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# Interact with Speciknee: A Software Tool for Design of Simple Four-bar Prosthetic Knee Joints

Thomas J. Thompson  
Cedarville University, [thompson@cedarville.edu](mailto:thompson@cedarville.edu)

Erkai L. Watson  
Cedarville University, [ewatson@cedarville.edu](mailto:ewatson@cedarville.edu)

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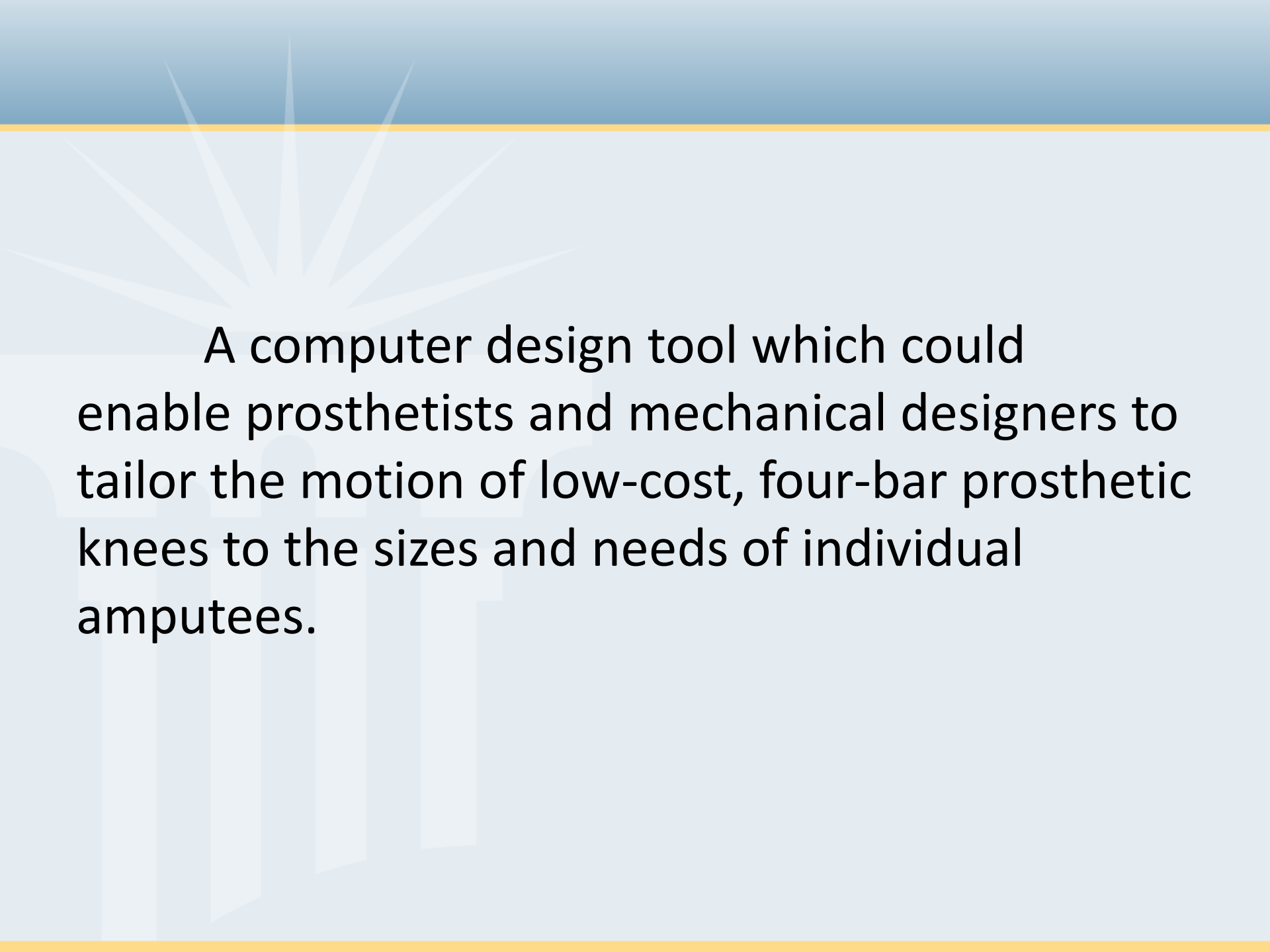
Thompson, Thomas J. and Watson, Erkai L., "Interact with Speciknee: A Software Tool for Design of Simple Four-bar Prosthetic Knee Joints" (2014). *The Research and Scholarship Symposium*. 24.  
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# **Interact with Speciknee: a software tool for design of simple four-bar prosthetic knee joints**

2014 Cedarville Research and  
Scholarship Symposium

Thomas Thompson and Er kai Watson  
Cedarville University  
April 16, 2014



A computer design tool which could enable prosthetists and mechanical designers to tailor the motion of low-cost, four-bar prosthetic knees to the sizes and needs of individual amputees.

