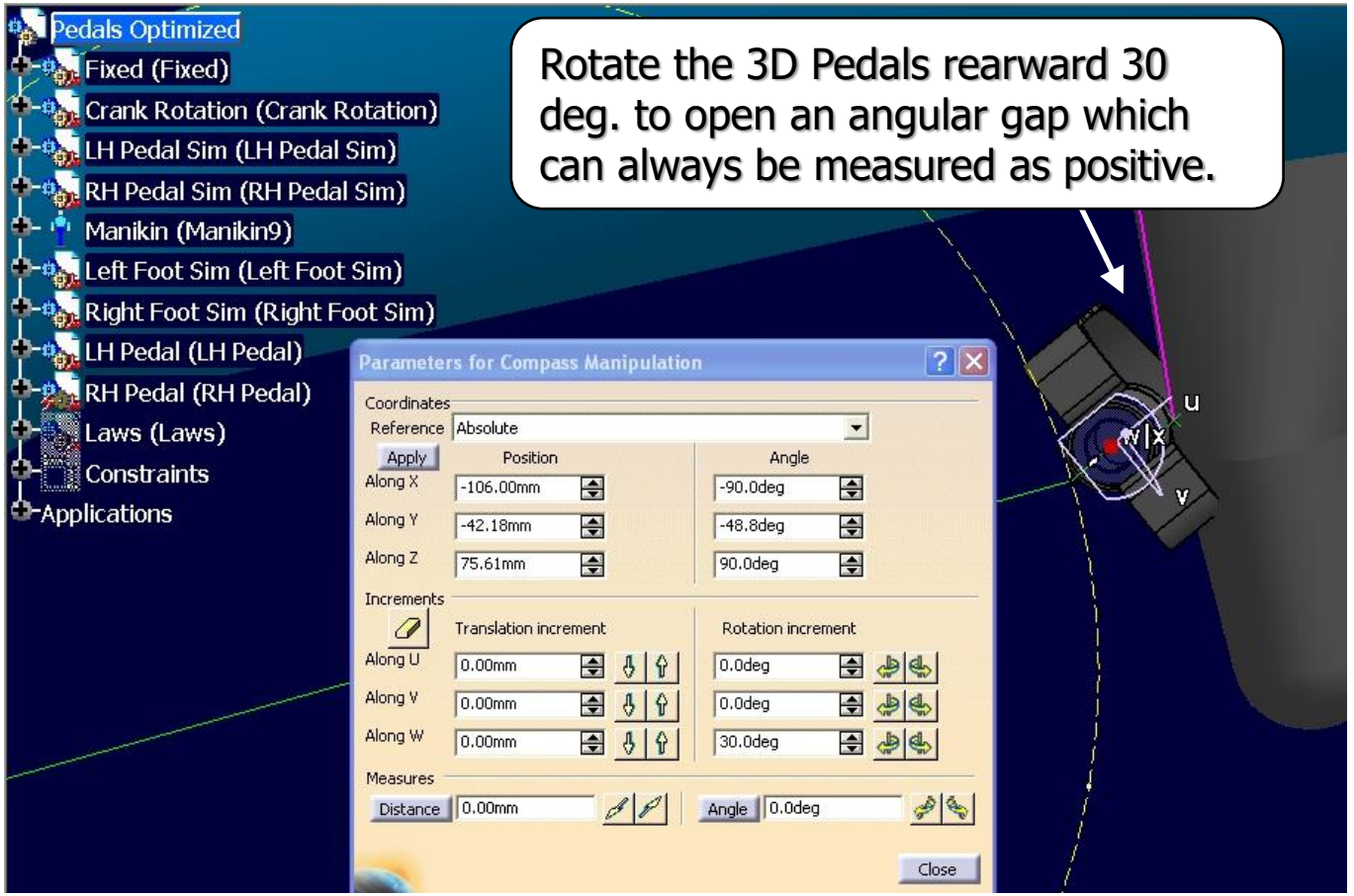
- Step 9: Measure the angular deviation.



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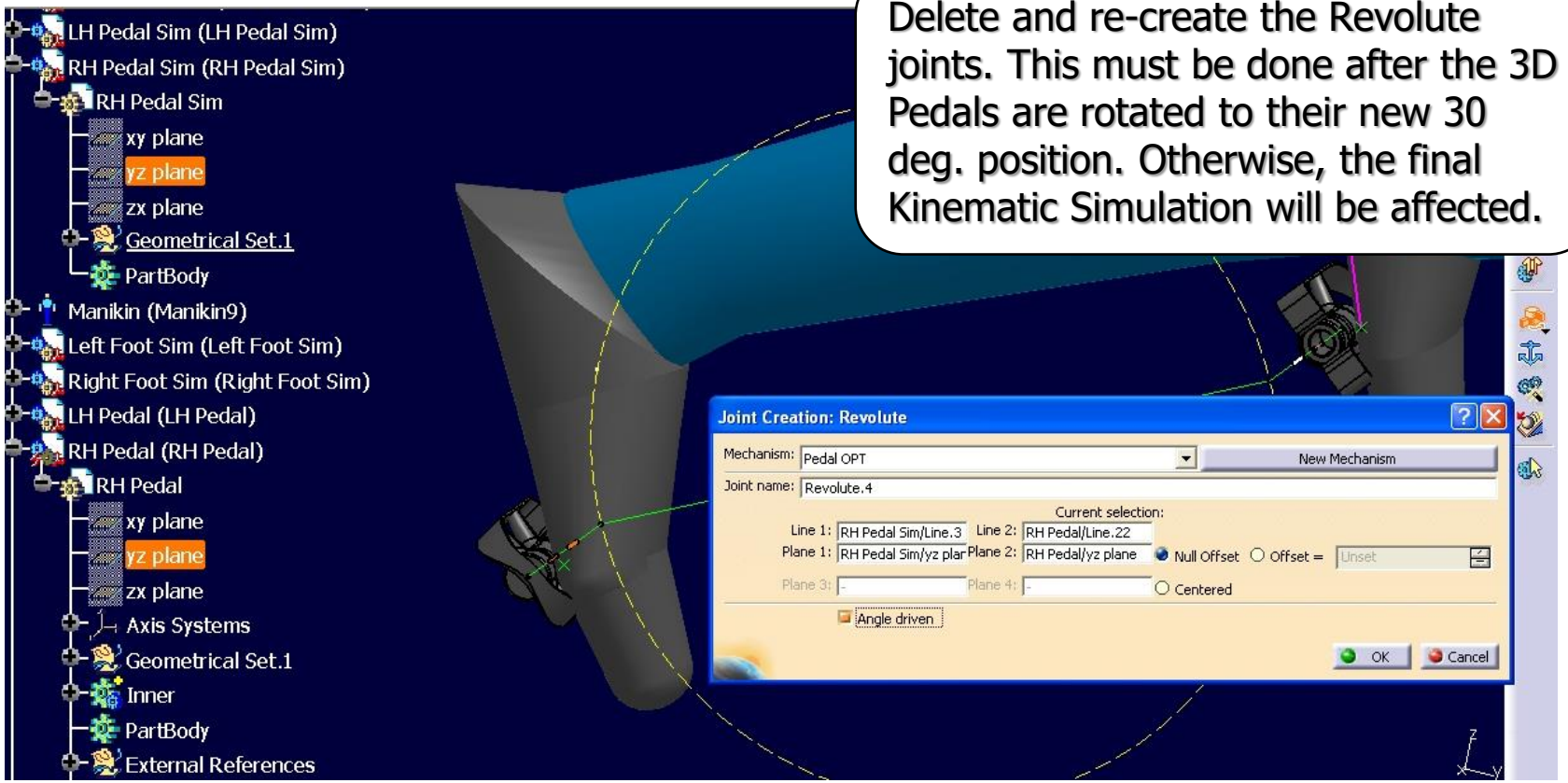
- Out with the old…In with the new.



