

*{Learn, Create, Innovate};*

# Line Following

*Line detection and following  
using OpenCV and ROS*

The logo for Manchester Robotics (MCR²) is a large black circle with a red arc. Inside the circle, the text "MCR" is in white, and "²" is in red. Above the "R" is a red triangle with three squares at its vertices, connected by red lines.

MCR<sup>2</sup>

Manchester **Robotics**



# The Task

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# Line Detection

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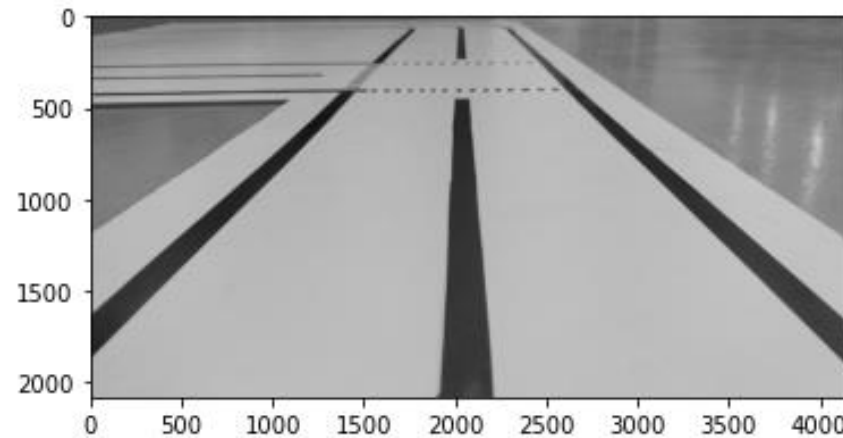
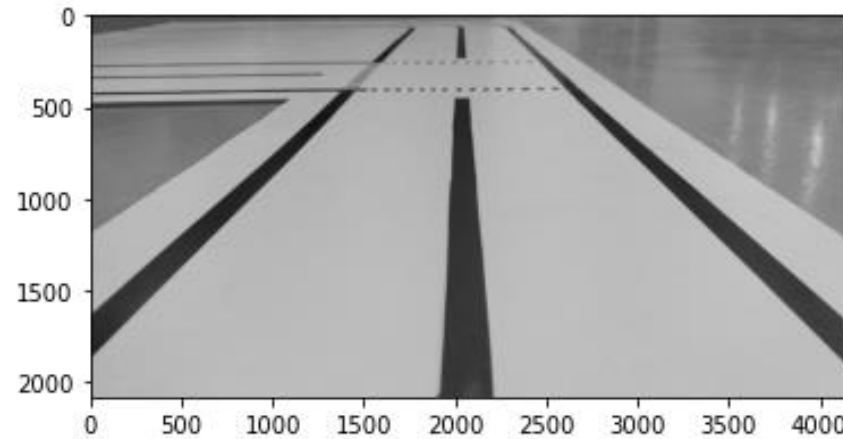
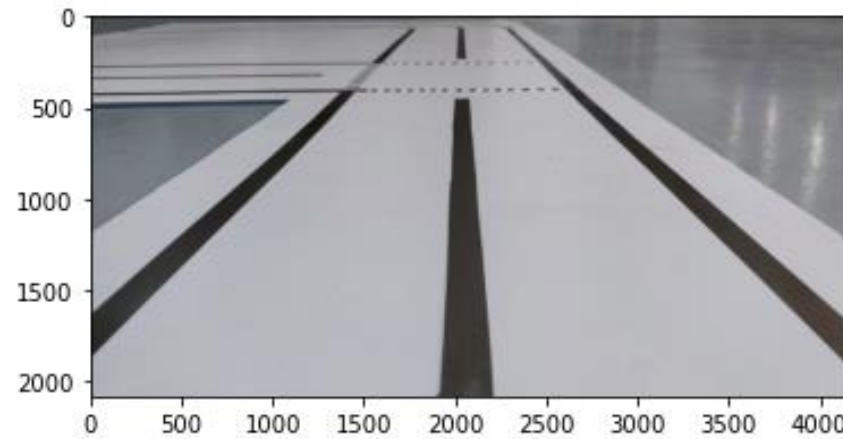


???