# Intent: Possibly work with LIMBS International

<http://limbsinternational.org/>

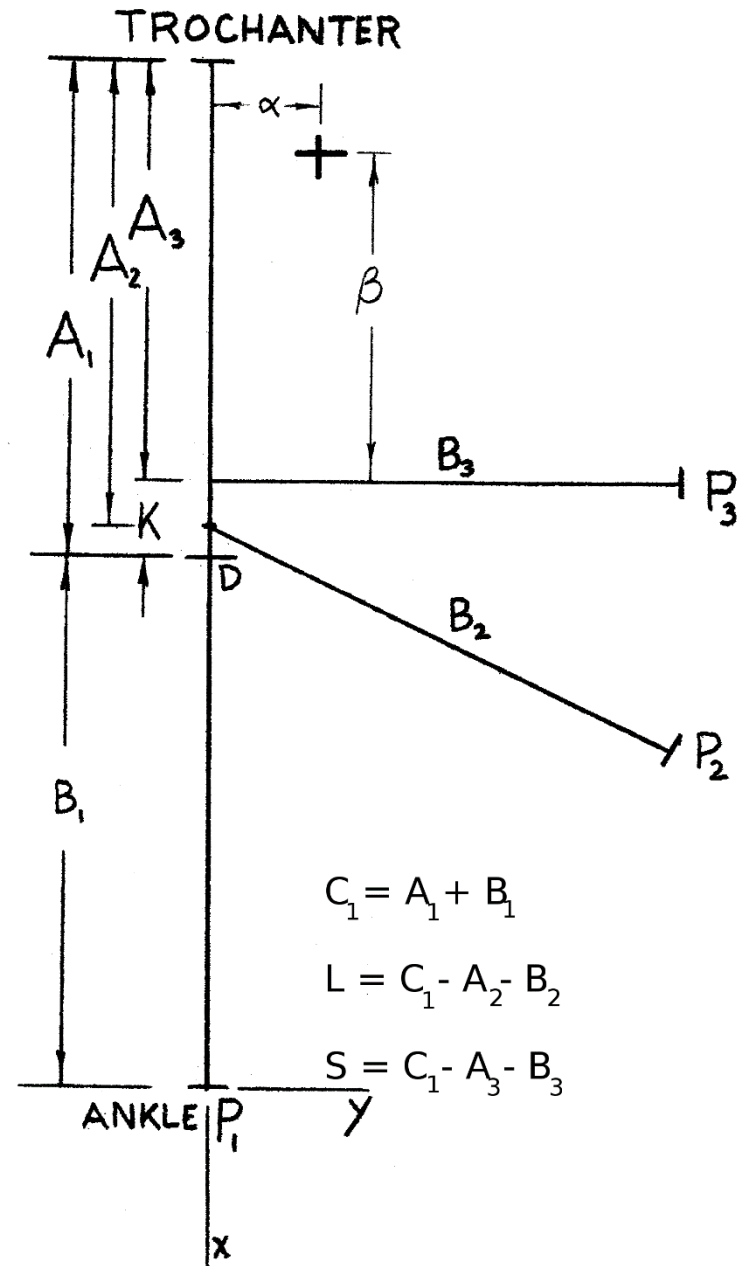
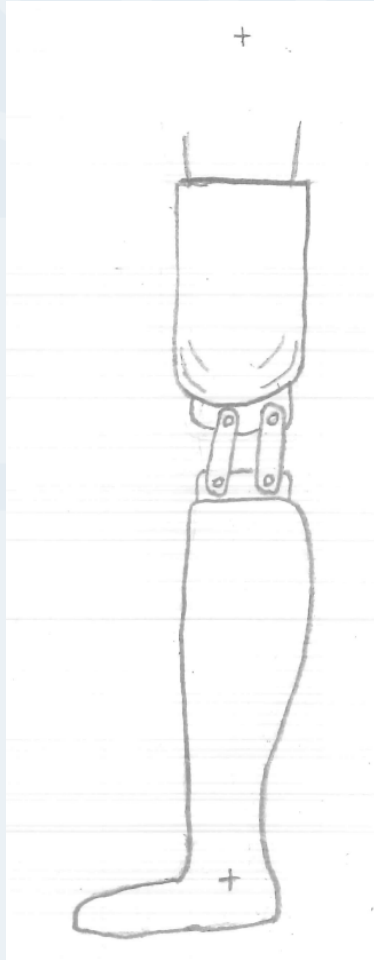


**Learning for LIMBS** *expand to learn more*

**Design, Create, Test and Train**  
**Highly Functional Low Cost Artificial Limbs**

The image shows a banner for LIMBS International. At the top, there is a dark blue rounded rectangle containing a white globe icon on the left and the text "Learning for LIMBS" in white, followed by "expand to learn more" in a smaller, italicized white font. Below this is a photograph of three men sitting on a grassy area. The man in the center is a white man with a beard, wearing a dark blue button-down shirt and khaki pants, with his arms around the shoulders of the two men on either side. The man on the left is a Black man wearing a red and grey t-shirt and a prosthetic left leg. The man on the right is a Black man wearing a dark t-shirt with "THE POINTERS" and "SWEAT" printed on it, and a prosthetic left leg. In the background, there is a building with a stone wall and a blue door, and some trees. The banner has navigation arrows on the left and right sides of the photo area.

# Knee Prosthesis Nomenclature



# Try It Yourself!

The image shows a software window titled "specikneer04bcedarville". The main area is a plot with axes from 0 to 1. The plot is currently empty, with the text "Cedarville campus check OK." displayed in the lower-left corner. To the right of the plot is a control panel titled "Speciknee".

**Input Values**

C	85	Input from File
A1	35	Save to File
A2	34	
K	0.0	Redraw
L	1.4	
S	3.5	Plot Curves
alpha	2.6	
beta	-0.2	Clear

**Select Pivot Locations**

<input checked="" type="checkbox"/> Fixed	<input checked="" type="checkbox"/> Moving
Dyad 1 Pivot	Dyad 2 Pivot
Fixed (black)	Fixed (black)
or	or
Moving (red)	Moving (red)
Plot Mechanism	