Delete and re-create the Revolute joints. This must be done after the 3D Pedals are rotated to their new 30 deg. position. Otherwise, the final Kinematic Simulation will be affected.

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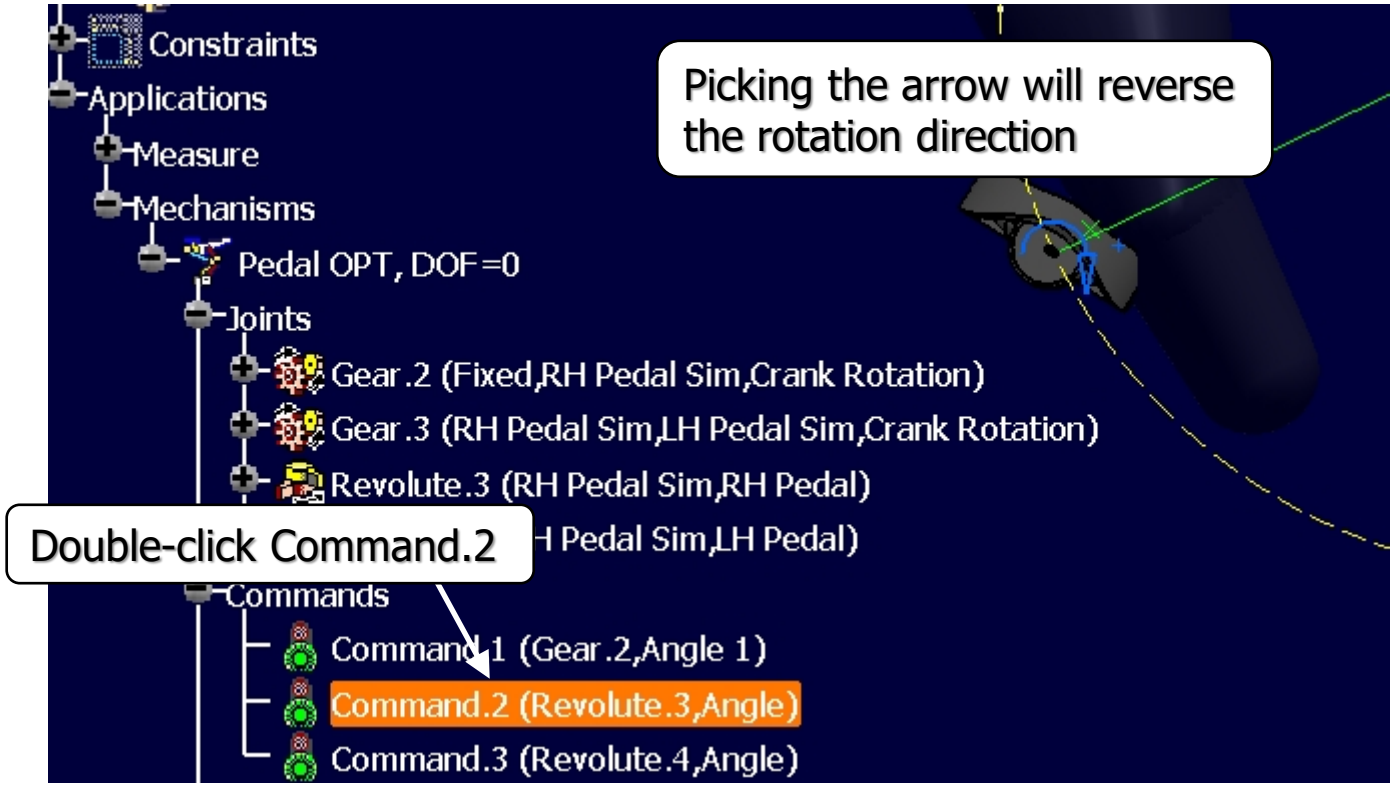
- Ensure the Pedal rotation direction is correct.



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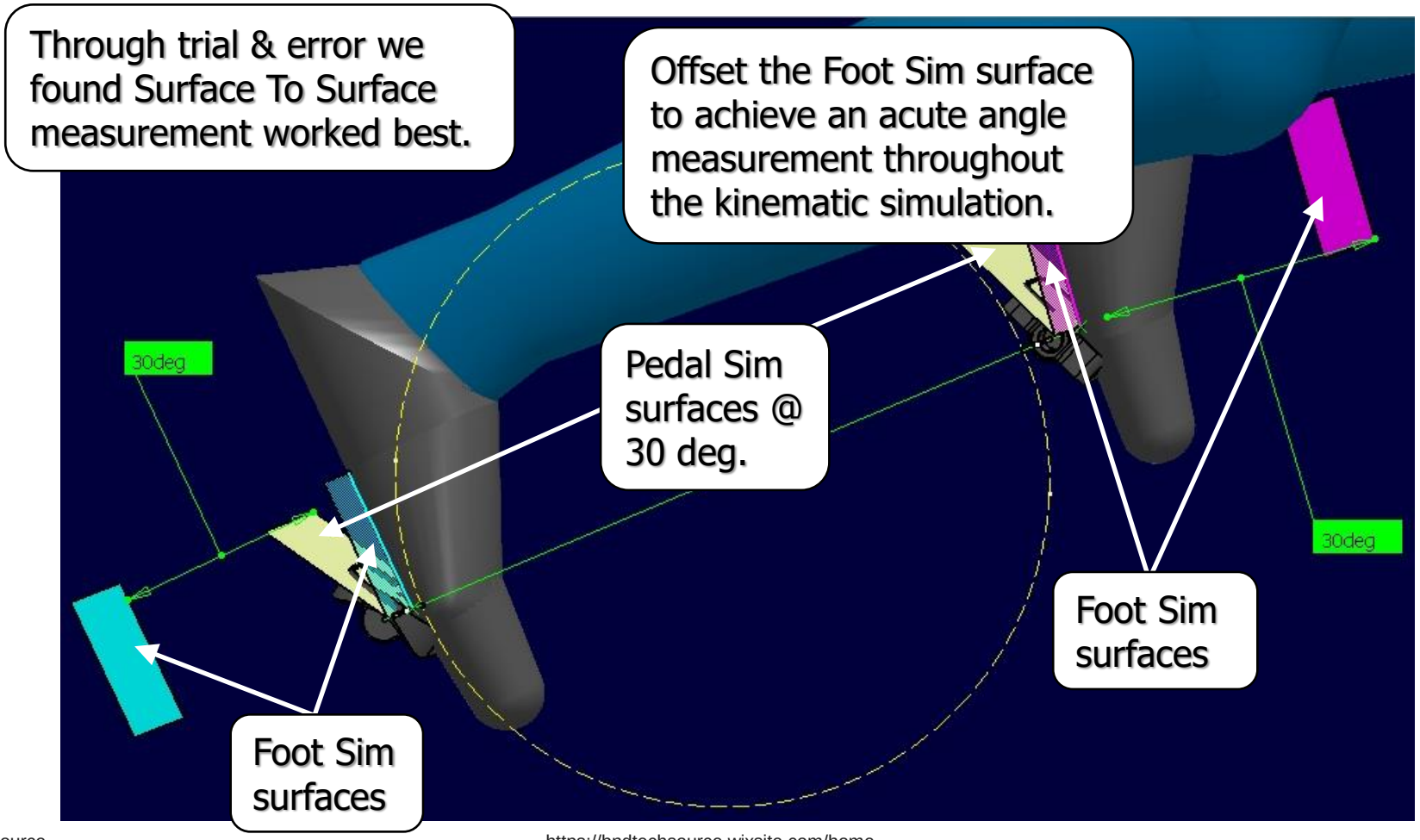
- Create Surfaces to measure between.