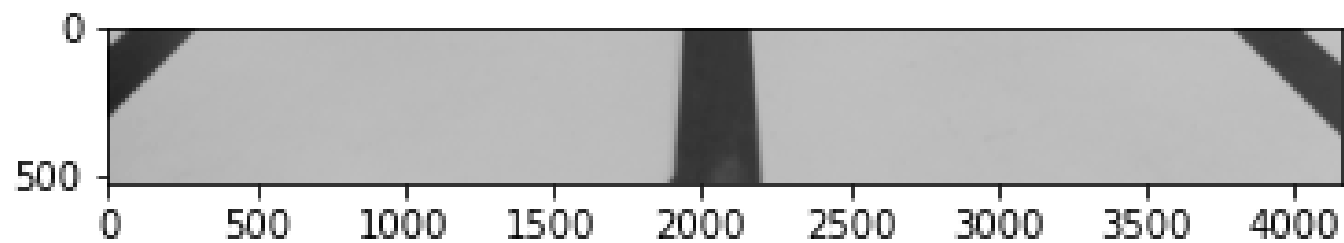
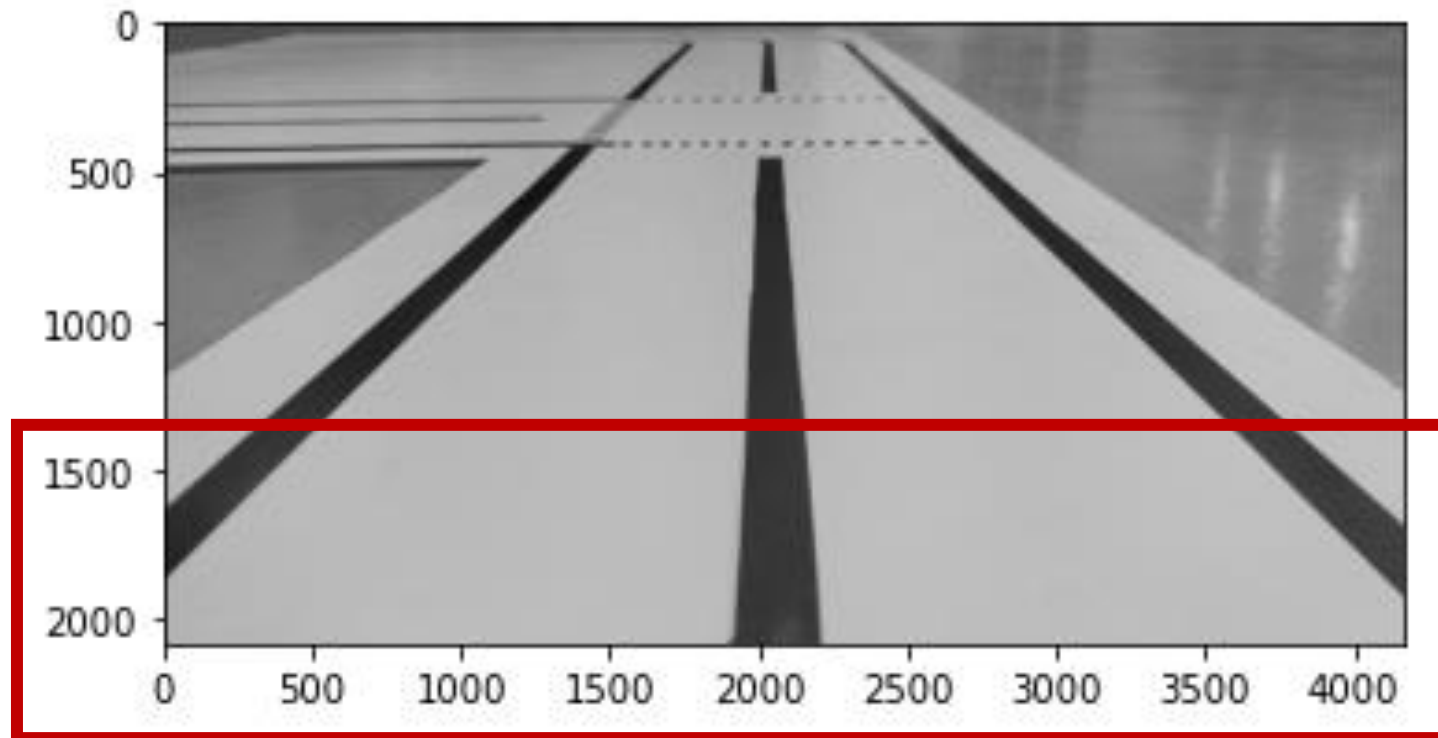


# Pre-processing

- Rotate
- Reduce image size
- Change image encoding if desired
- Remove noise
  - Gaussian Blur
  - Dilate and Erode