**Animate**

Animate

**Record**

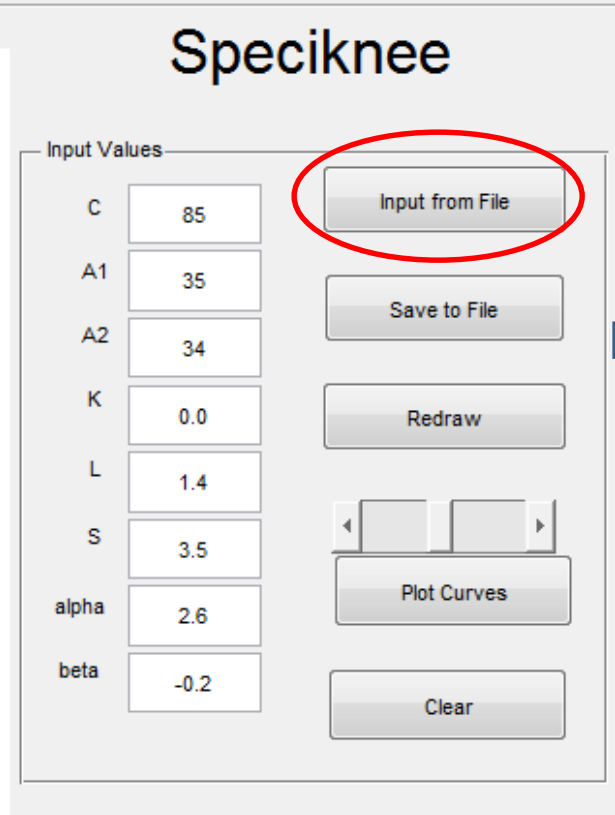
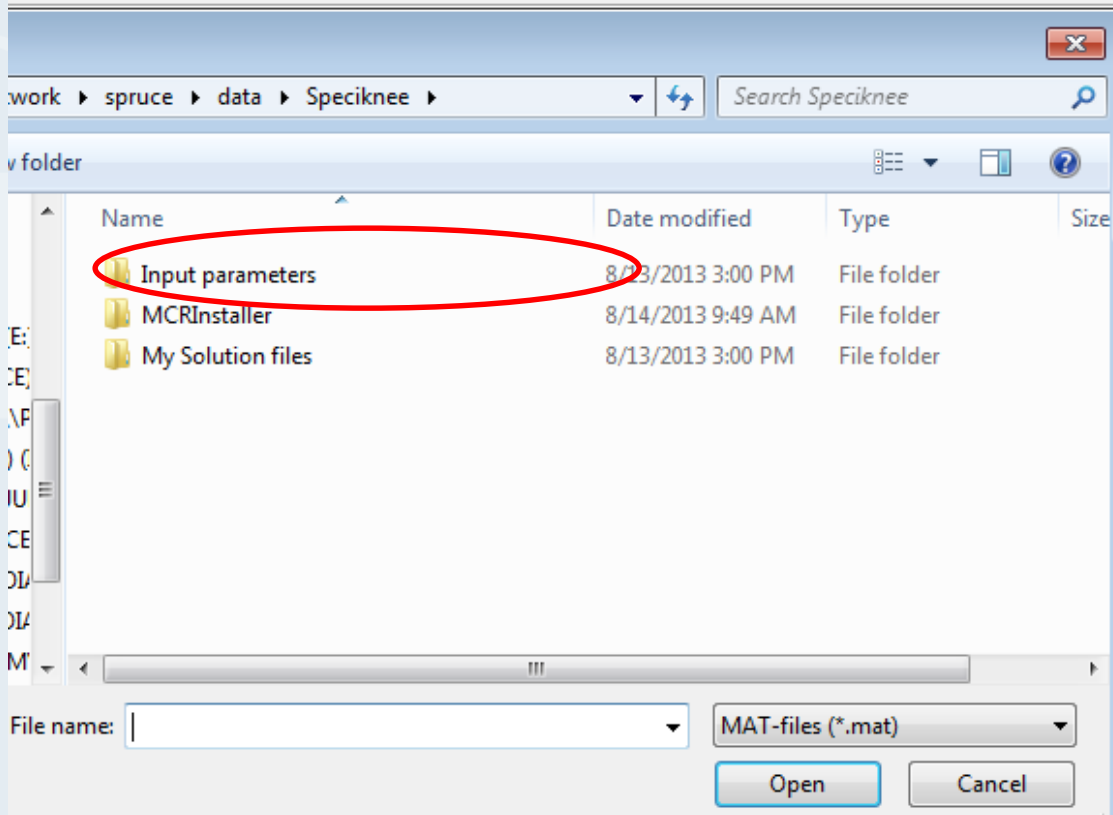
Save Linkage Specifications