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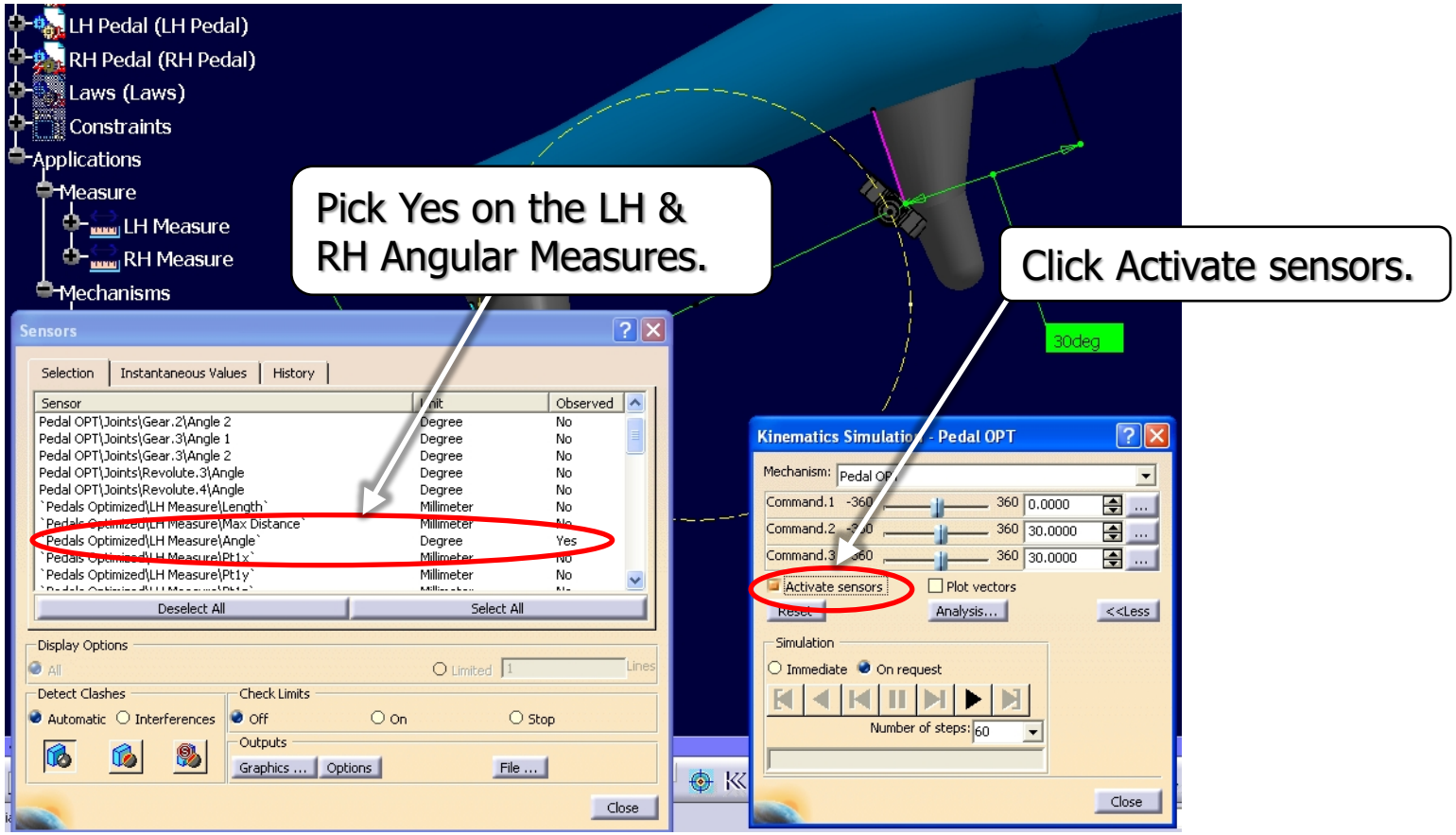
- Prepare the test using DMU Kinematics.