# Region of Interest



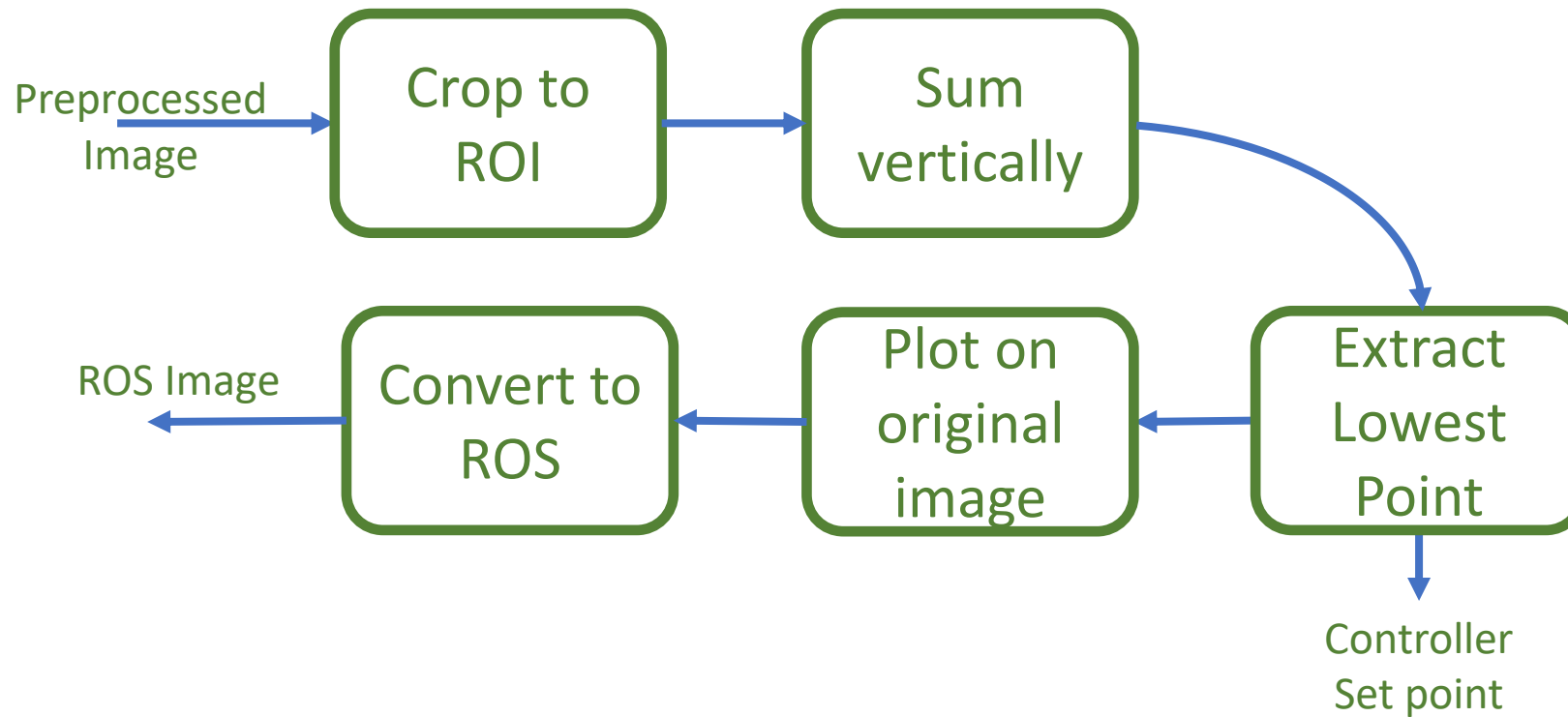


# Solution 1

## Gradients

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- The simplest solution is to just use the minimum value.



- Problems with this solution?

# Convert to graph

- The picture is a matrix of values between 0 and 255
- Each row will have lower values around the line

3	4	151	...	112	2	3
5	1	175	...	158	3	6
1	2	147	...	145	31	2
⋮	⋮	⋮	⋮	⋮	⋮	⋮
3	5	163	...	122	41	10
18	12	189	...	168	15	11
2	14	74	...	185	19	5

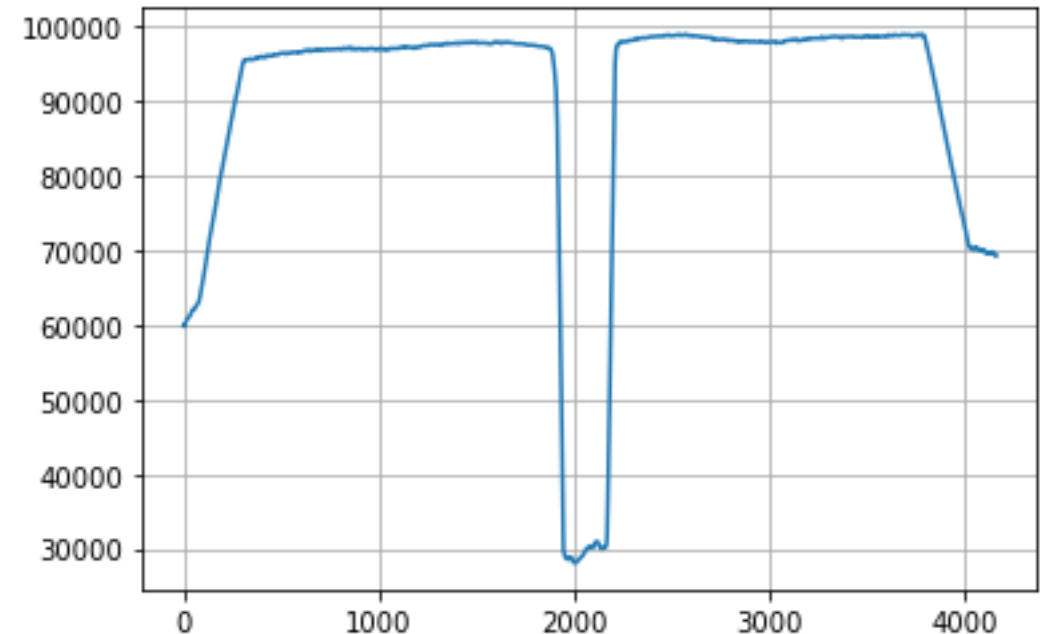
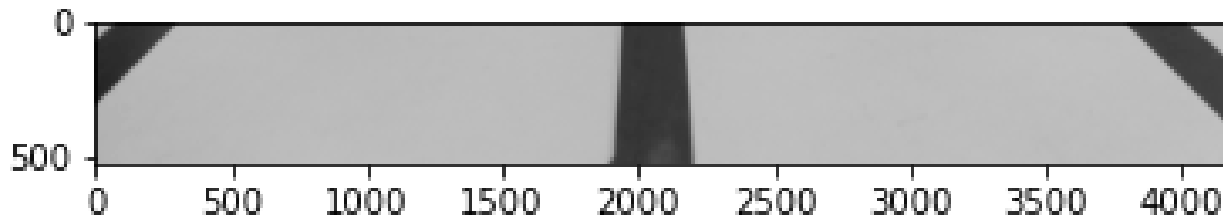
Image height

