EME 152 Discussion 8

November 17, 2021

Agenda

- Midterm and project overview
- Quick Animation revisit + tips
- Angular velocity analysis
- Angular acceleration analysis
- Instant center analysis example

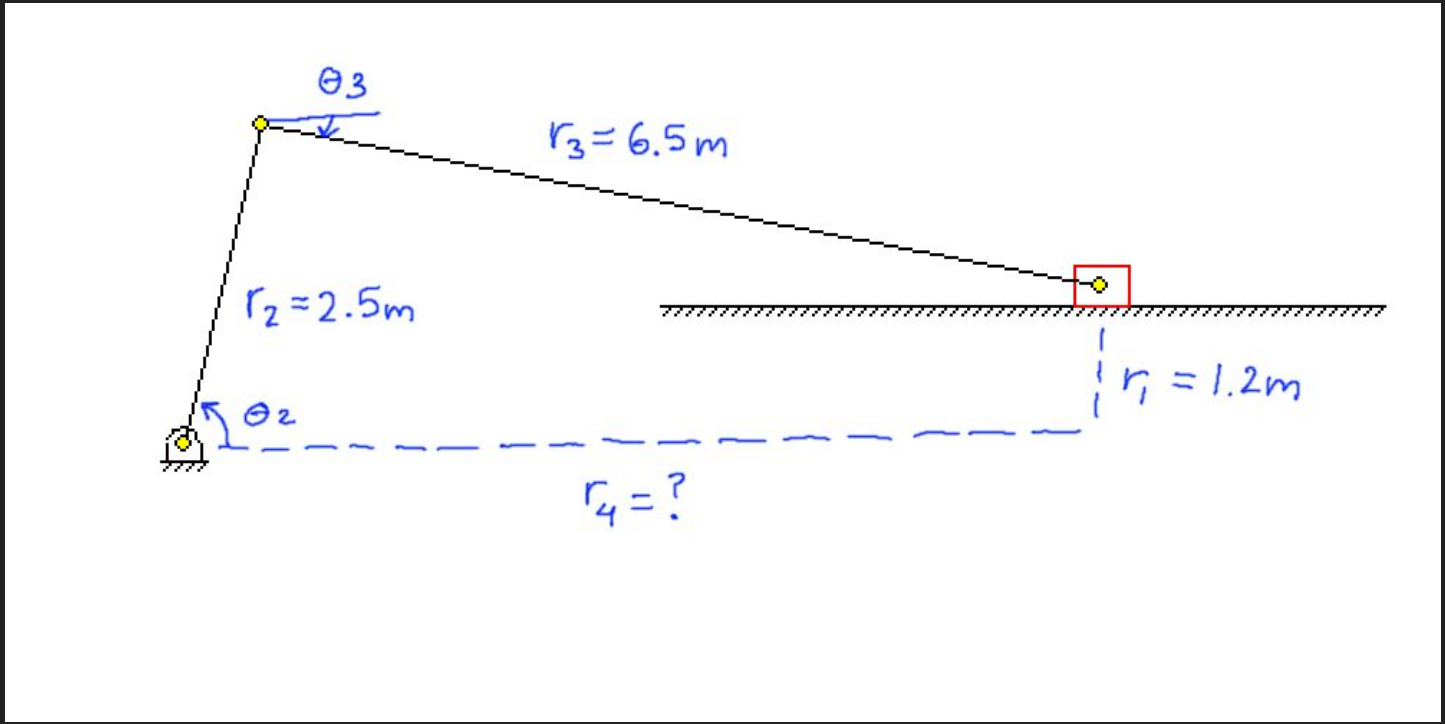
Midterm

- Monday, November 22
- Midterm will cover up to last Friday’s lecture on angular acceleration
- Open book/notes
- Hand calculations and Ch programs, similar to the homework
- During normal lecture time (must be logged into Zoom)
- **WORK ALONE**

Project

- Due Friday, December 3 (week 10)
- Work in teams of 2
- Two parts:
  - Software package portion. Need at least 3 files:
    - *.c/*.ch code with the main() function
    - *.h code for your header file + class definition
    - *.chf file as your function file
  - Report portion
    - LaTeX preferred, but Word, Google Docs, is fine
    - Requirements in project description
- Form a team: https://forms.gle/YznRXLTYiD8kDVN58

Quick Animation revisit



Quick Animation revisit

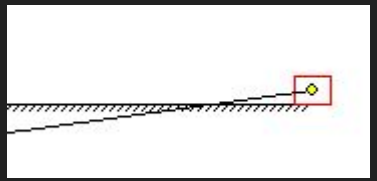
```
// To help clean up code
struct Slider {
    double width;
    double height;
    char color[32];
};
```

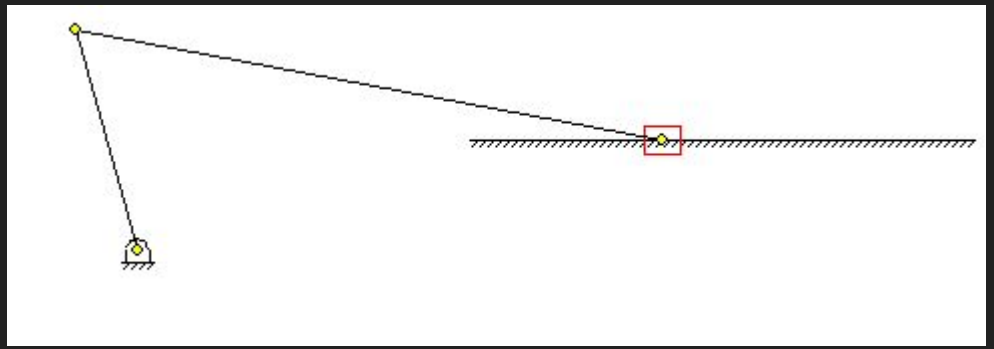
Quick Animation revisit

To draw the ground, use:

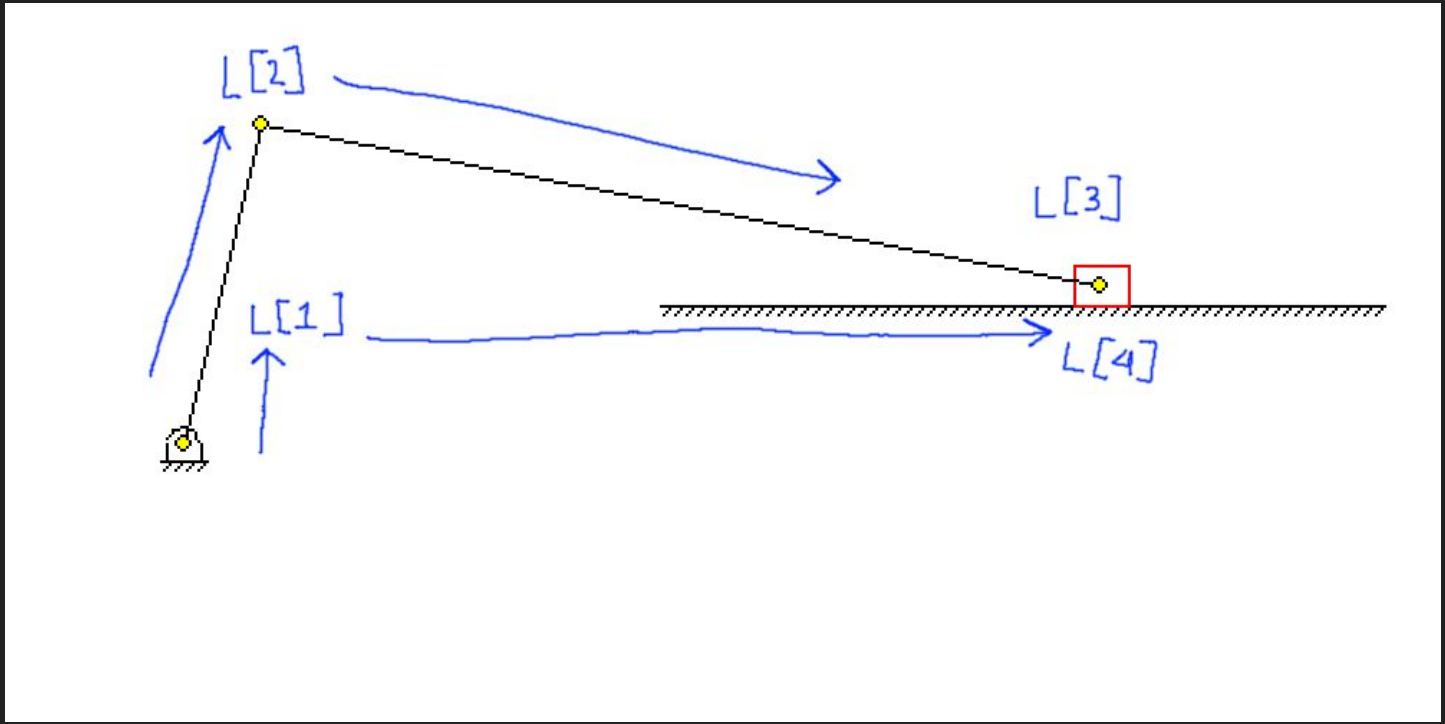
```
ground X1 Y1 X2 Y2
```

Make sure to subtract half of the slider height for y_1 and y_2! Subtract half the slider width for x_1 and add half the slider width for x_2.





Quick Animation revisit



Quick Animation revisit

Add a double backslash (\\) before the newline (\n) to render primitives in the same frame. Add a second newline (\n) to move on to the next frame.

Example in Ch:

```
printf("link 0 0 %lf %lf \\\n", …);
```

Equivalent in .qnm:

```
link 0 0 2.49 -0.15 \

# empty line

link 0 0 2.50 1.20 \
```

Quick Animation Code Demo

Angular Velocity Analysis Example

A four-bar linkage has the following dimensions: r1 = 6cm, r2 = 2cm, r3 = 4cm, r4 = 5.5cm, theta1 = 10 deg, rp = 3.5cm, and beta = 20 deg. Link 2 is the input link. When theta2 = 35 deg and the input link is rotating at a constant clockwise angular velocity 20 rad/s, write a program that uses CFourbar to calculate the angular velocities omega3 and omega4 for the coupler and output links.

Angular Velocity Analysis Example

Solution:

```
fourbar.angularVel(theta_1, omega_1, FOURBAR_LINK2);
fourbar.angularVel(theta_2, omega_2, FOURBAR_LINK2);
```

`theta_1` and `theta_2` are the two solutions computed by `fourbar.angularPos()`. `omega_1` and `omega_2` are the function outputs, which are outputted as an array of 4 angular velocities of the 4 links. The enum `FOURBAR_LINK2` tells the function that link 2 is the input link.

Angular Acceleration Analysis Example

A four-bar linkage has the following dimensions: r1 = 6cm, r2 = 2cm, r3 = 4cm, r4 = 5.5cm, theta1 = 10 deg, rp = 3.5cm, and beta = 20 deg. Link 2 is the input link. When theta2 = 35 deg and the input link is rotating at a clockwise angular velocity 20 rad/s and counterclockwise angular acceleration of 5 rad/s^2, write a program that uses CFourbar to calculate the angular accelerations alpha3 and alpha4 for the coupler and output links.

Angular Acceleration Analysis Example

Solution:

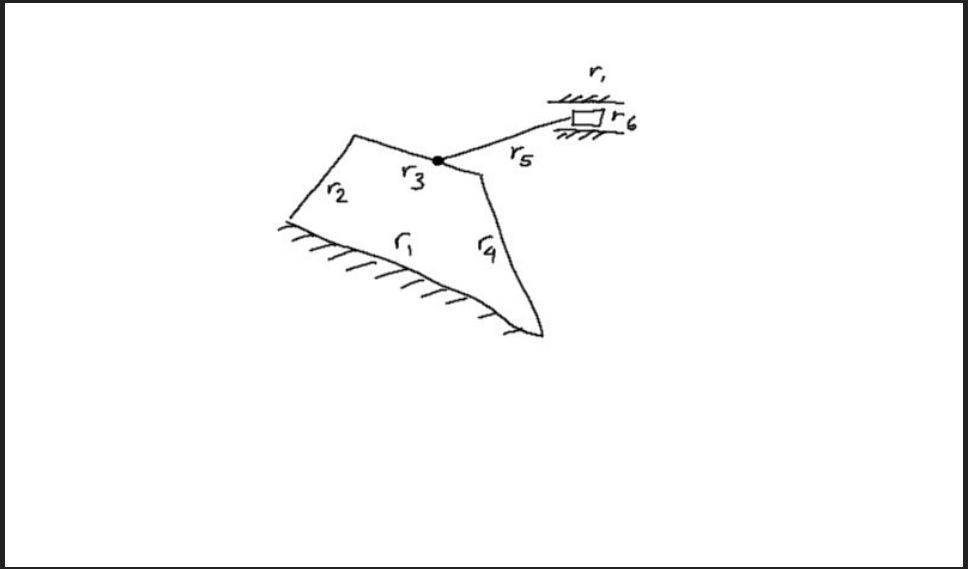
```
fourbar.angularAccel(theta_1, omega_1, alpha_1, FOURBAR_LINK2);

fourbar.angularAccel(theta_2, omega_2, alpha_2, FOURBAR_LINK2);
```