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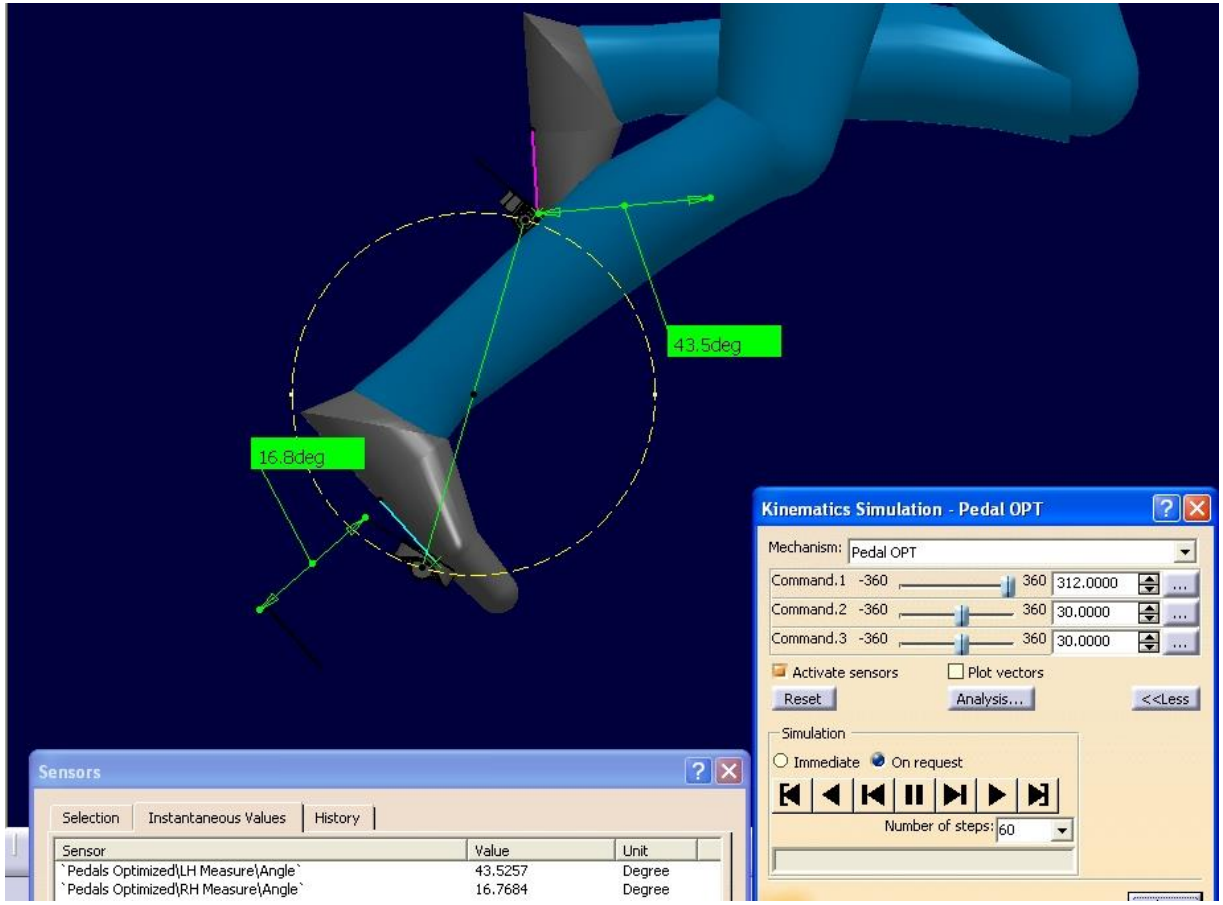
- Run a test using DMU Kinematics.



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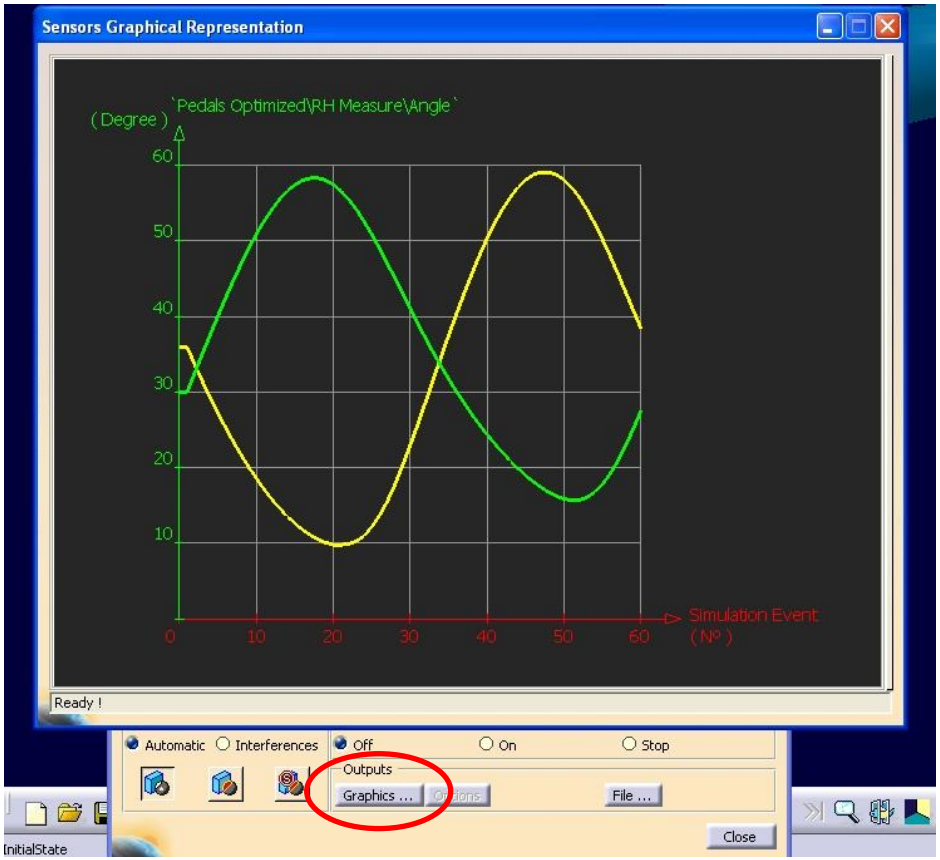
- The graphic results show measurement output as acute angles.



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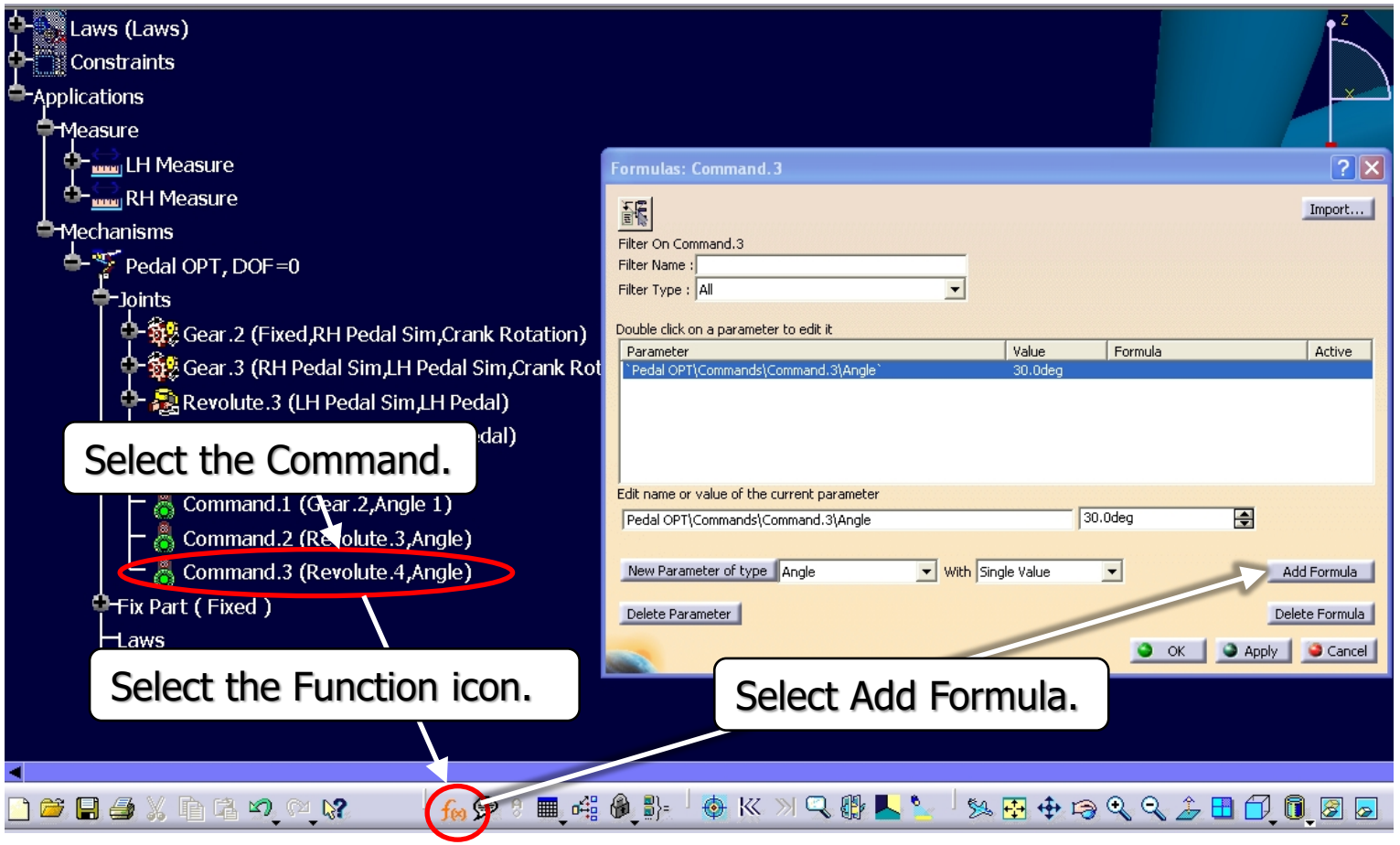
- Step 10: Set up Functions for the Commands.