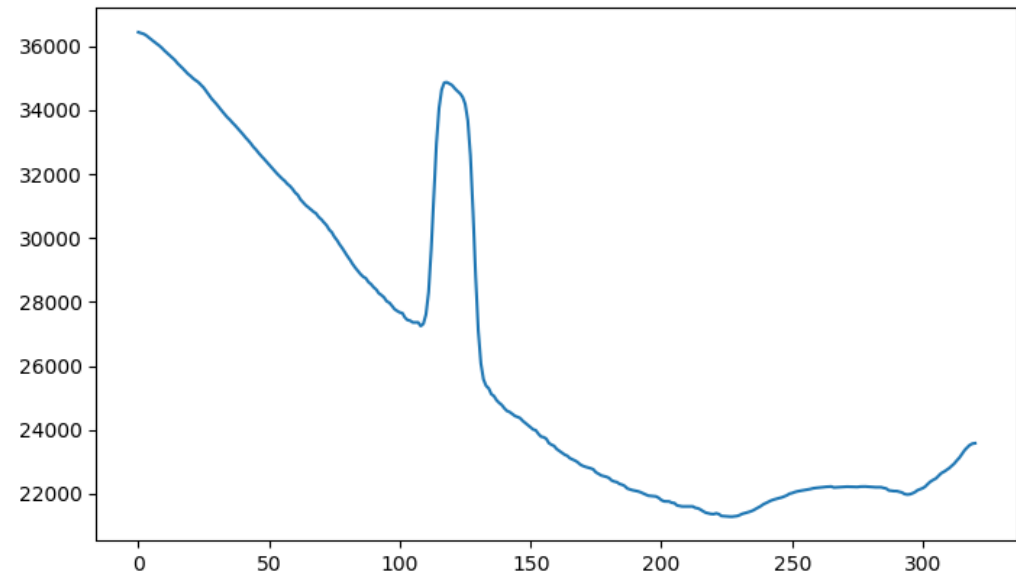
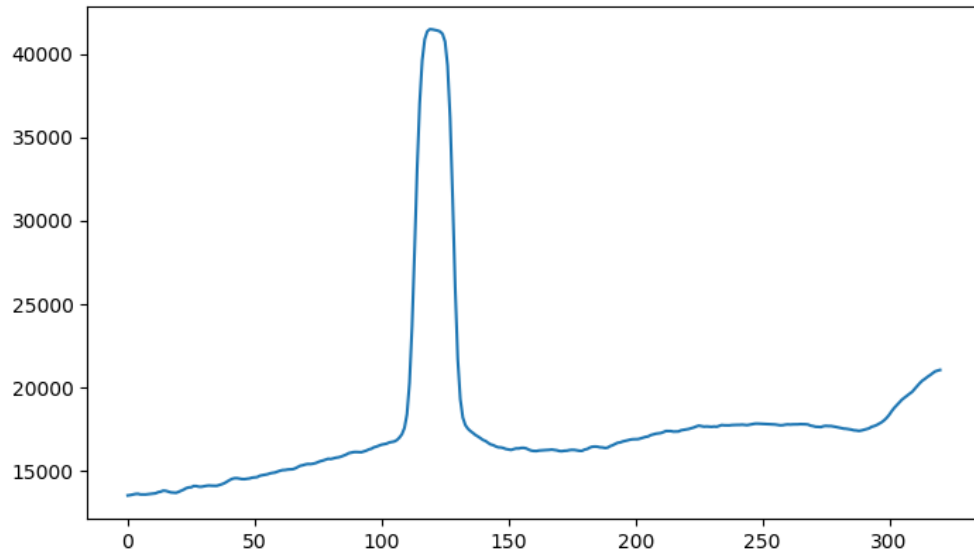
Image Width



# Convert to graph

- Exaggerate this by summing vertically
- This is easily done using numpy

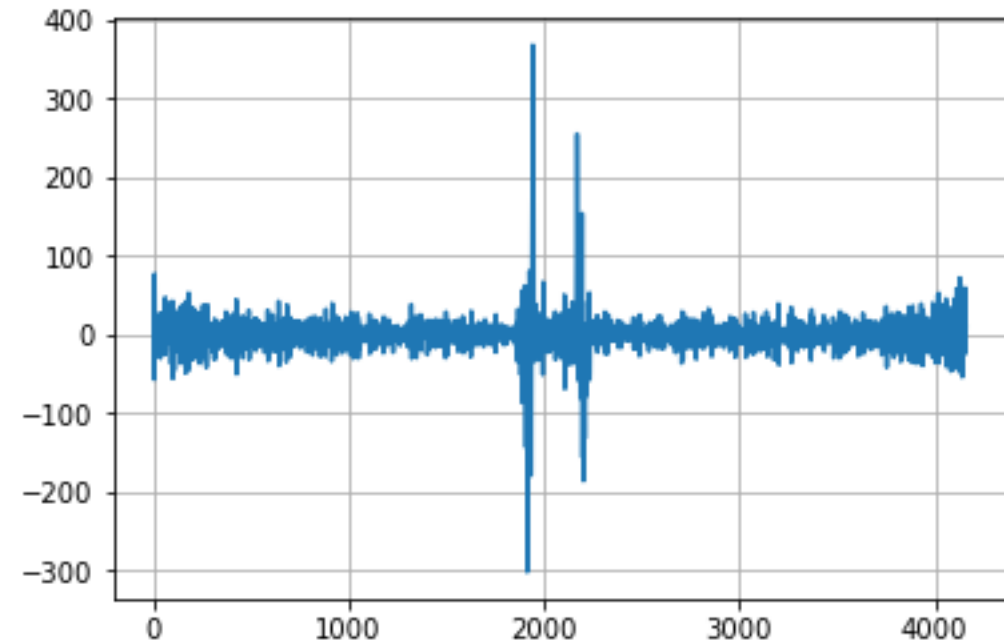
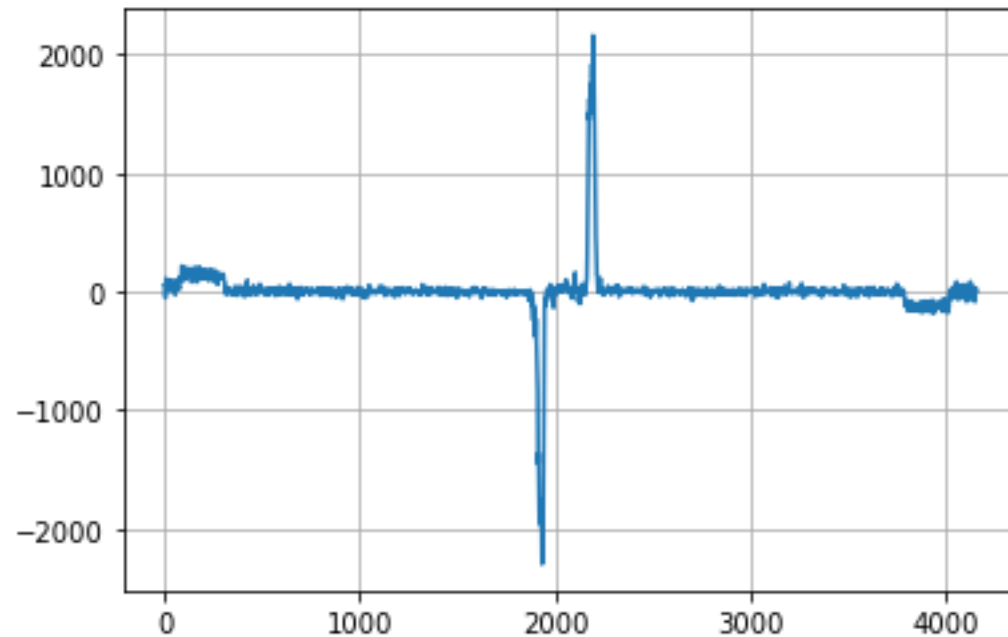