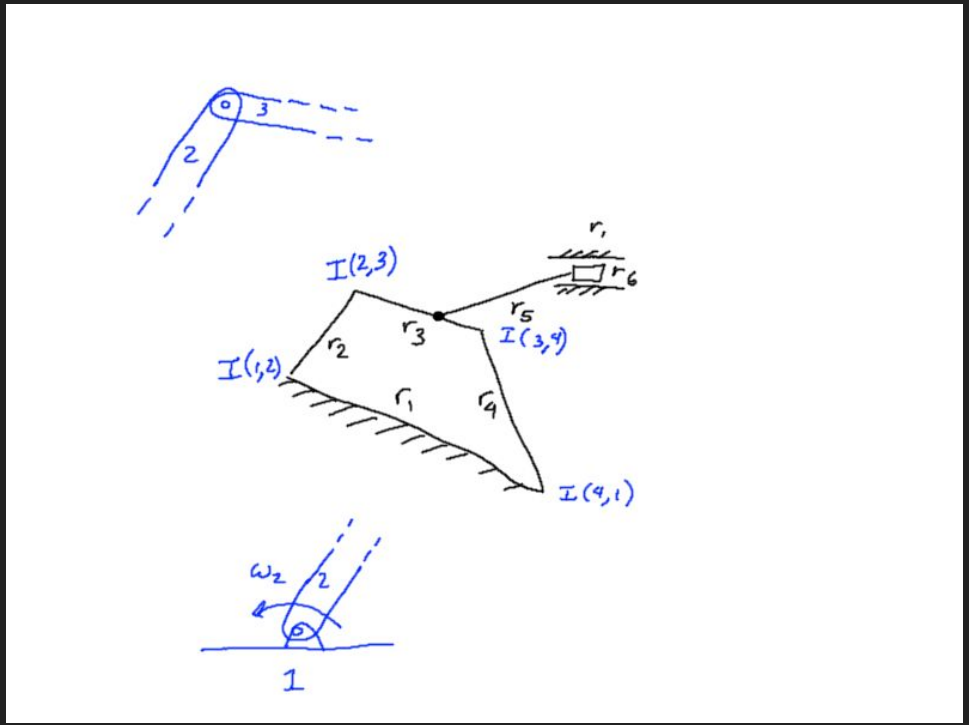
`theta_1`, `theta_2`, `omega_1`, and `omega_2` are arrays of 4 doubles and should already be solved. `alpha_1` and `alpha_2` are the function outputs which will output an array of 4 doubles. The enum `FOURBAR_LINK2` tells the function that link 2 is the input link.

Instant Center Analysis

- Find the instantaneous center of motion of link 5 of the mechanism



Instant Center Analysis



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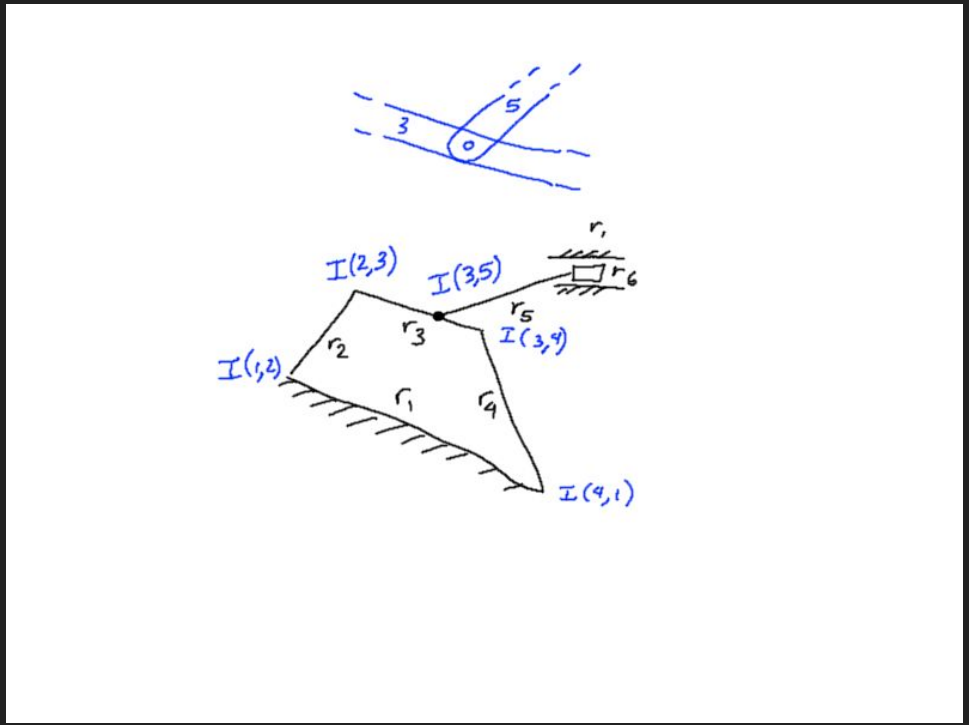

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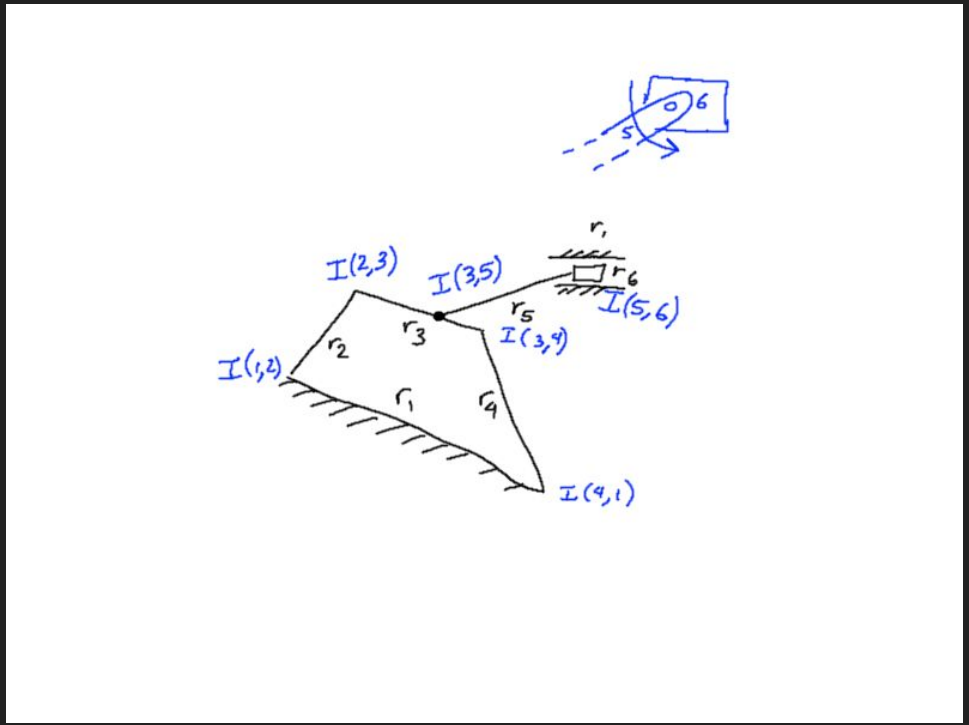