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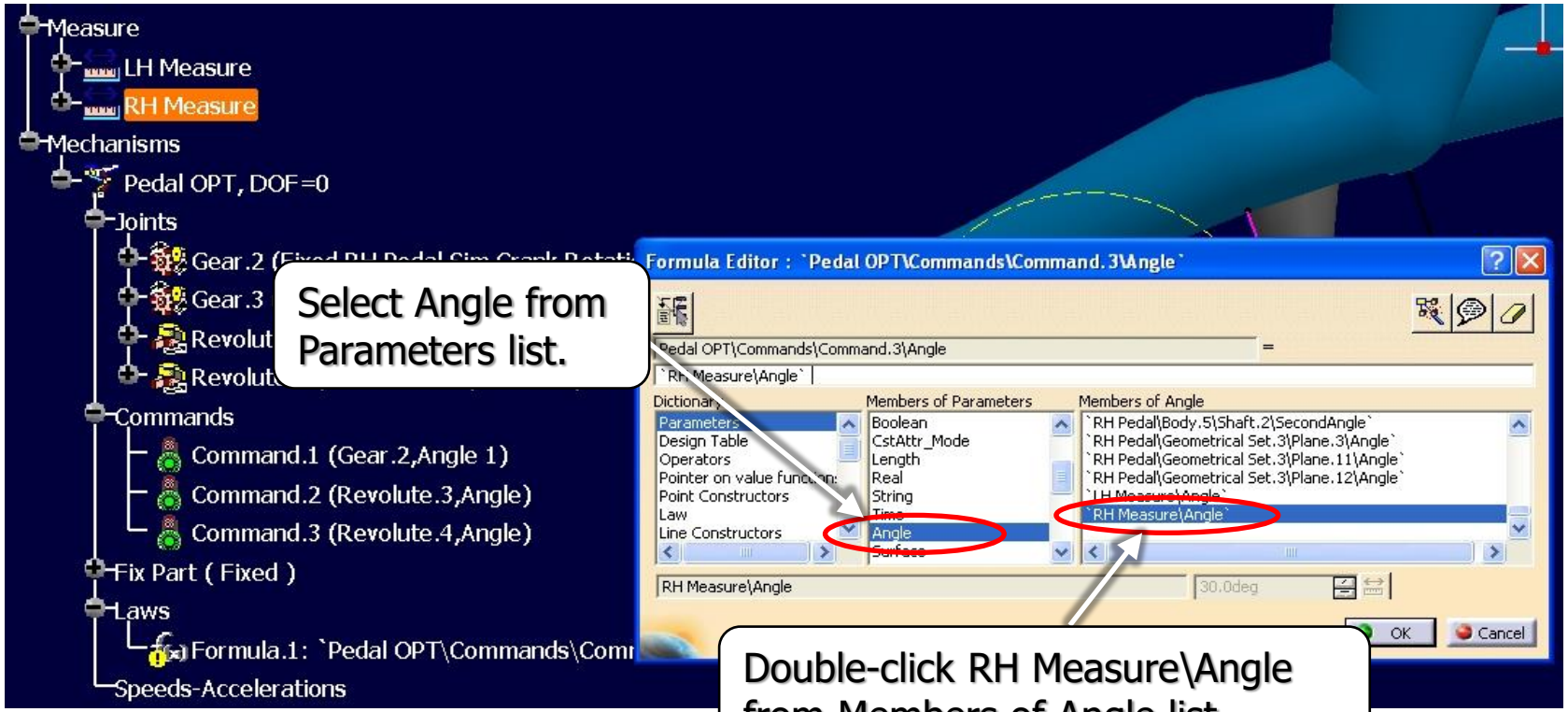
- Setting up the Functions (RH shown, repeat for LH).



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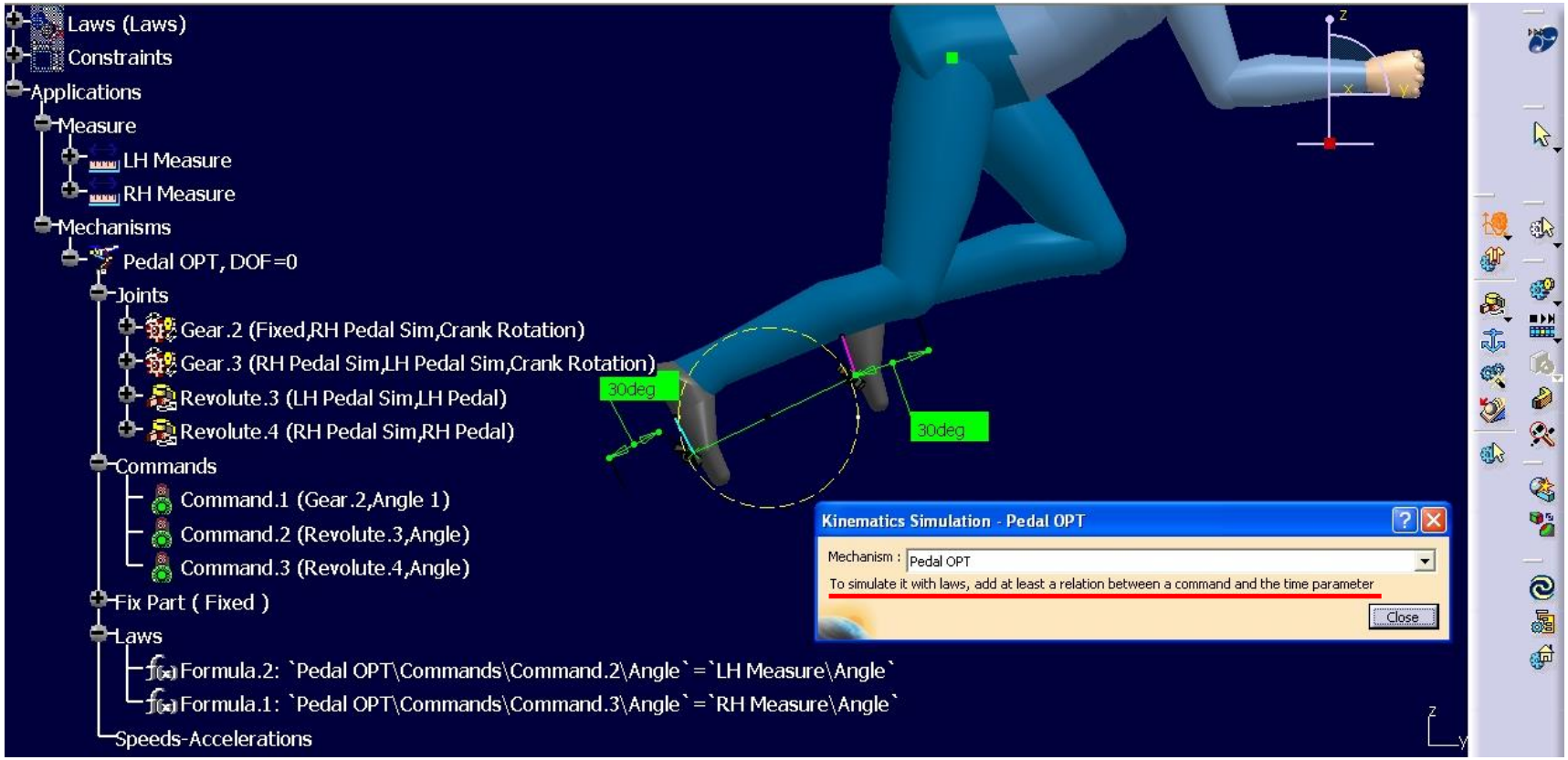
- To run a kinematic simulation with Laws, there must be a Law created relative to time.