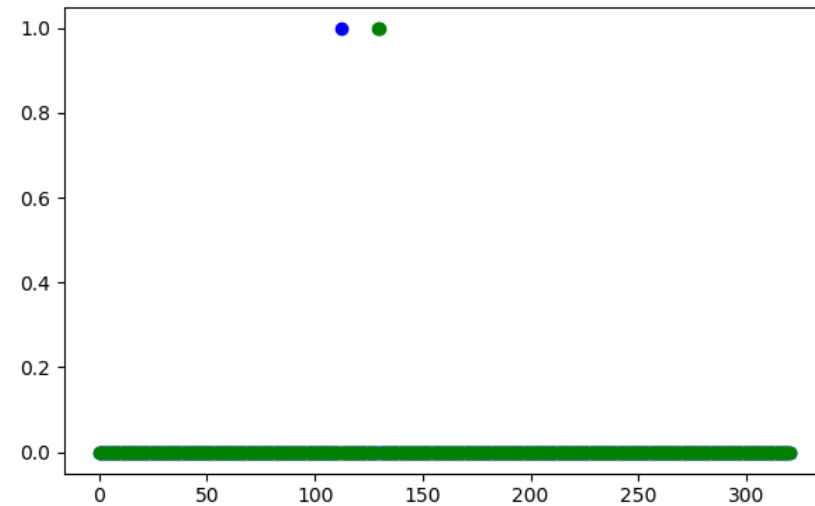
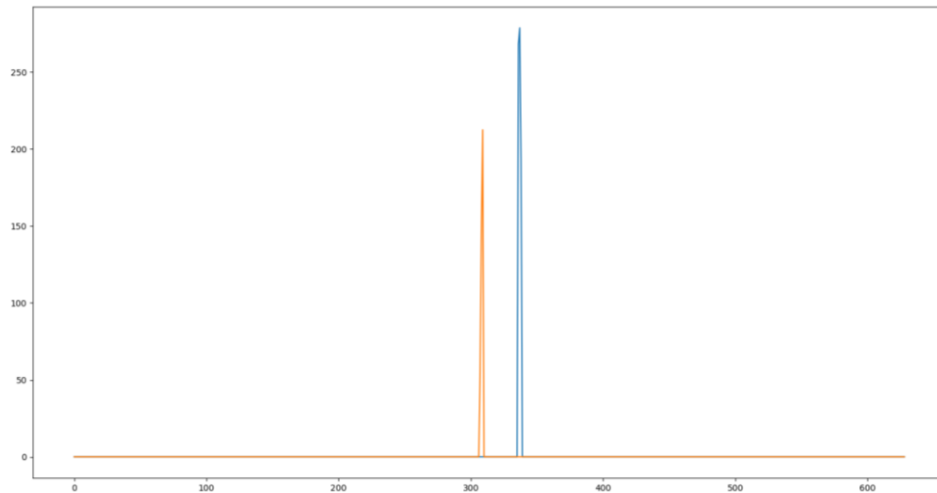
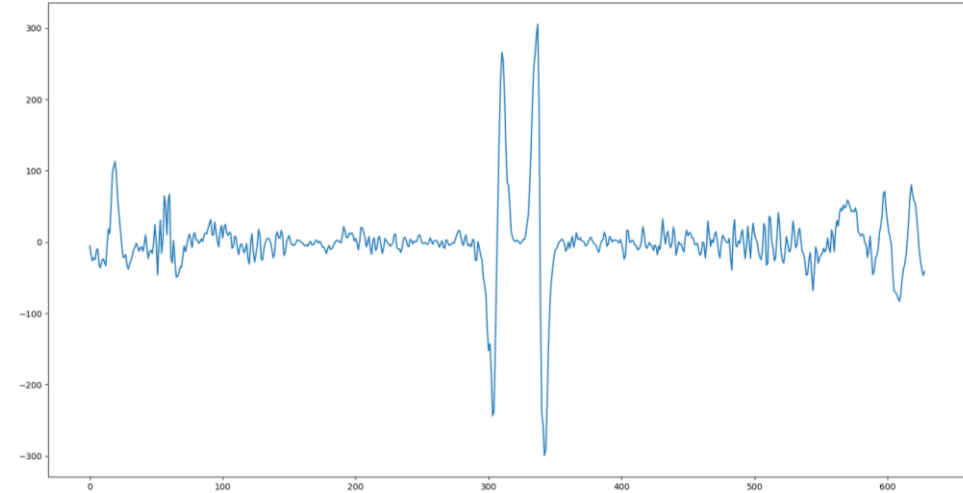
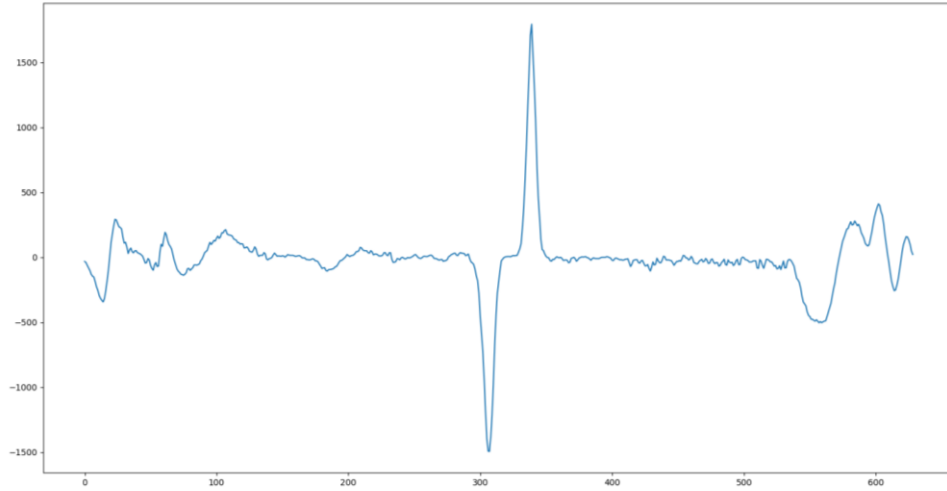
- Problems with this solution?