Save Solution to File

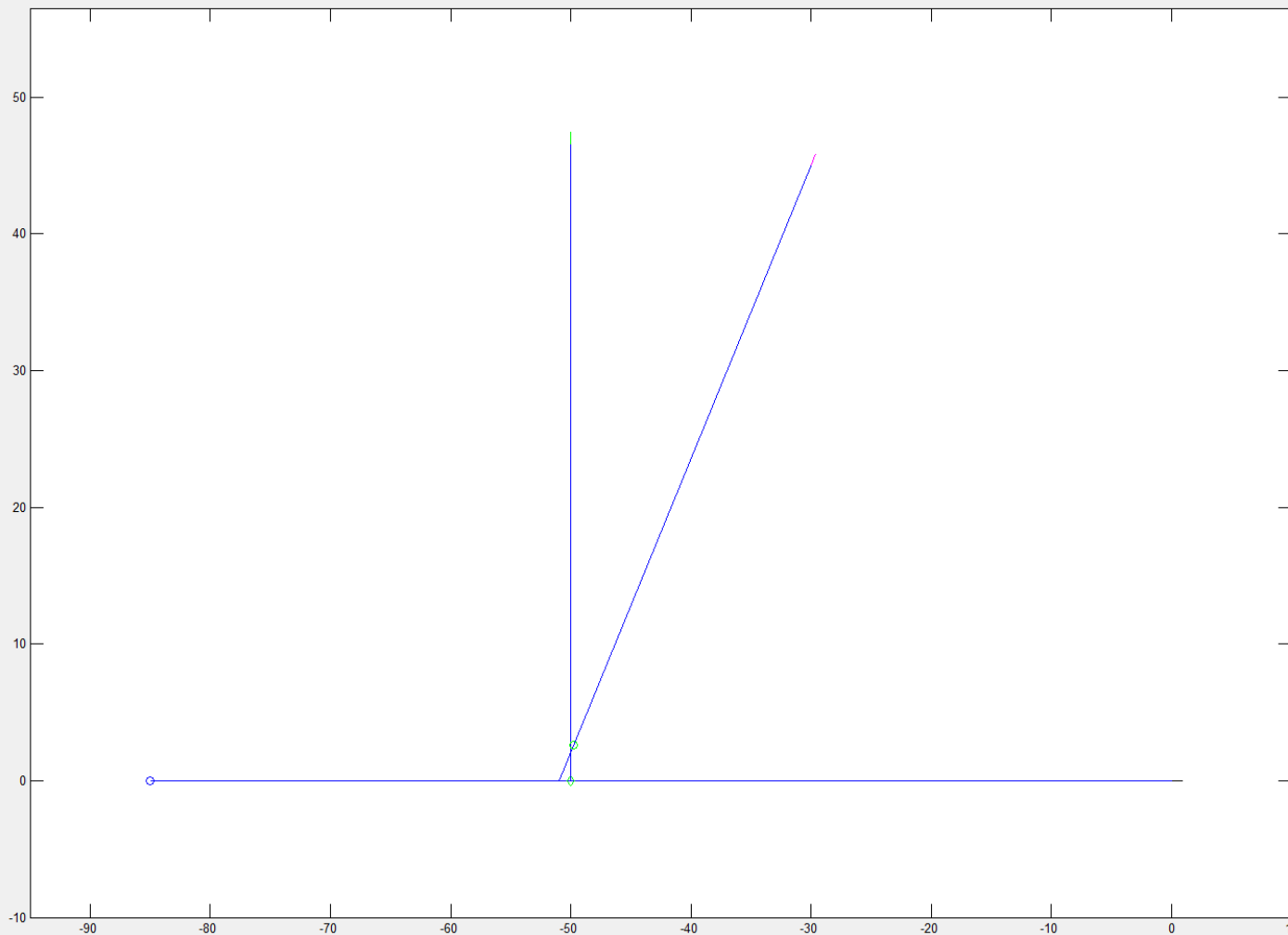
Load Solution

A blue arrow points from the right side of the control panel towards the right edge of the image.

# Upload Classic Parameter Sets (input from file), Define Your Own, or Use Defaults



# Redraw to Show Positions



### Speciknee

Input Values

C	85	Input from File
A1	35	Save to File
A2	34	<b>Redraw</b>
K	0.0	
L	1.4	
S	3.5	
alpha	2.6	Plot Curves
beta	-0.2	Clear

Select Pivot Locations

<input checked="" type="checkbox"/> Fixed	<input checked="" type="checkbox"/> Moving
Dyad 1 Pivot	Dyad 2 Pivot
Fixed (black)	Fixed (black)
or	or
Moving (red)	Moving (red)
Plot Mechanism	