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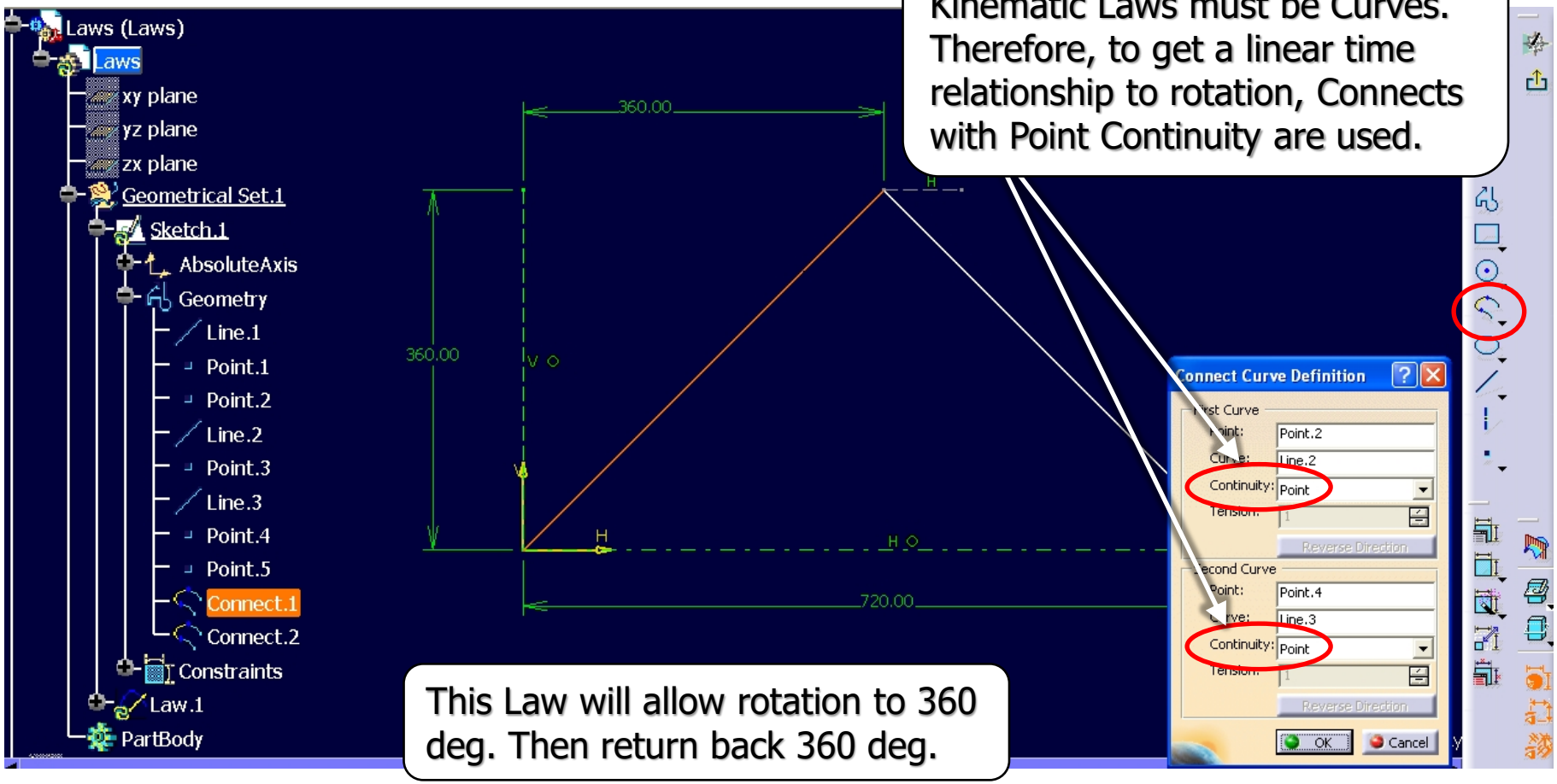
- Create a Time Law.