# Increasing reliability

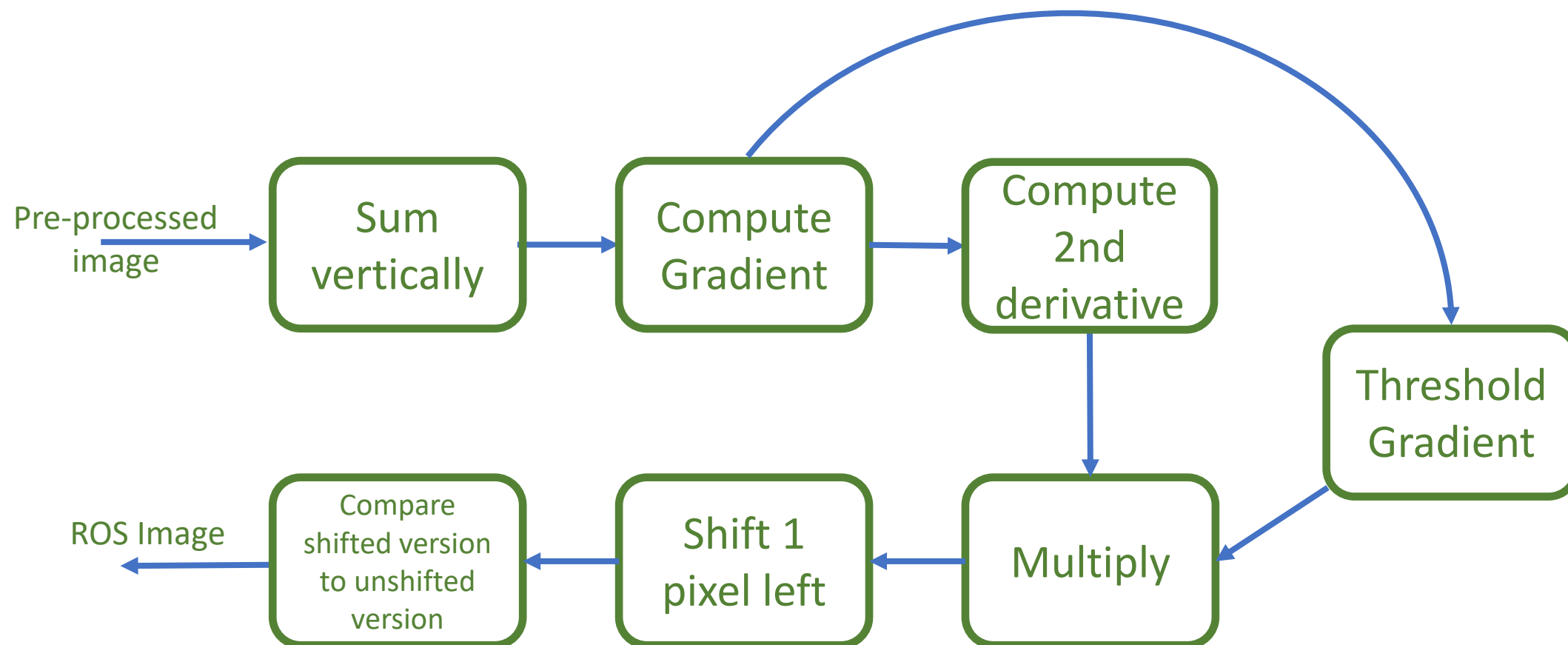
- If additional information could be extracted, the algorithm may become more reliable
- Using the derivative and second derivative can do this for us



