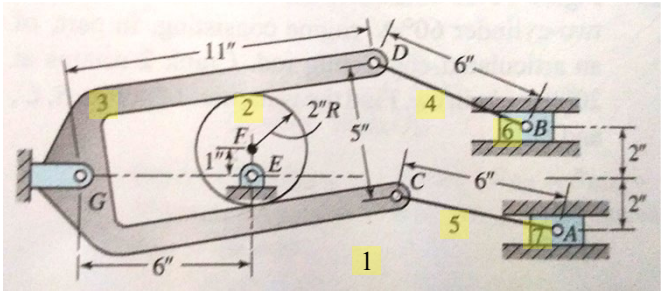
AME40423 Mechanisms and Machines
Fall 2023
Homework 3
Due: Sept 12 at 11:55pm

Problem 1: Draw a mechanism graph

Consider the following mechanism.

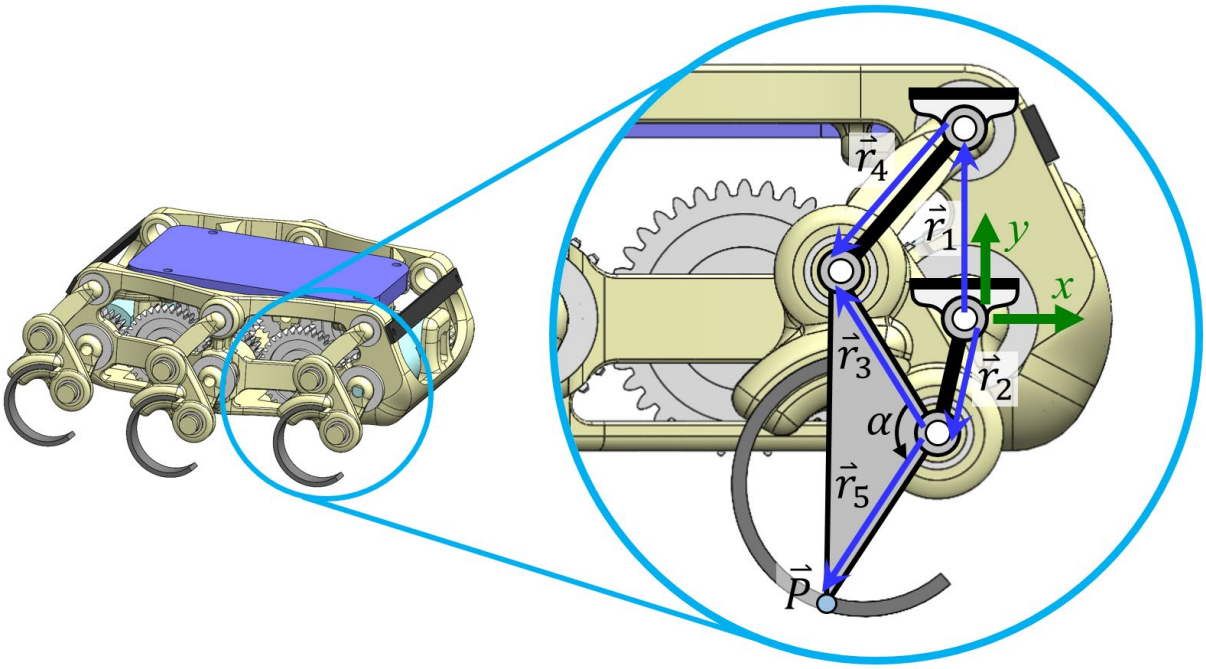


(a.) Draw the mechanism's graph. Each link is a vertex. Each joint is an edge. Use the highlighted link labels provided in the figure. Here is the relevant portion of class for you to follow along. When you first draw the graph, you will probably have edges intersecting. Then think about it, and draw a clean version with no edges intersecting. Hint: Applying Grübler's criterion last week you found 7 links and 9 edges, indicating how many vertices and edges your graph should have.

(b.) How many fundamental cycles does the graph have? You do not need to methodically determine this (by drawing a spanning tree like described in class). You can just look at it & tell.

Problem 2: Write out a closed form solution

The following four-bar serves as the leg of a hexapedal robot.



The input is θ_2. Please give the closed-form solution for θ_3, θ_4, θ_5.

Problem 3: Use the closed-form solution to track a point

Consider the mechanism of Problem 2 to have the dimensions r_1 = 0.8, r_2 = 0.5, r_3 = 0.8, r_4 = 0.8, r_5 = 0.9, and α = 117°. θ_2 rotates continuously clockwise. Write some Matlab code to display the path that point $\vec{P}$ traces out. That is, you are putting your result from Problem 2 into Matlab and drawing the path of $\vec{P}$.
Submit a screenshot of your code, and a screenshot of the path.
Hint: Check out this tutorial.

Problem 4: Animate the leg

Now rearrange your code for Problem 3 to fit into the following function:

```
function [th3, th4, th5, P] = position(th2, dim)
```

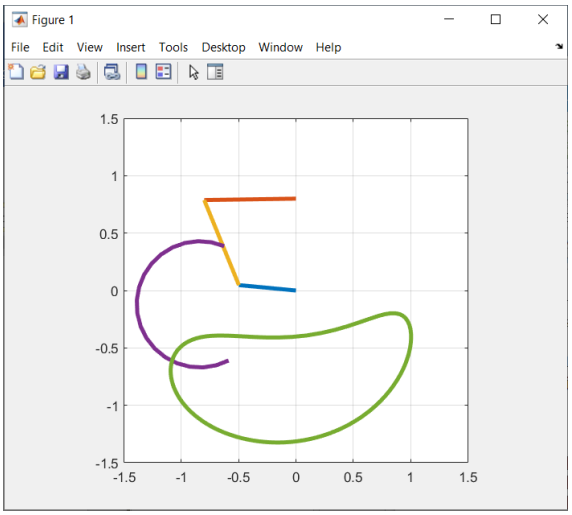
You need to follow the template for input arguments and outputs closely.
Input:

`th2` — a single value of θ_2
`dim` — a single column vector of dimensions, `dim = [r1; r2; r3; r4; r5; alpha]`

Output:

`th3` — a single value of θ_3
`th4` — a single value of θ_4
`th5` — a single value of θ_5
`P` — a single column vector `P = [Px; Py]`

If you did this correctly, you can drop your new position function into this code to see the four-bar animate. You should see:



You can use this animation code as a template for animating your own mechanisms later.

Submit a screenshot of your code and the animation.