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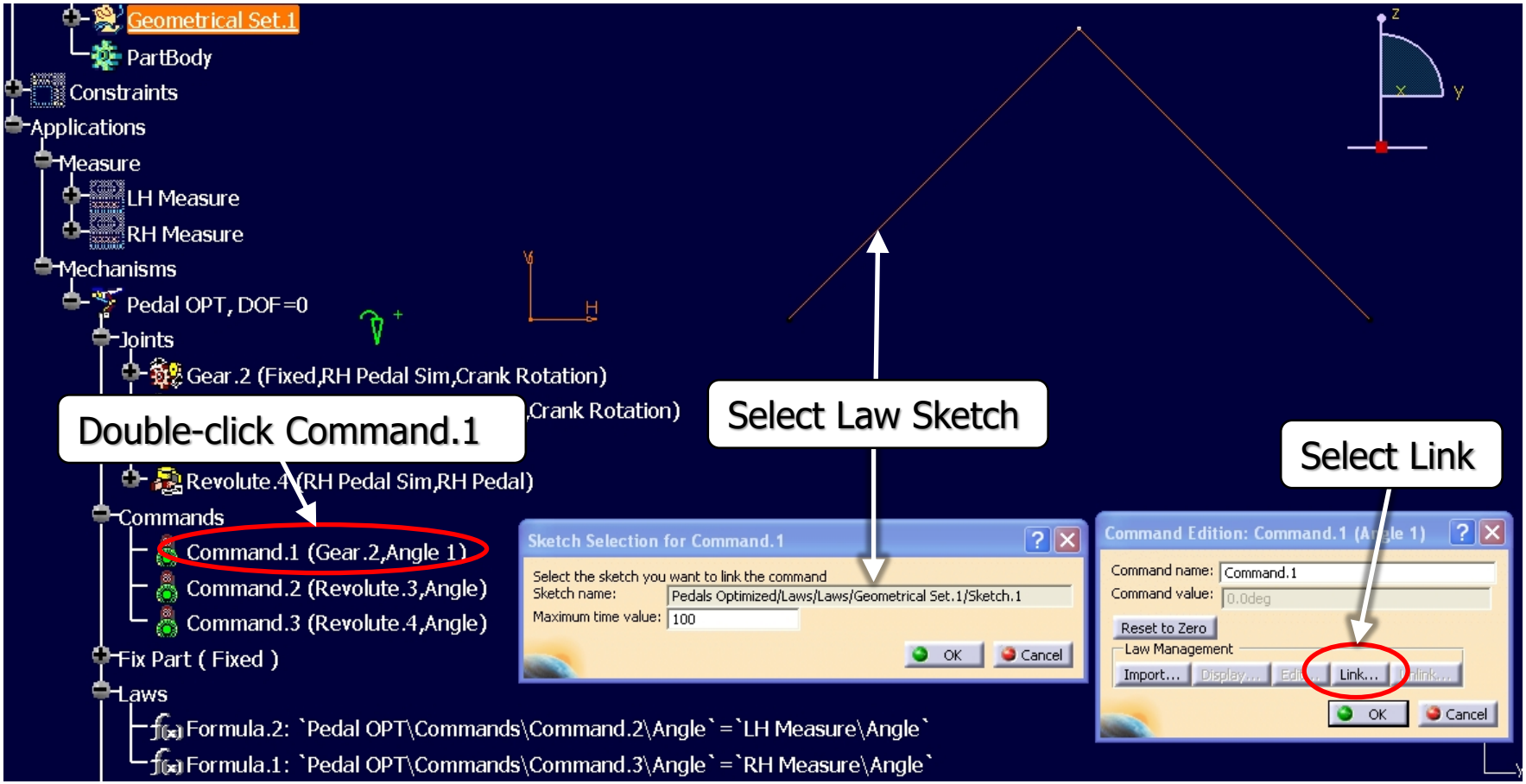
- Apply the time Law to Command.1



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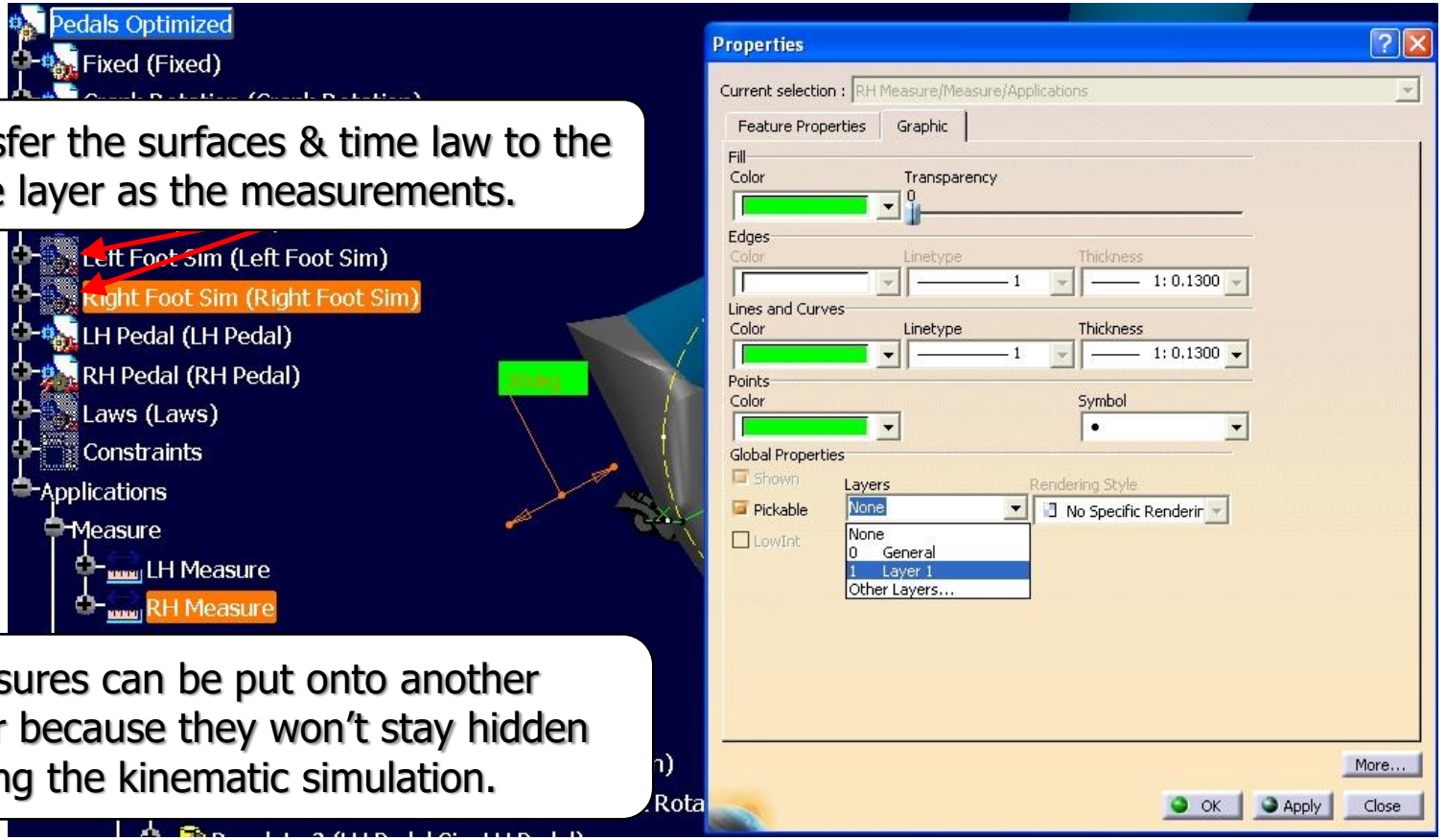
- Step 11: Clean up the appearance.