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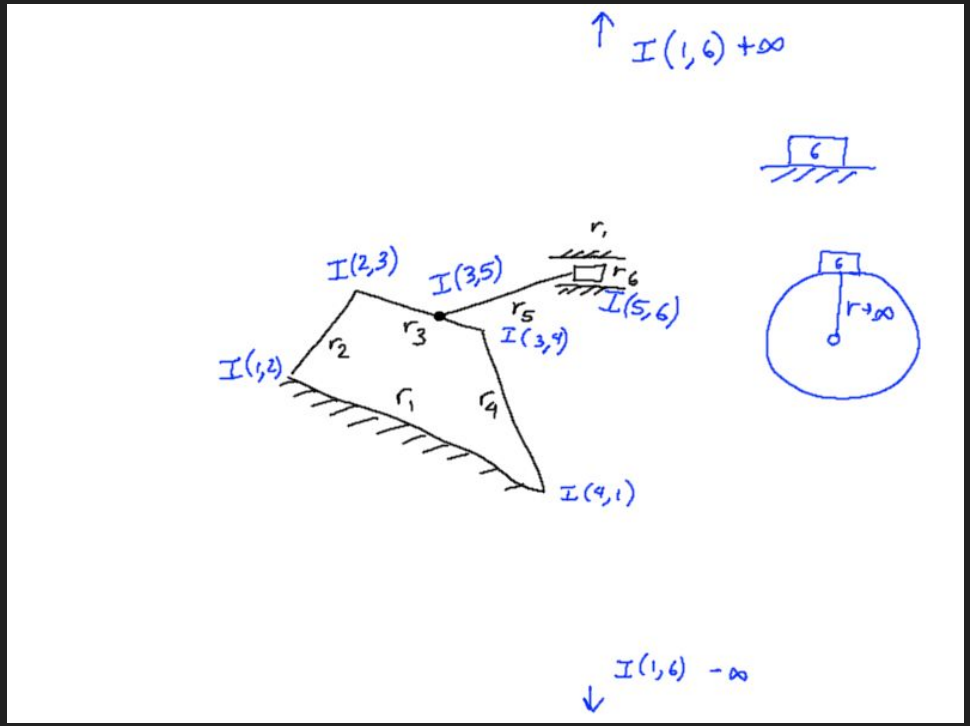

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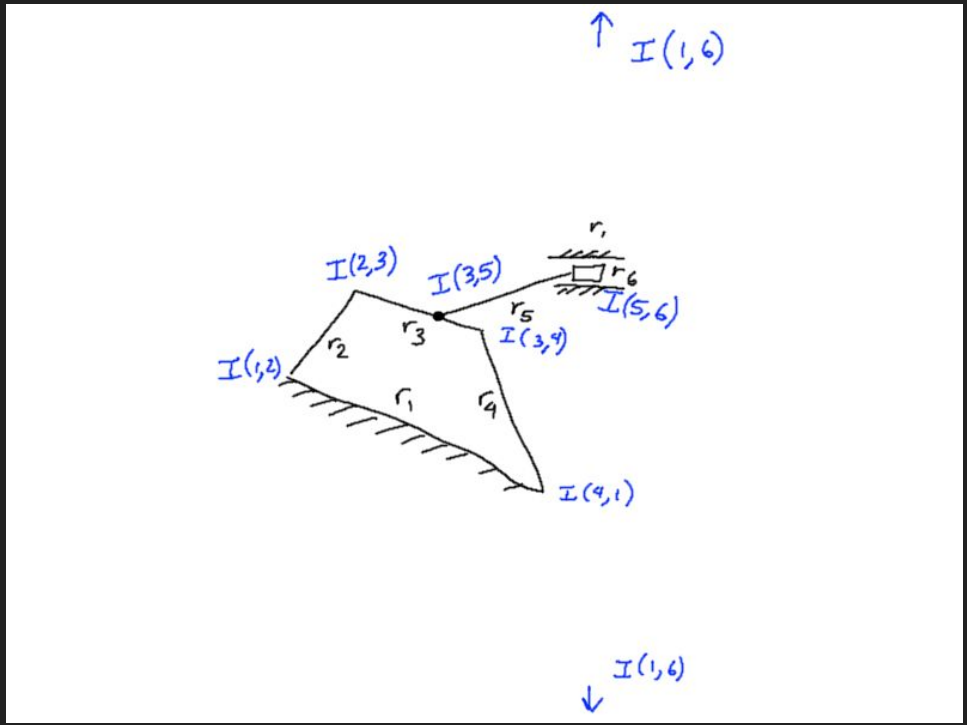

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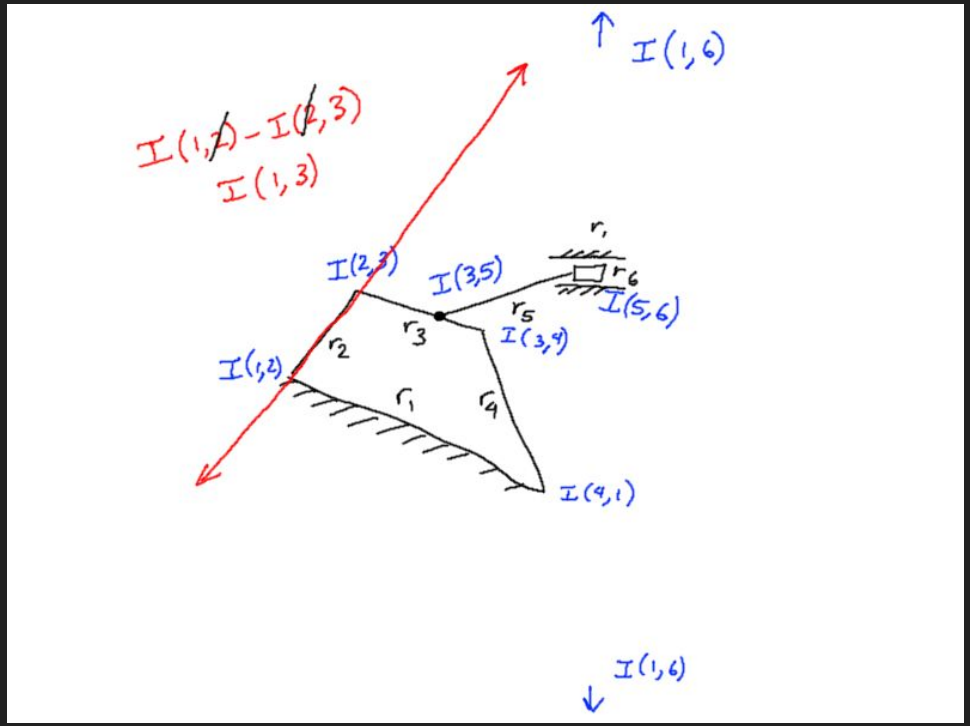