Animate

Animate

Record

Save Linkage Specifications

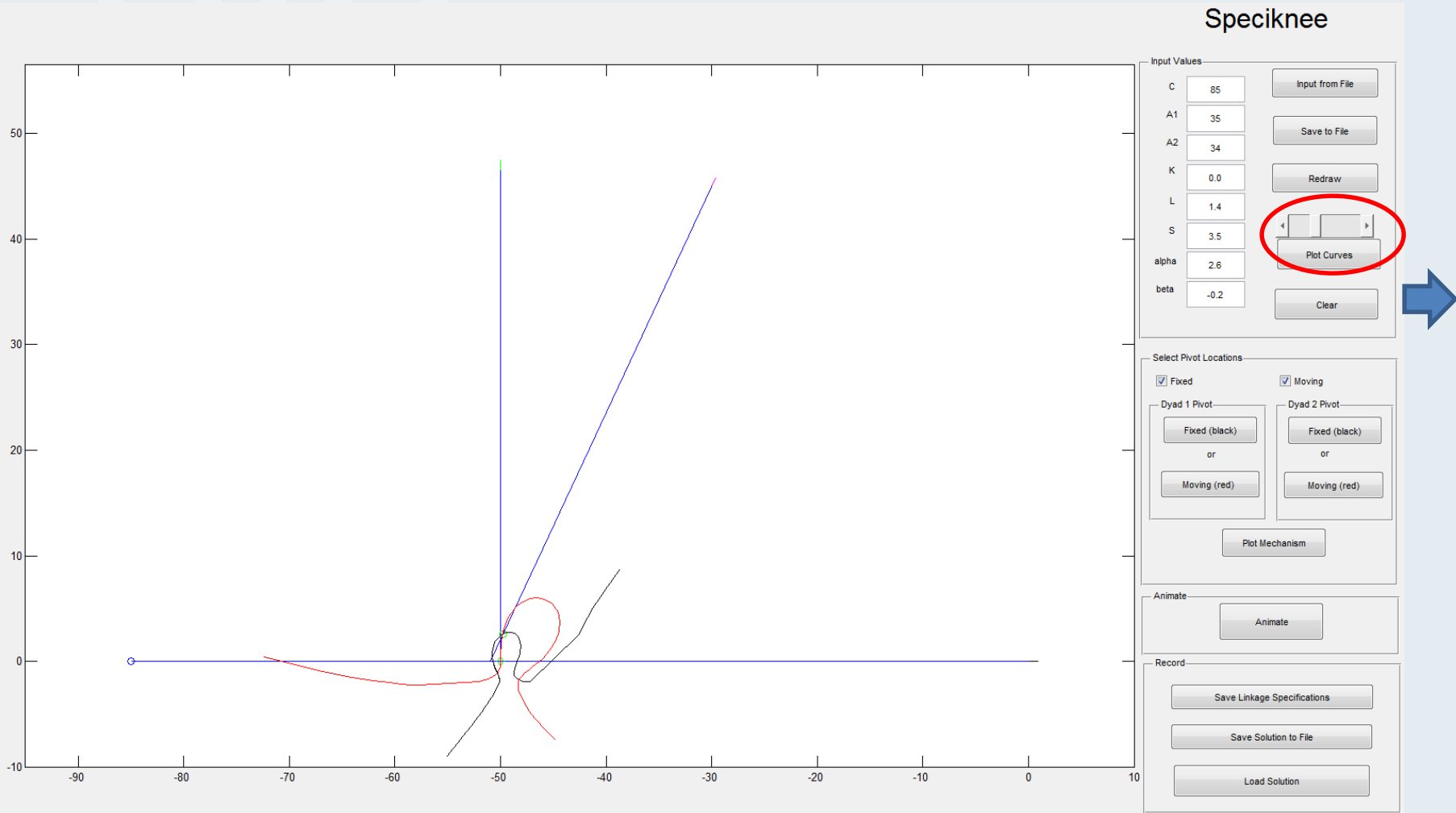
Save Solution to File

Load Solution

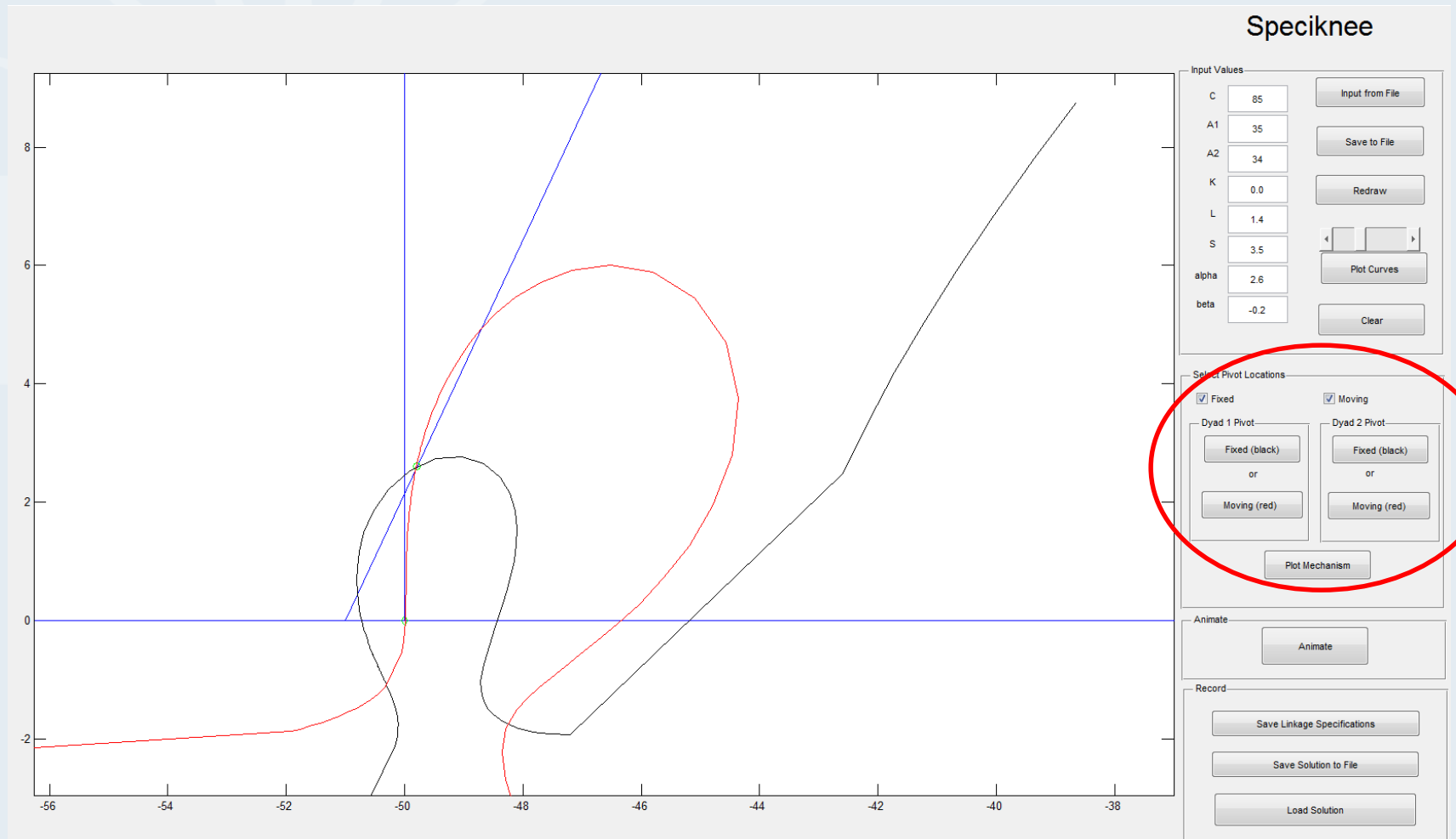




# Plot Curves, Using the Slider to Adjust Point Density if Necessary



# After Zooming, Pick Fixed or Moving Pivots Along Curves



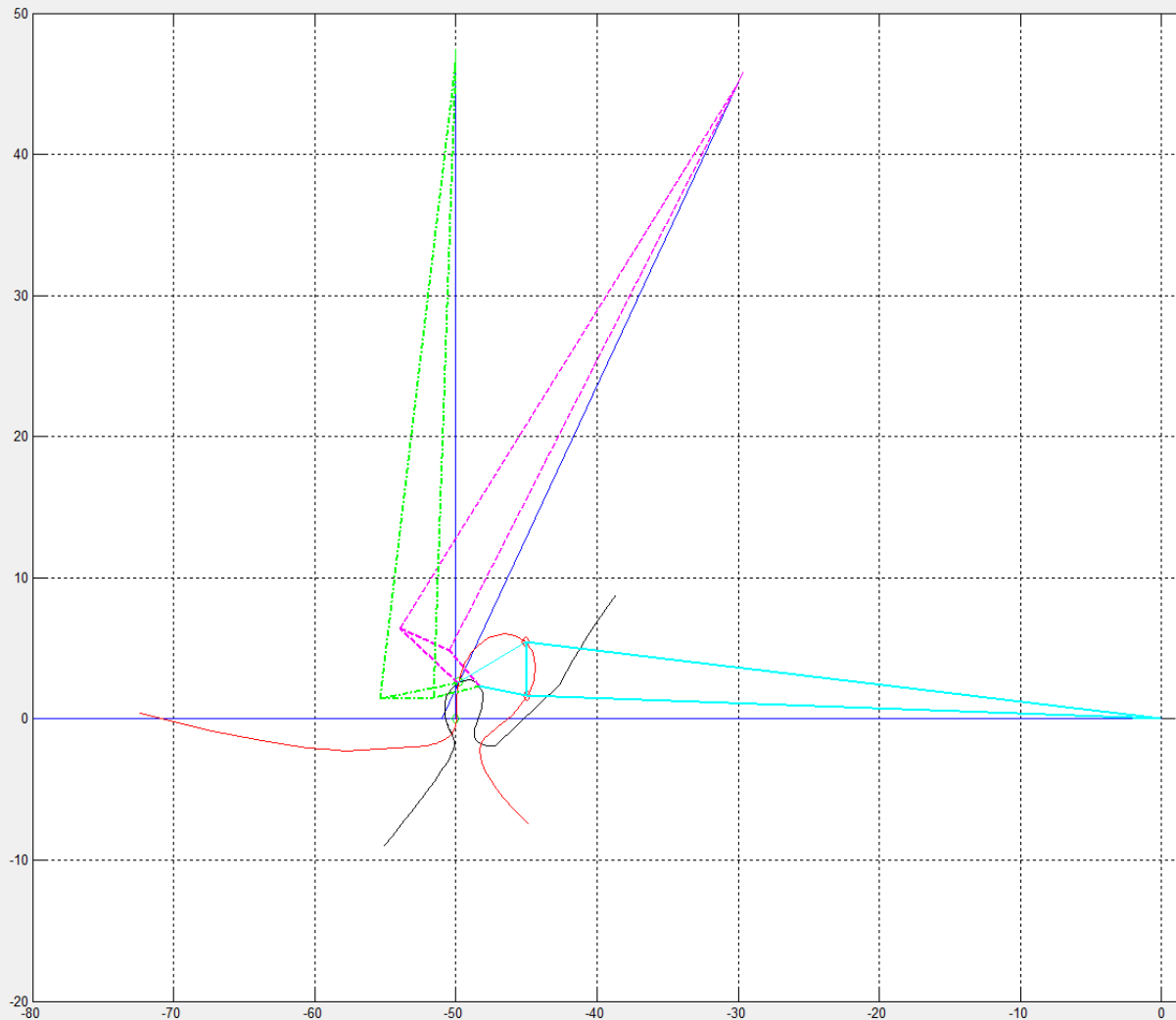
# For Dyad 1, Moving Pivot Location was Selected (along red curve)



# For Dyad Two, the Fixed Pivot was Chosen (along the black curve)



# Then Plot the Mechanism's Three Defining Positions



## Speciknee

Input Values

C	85	Input from File
A1	35	Save to File
A2	34	Redraw
K	0.0	
L	1.4	
S	3.5	Plot Curves
alpha	2.6	
beta	-0.2	Clear

Select Pivot Locations

Fixed  Moving

Dyad 1 Pivot: Fixed (black) or Moving (red)

Dyad 2 Pivot: Fixed (black) or Moving (red)