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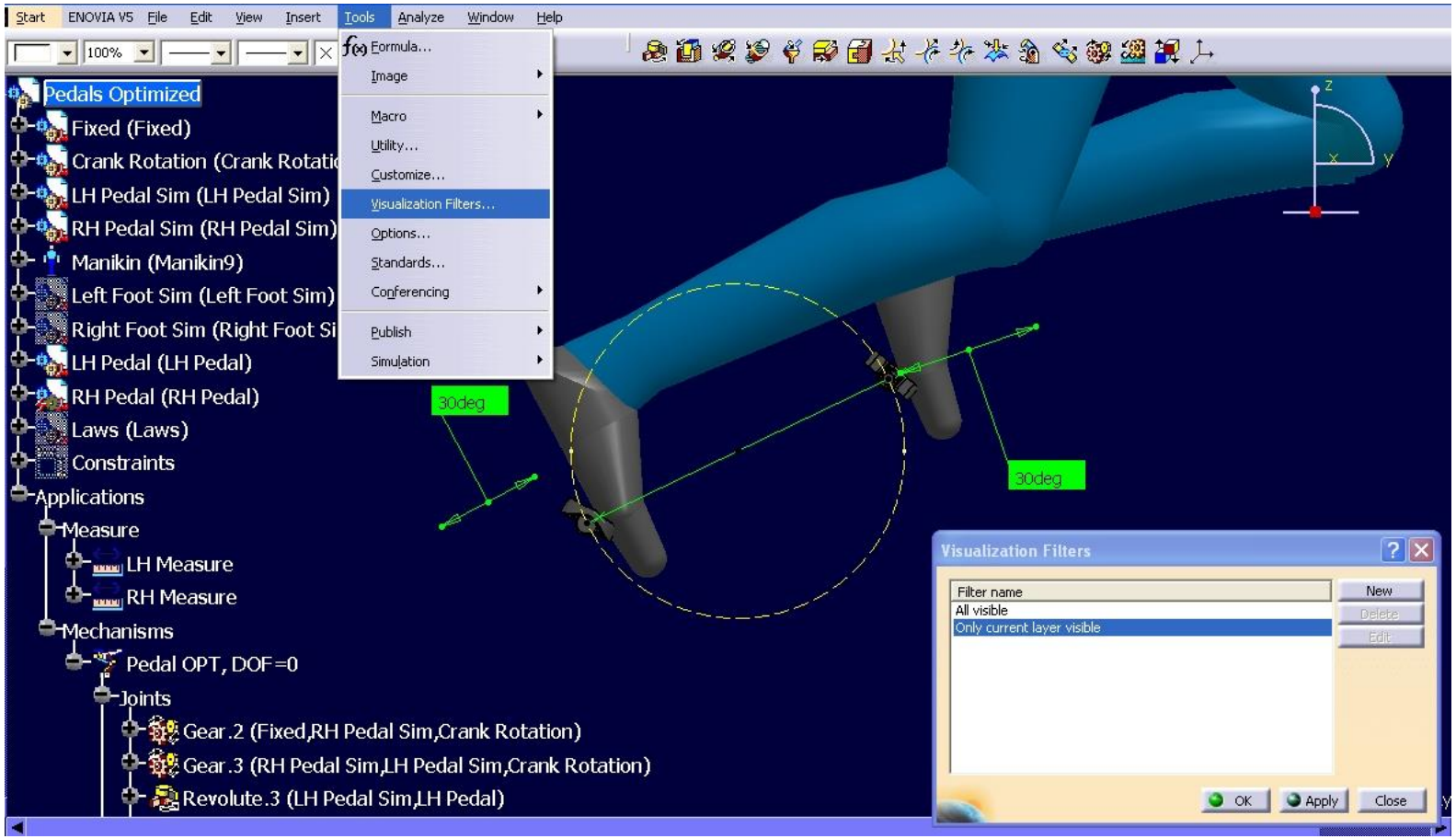
- Apply a Filter for the Kinematic simulation.



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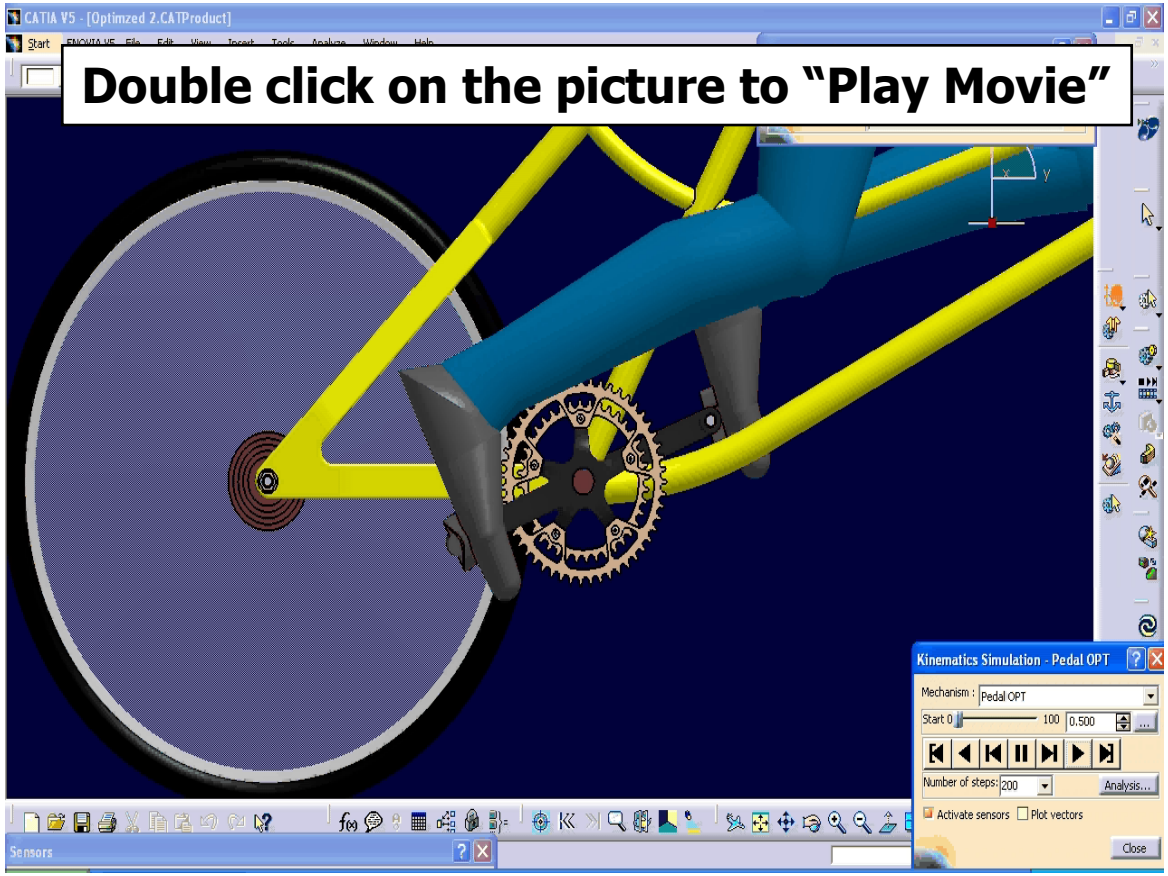
- Run the DMU Kinematic Simulation with Laws.



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- Conclusion:

  This is an example of how to use CATIA DMU Kinematics along with Ergonomic Design & Analysis to simulate a 3D Manikin pedaling a bicycle.

  We hope this will help those who need this type of simulation.

  As always, we are open to any discussions this may bring.

  Please ***subscribe*** to our YouTube channel!