# Increasing reliability



# Increasing reliability

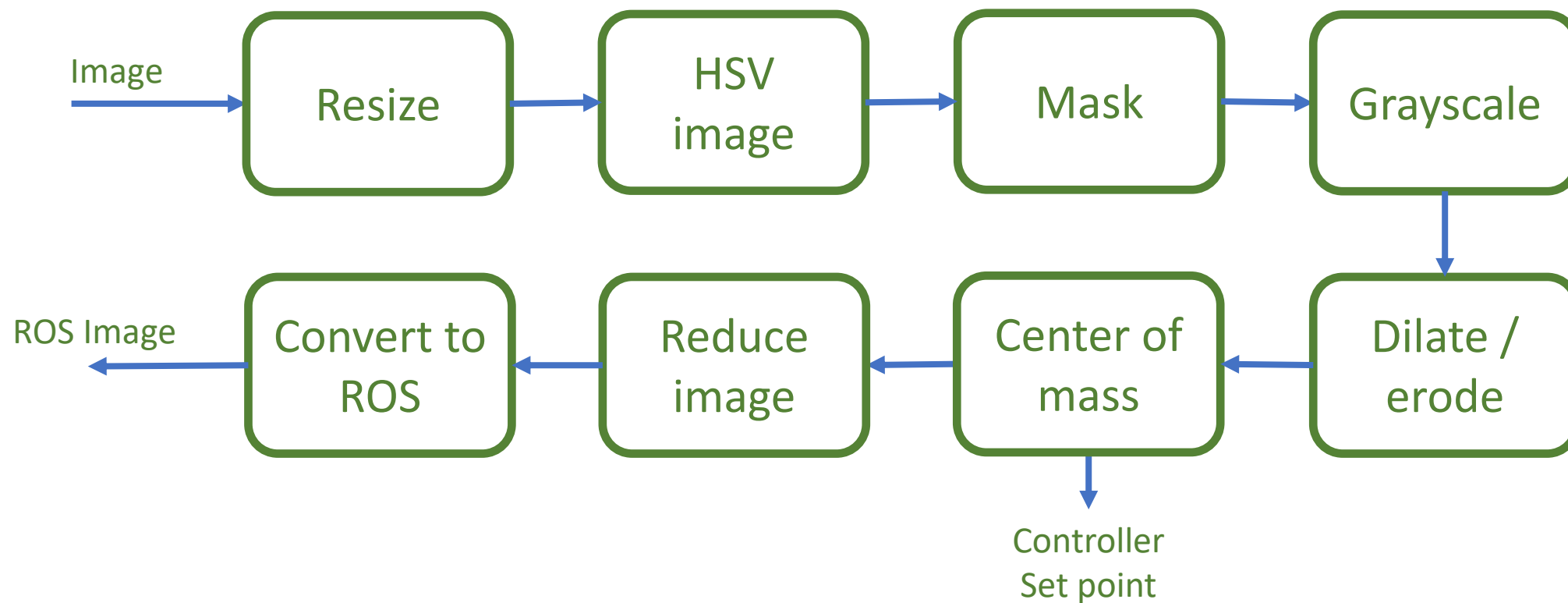




# Solution 2

## Center of Mass

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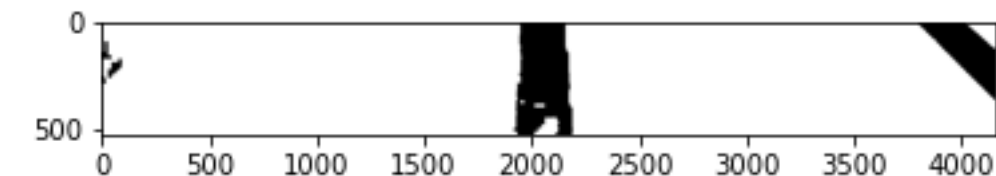
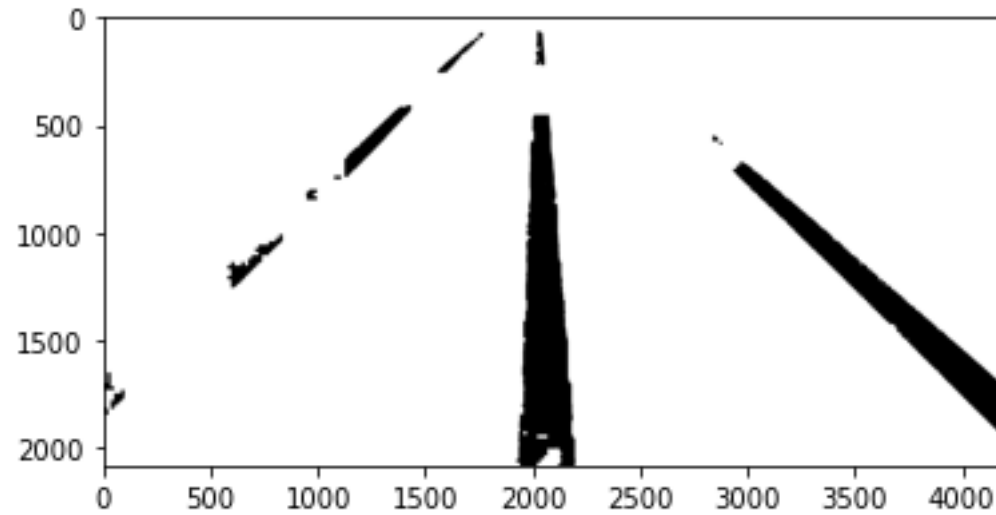
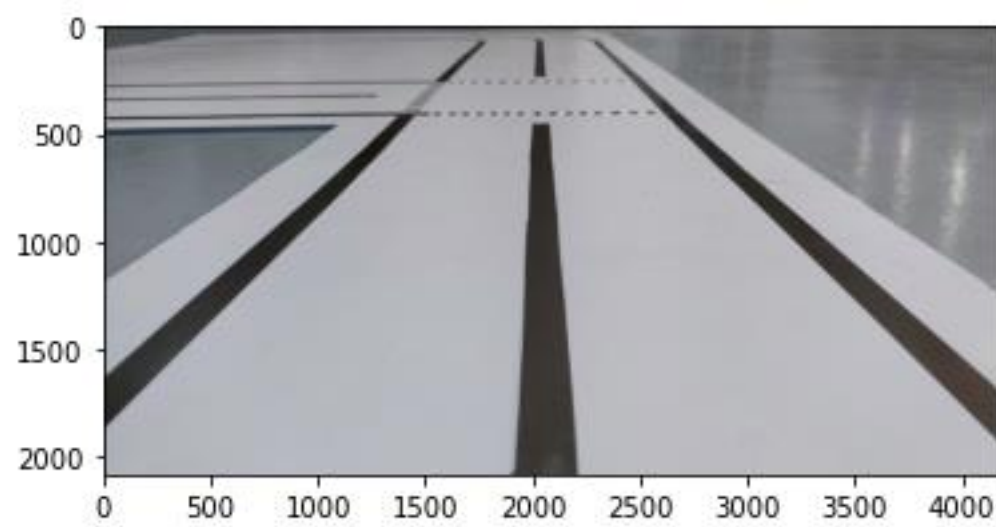


- Problems with this solution?