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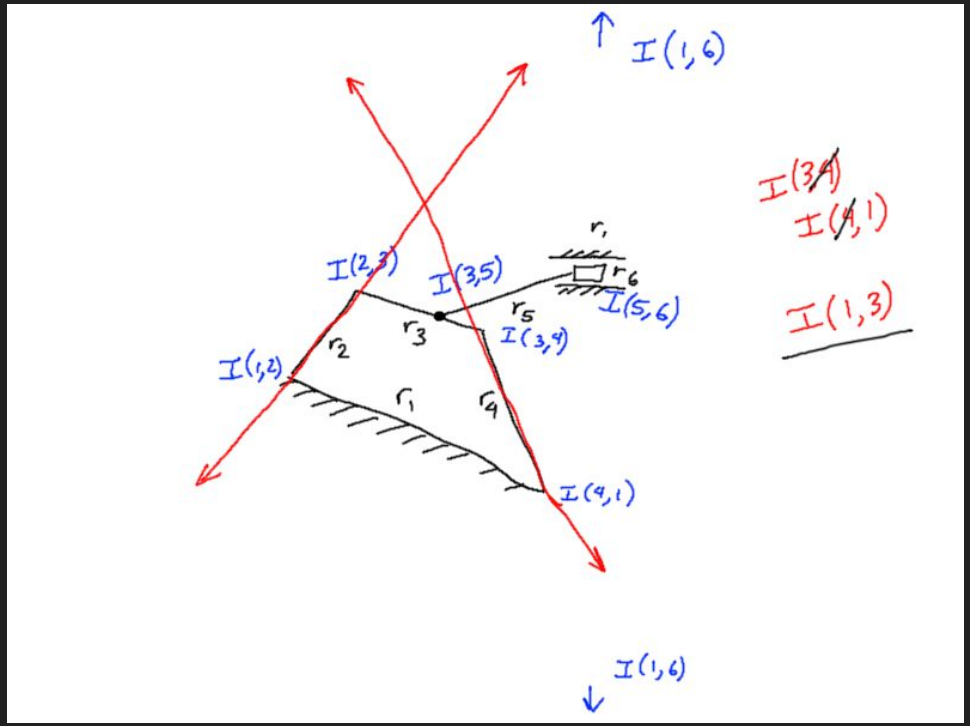

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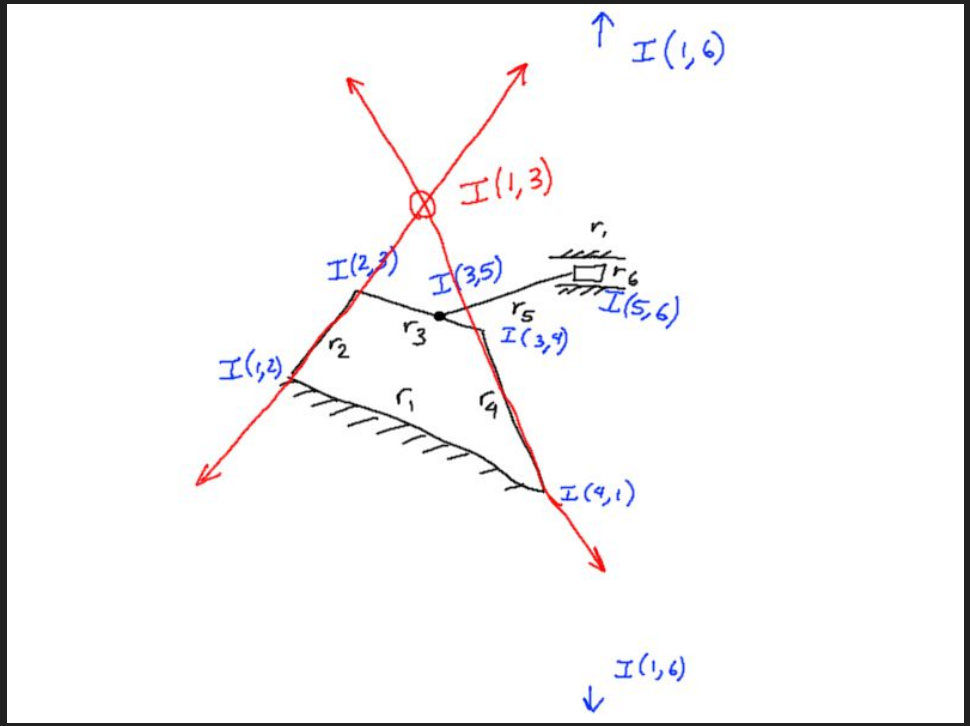

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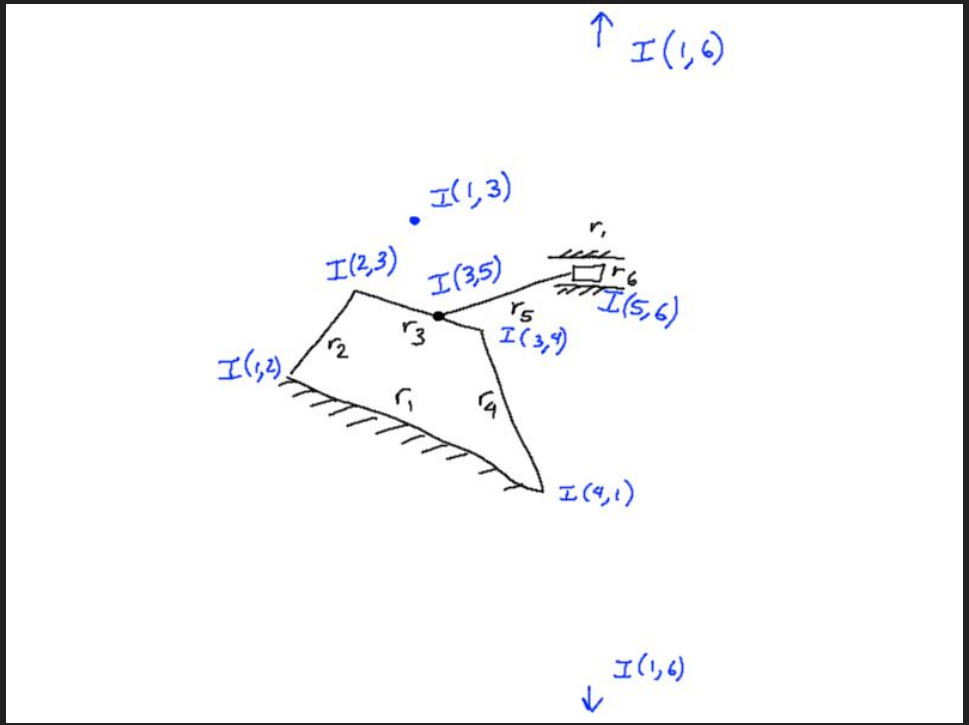