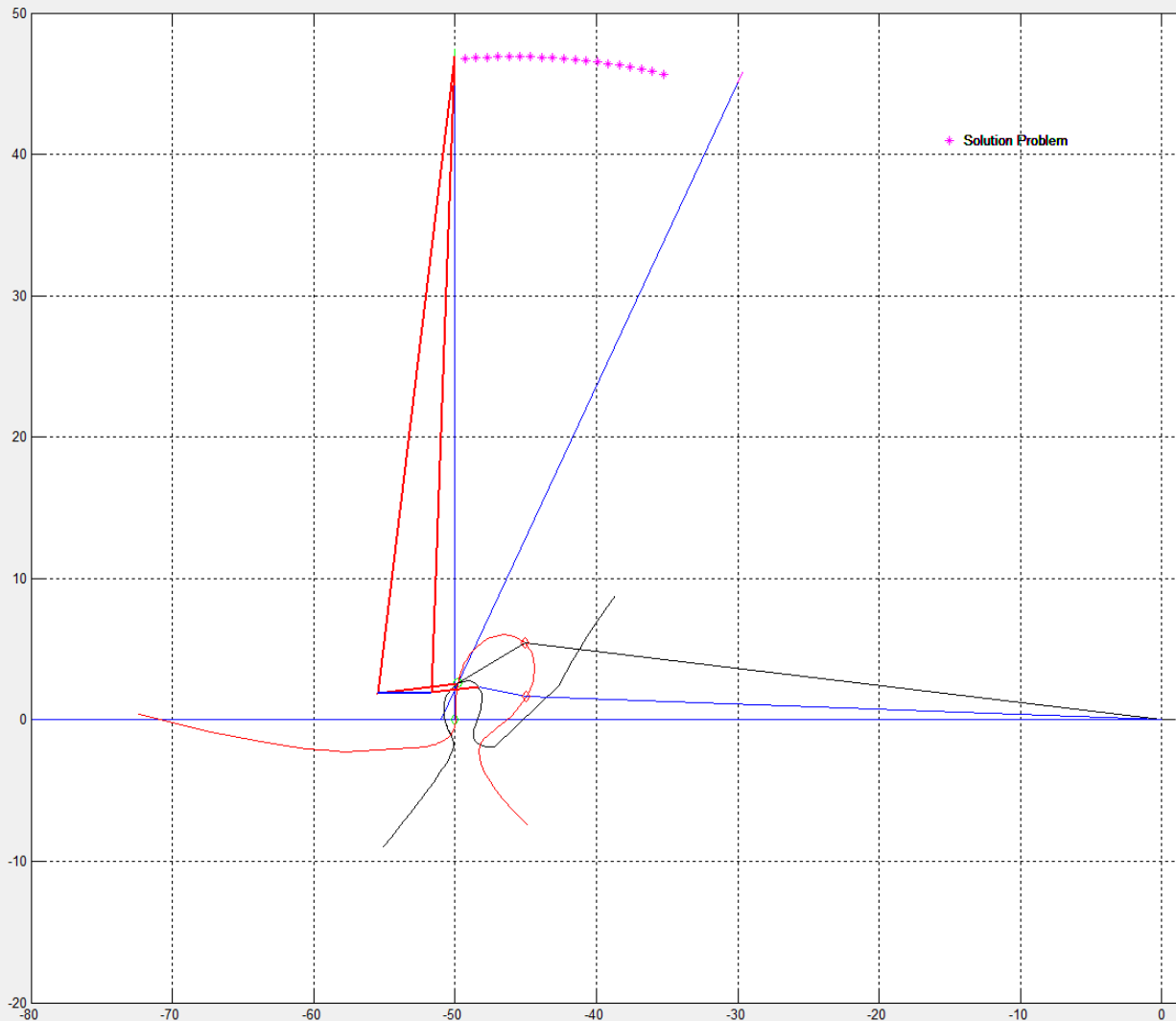
**Plot Mechanism**

Animate: Animate

Record: Save Linkage Specifications, Save Solution to File, Load Solution



# Animate (Magenta Stars Indicate Problem Positions)



### Speciknee

Input Values

C	85	Input from File
A1	35	Save to File
A2	34	Redraw
K	0.0	
L	1.4	
S	3.5	Plot Curves
alpha	2.6	
beta	-0.2	Clear

Select Pivot Locations

Fixed  Moving

Dyad 1 Pivot: Fixed (black) or Moving (red)

Dyad 2 Pivot: Fixed (black) or Moving (red)