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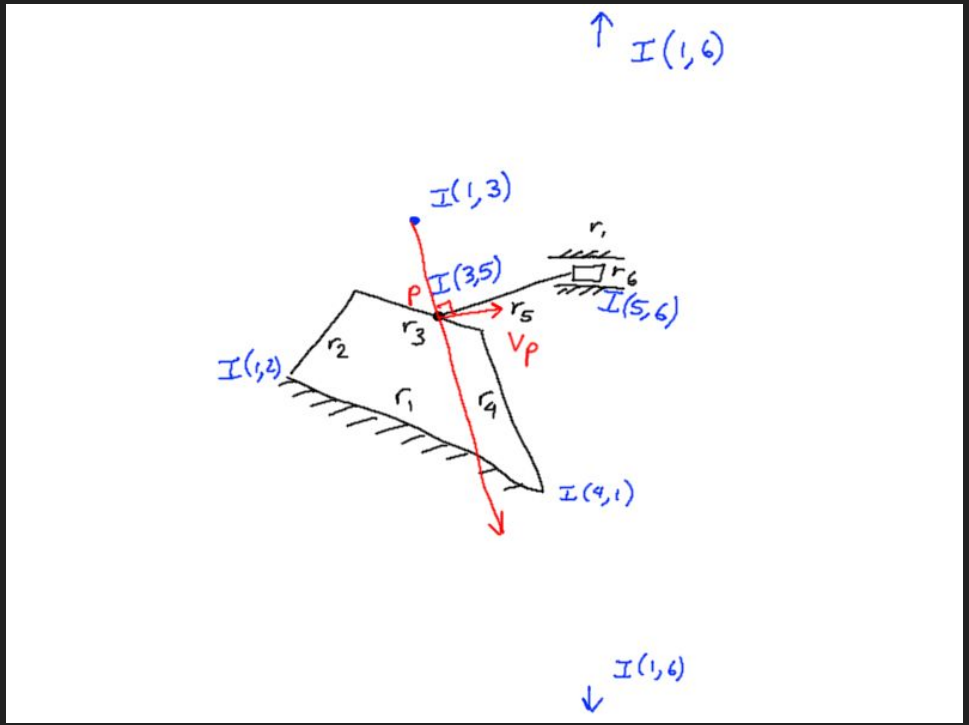

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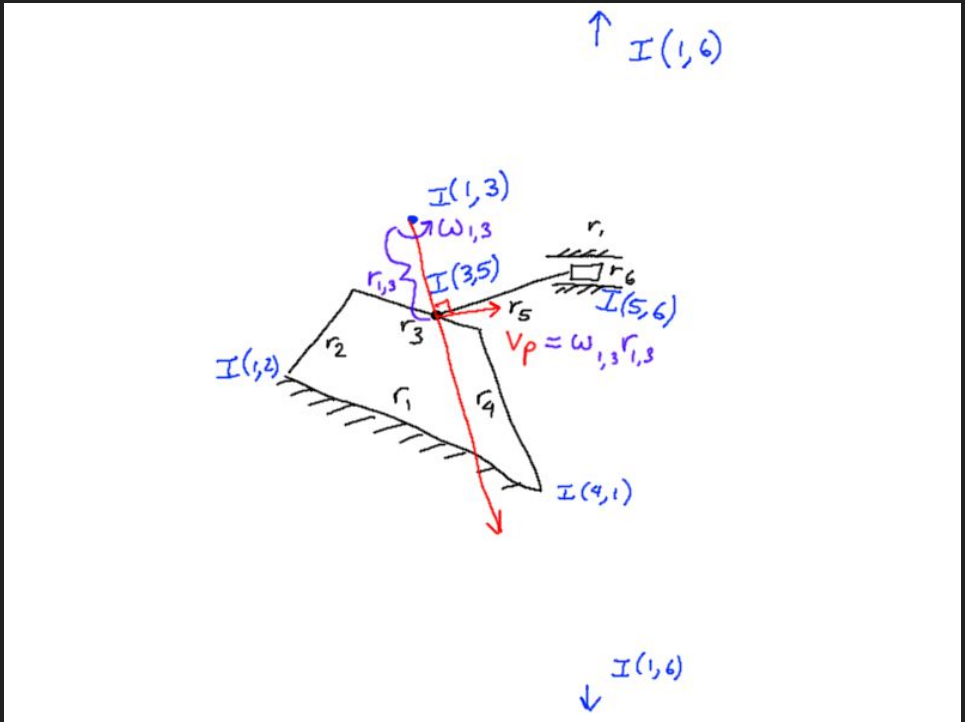

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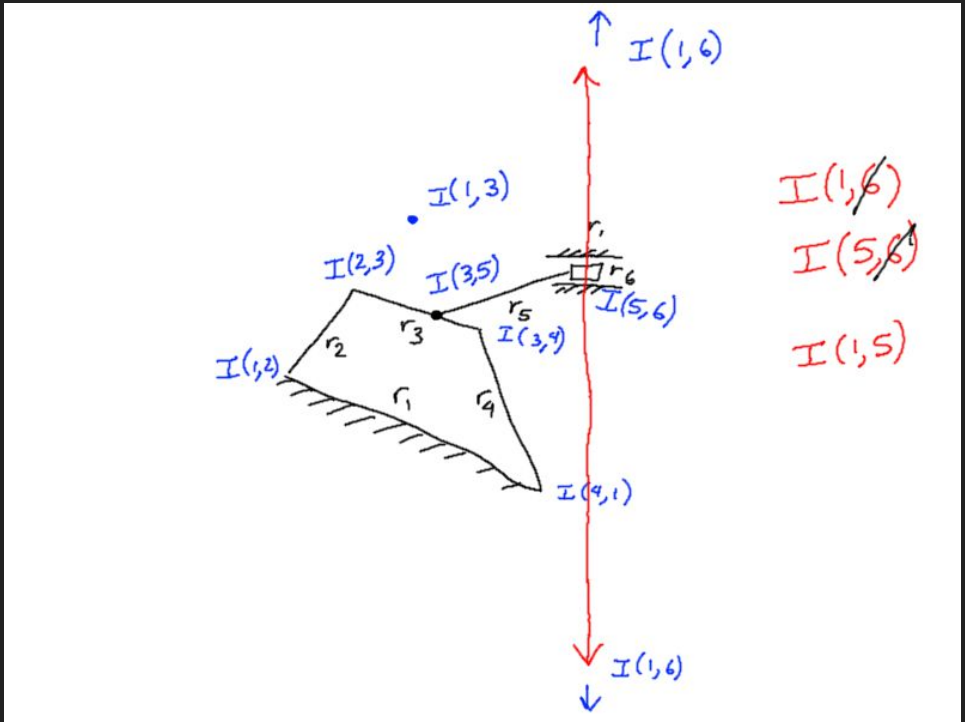

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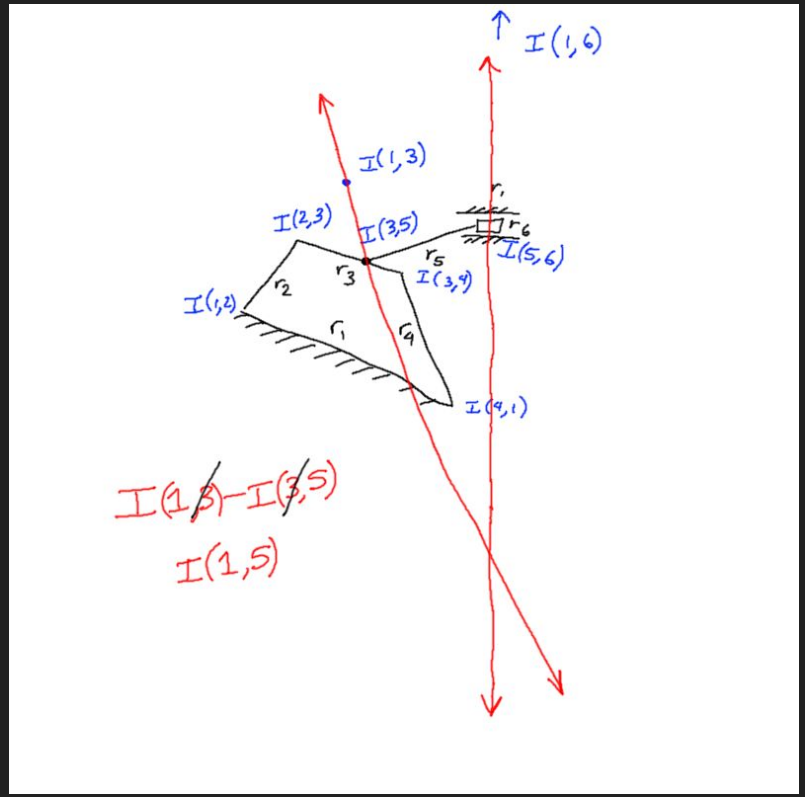

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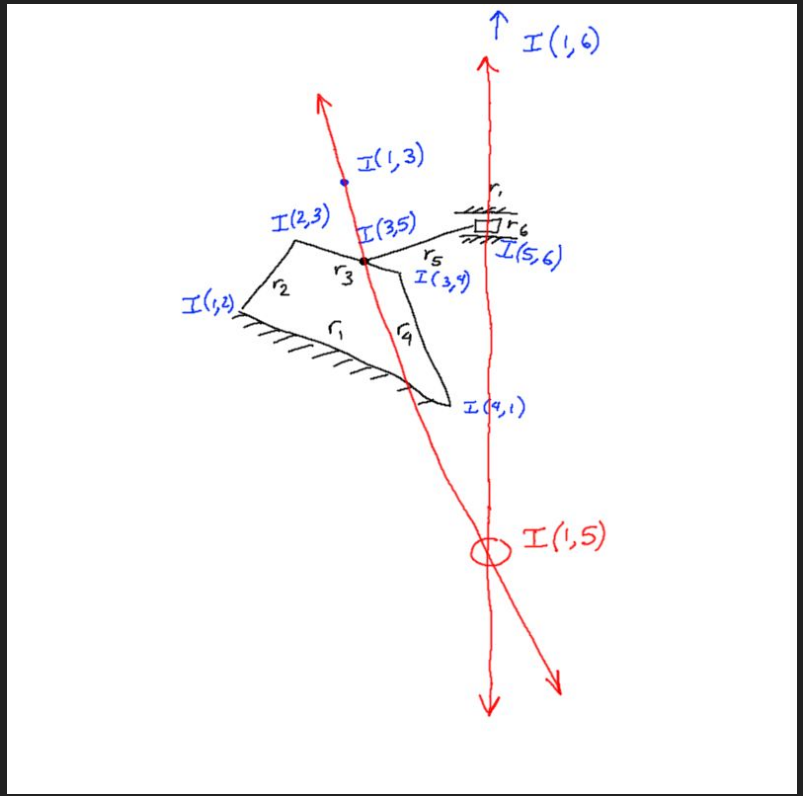

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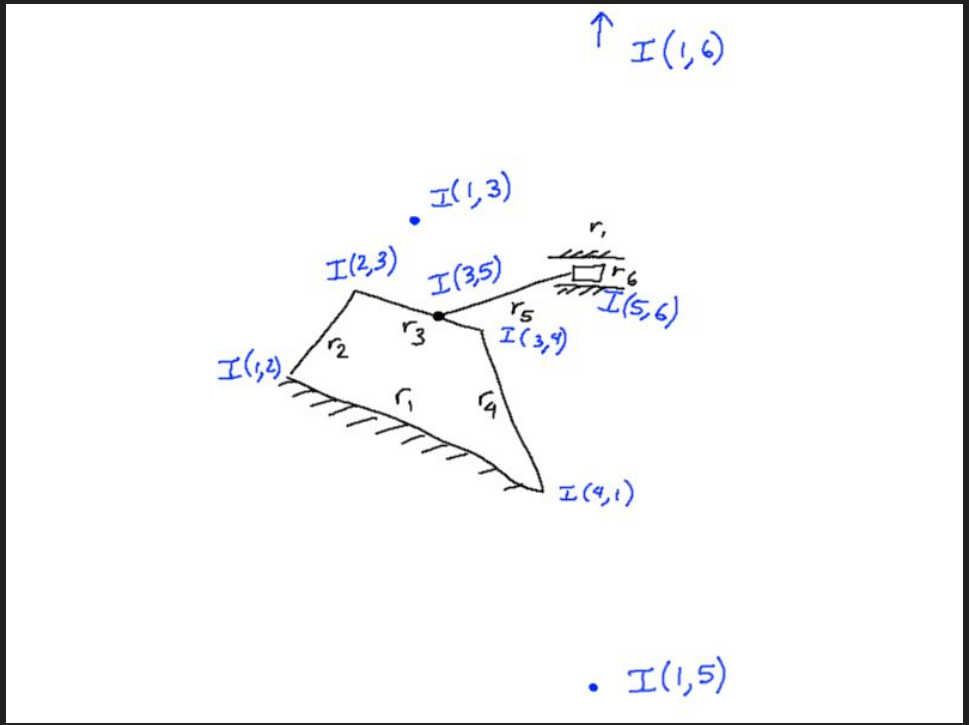