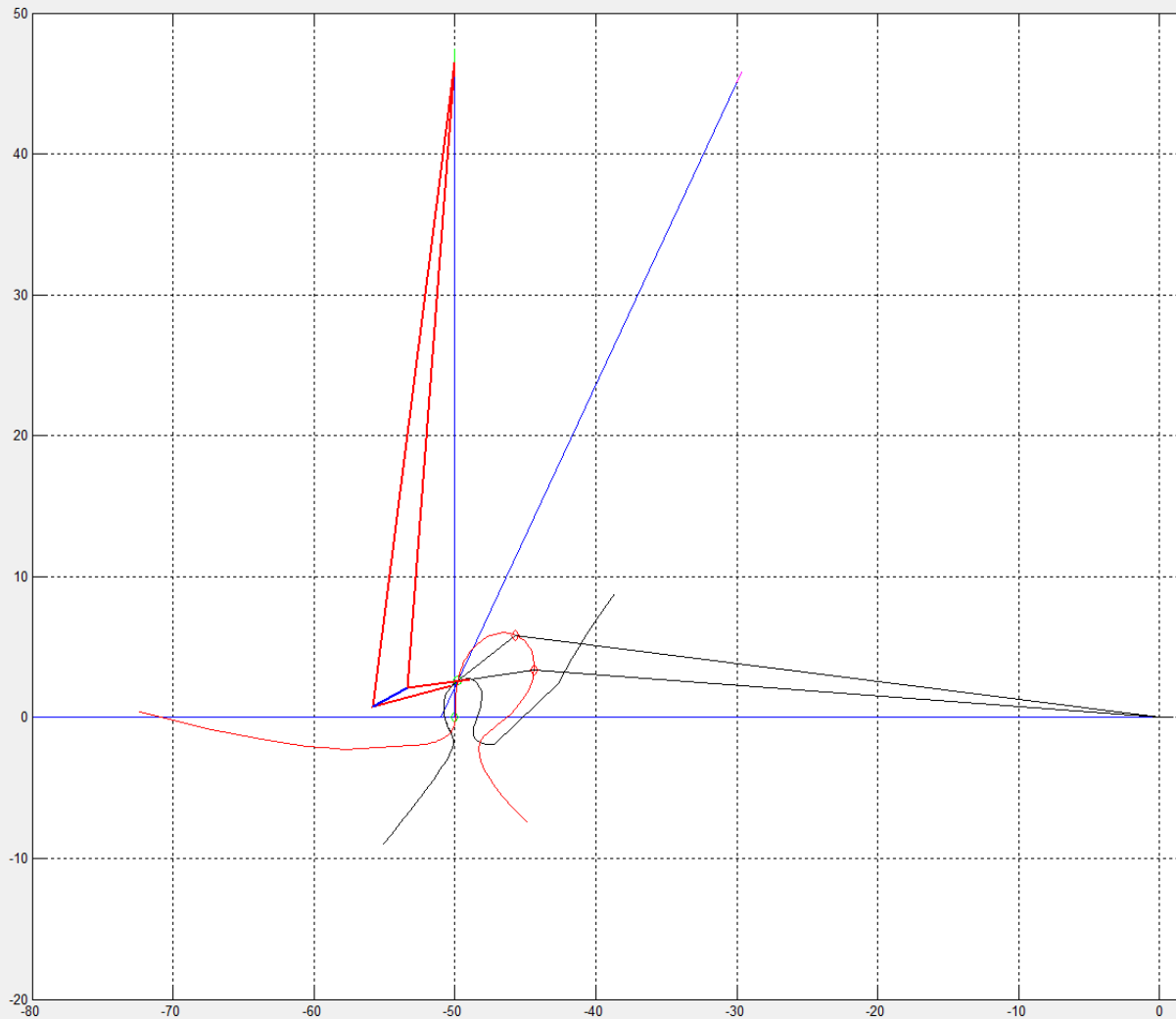
Plot Mechanism

Animate: **Animate**

Record: Save Linkage Specifications, Save Solution to File, Load Solution



# After Iterating on Pivot Positions



### Speciknee

Input Values

C	85	Input from File
A1	35	Save to File
A2	34	Redraw
K	0.0	
L	1.4	
S	3.5	Plot Curves
alpha	2.6	
beta	-0.2	Clear

Select Pivot Locations

Fixed  Moving

Dyad 1 Pivot: Fixed (black) or Moving (red)

Dyad 2 Pivot: Fixed (black) or Moving (red)

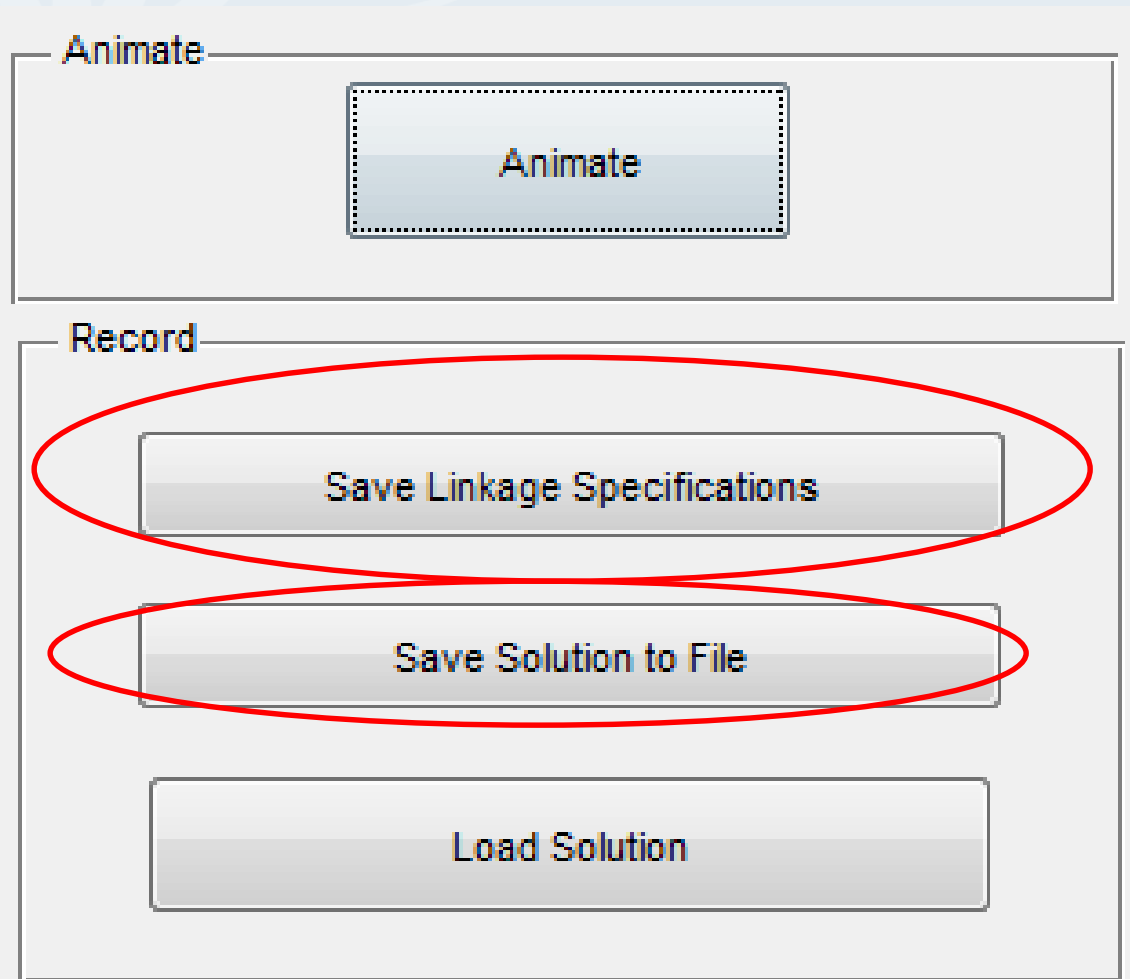
Plot Mechanism

Animate: **Animate**

Record: Save Linkage Specifications, Save Solution to File, Load Solution



# Can Save to a File Describing Linkage or a File Containing Complete Solution Information





# Thanks to

- Faculty Scholarship Summer Grant--Cedarville University Office of Institutional Research, Lindsey McCarty
- Cedarville University IT, Tim Overdorf
- Professor Tim Tuinstra, matlab go-to
- Er kai Watson, programming assistant