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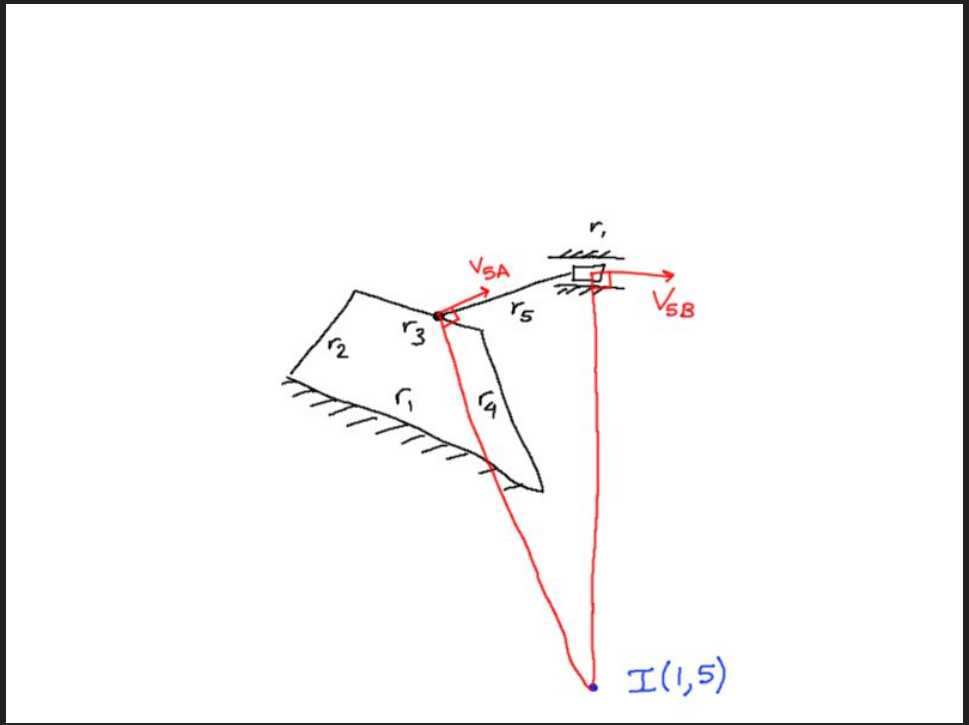

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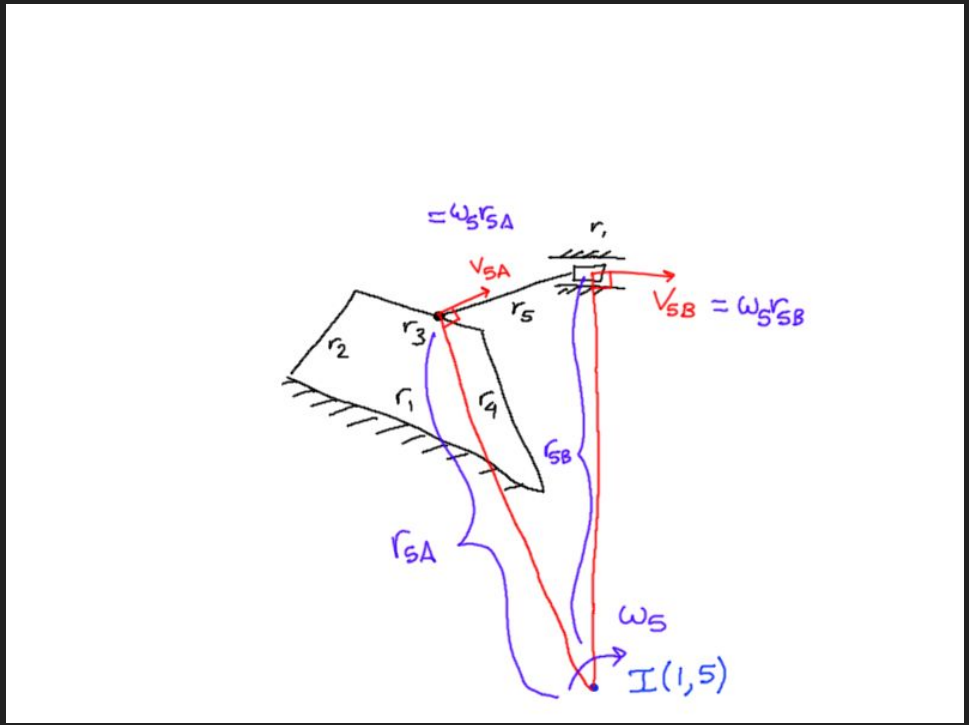

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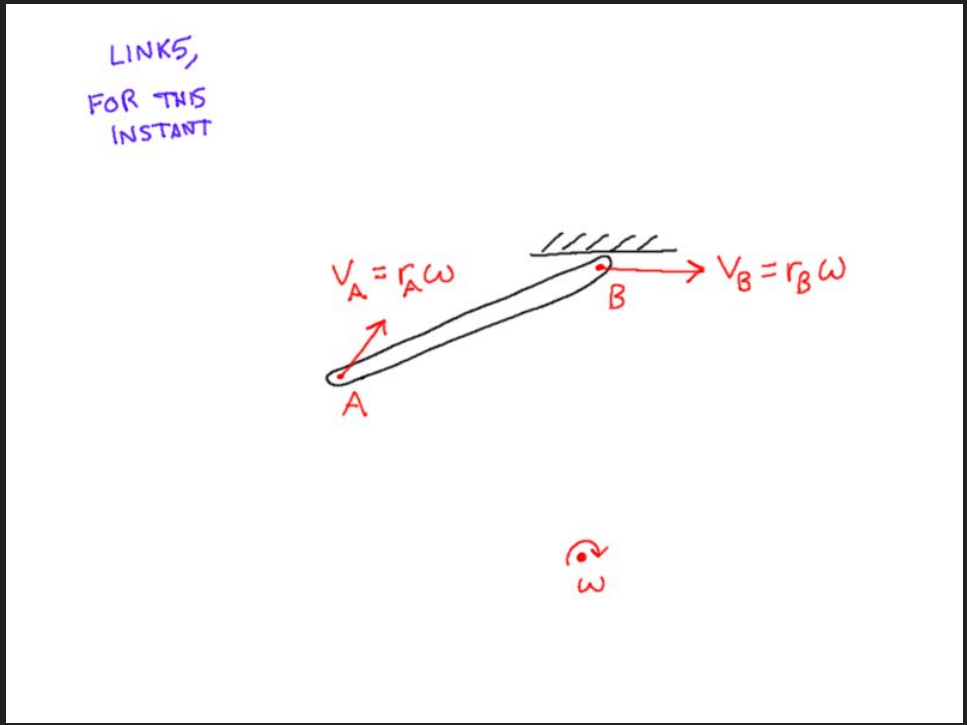

Thank you!

Questions?