# Center of Mass

- Resize image
- Convert the image to HSV
- Create a mask
- Change to grayscale
- Apply a threshold
- Dilate and/or erode
- Reduce image

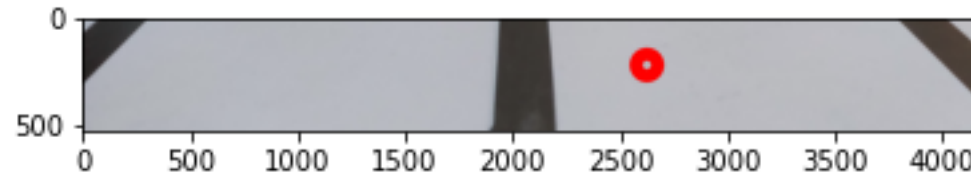
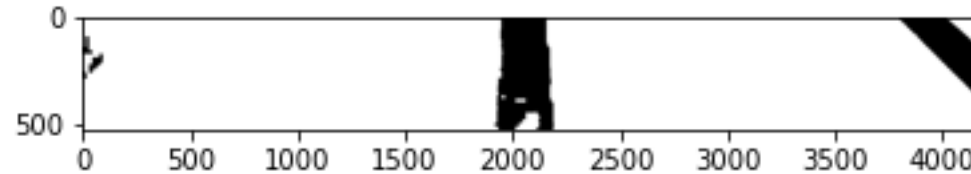




- $\mathbf{r} = \frac{\sum_i m_i \mathbf{r}_i}{\sum_i m_i} = \frac{1}{M} \sum_i m_i \mathbf{r}_i$

- Problems with this method?

- How can we correct the issues?

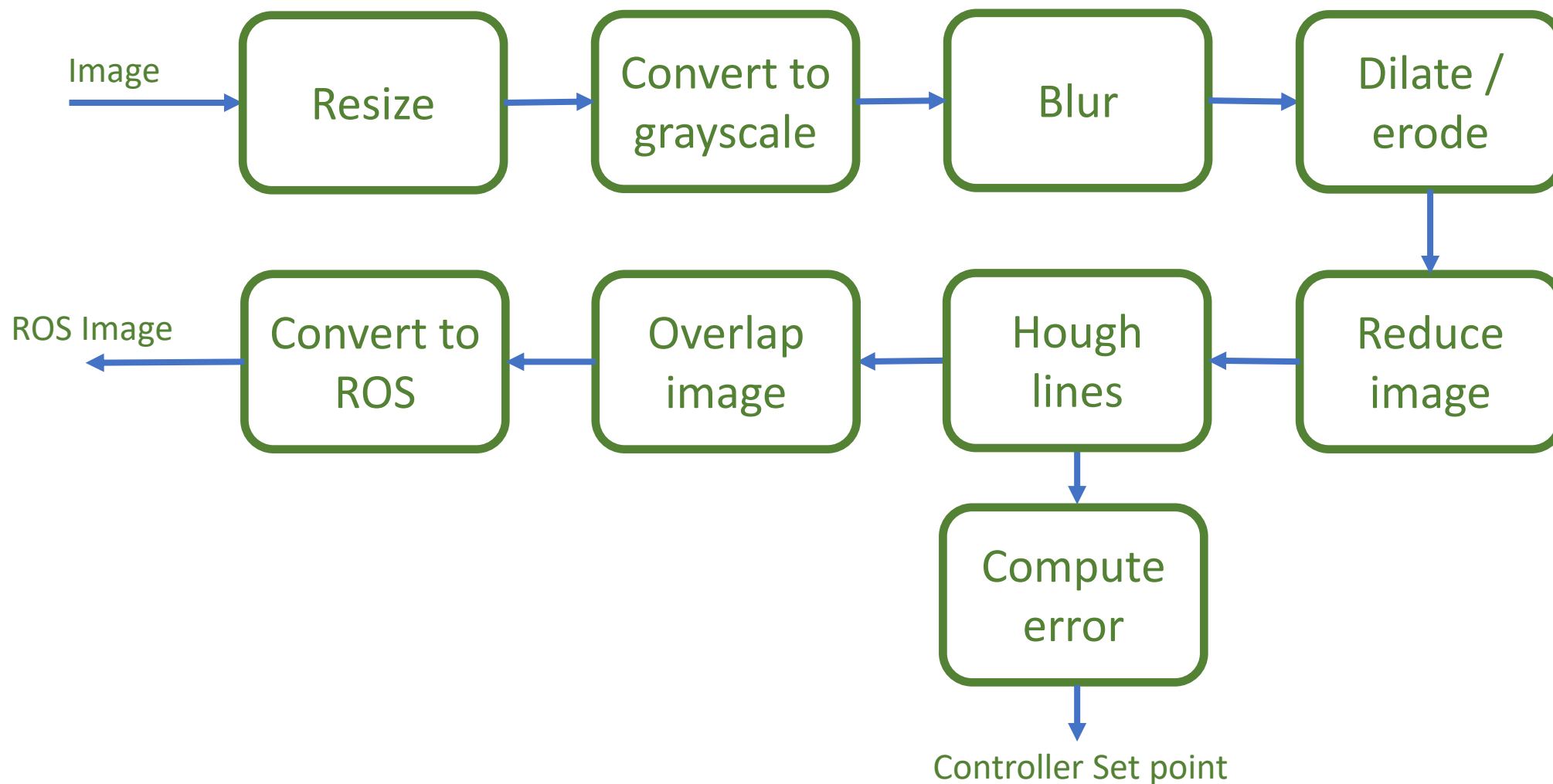




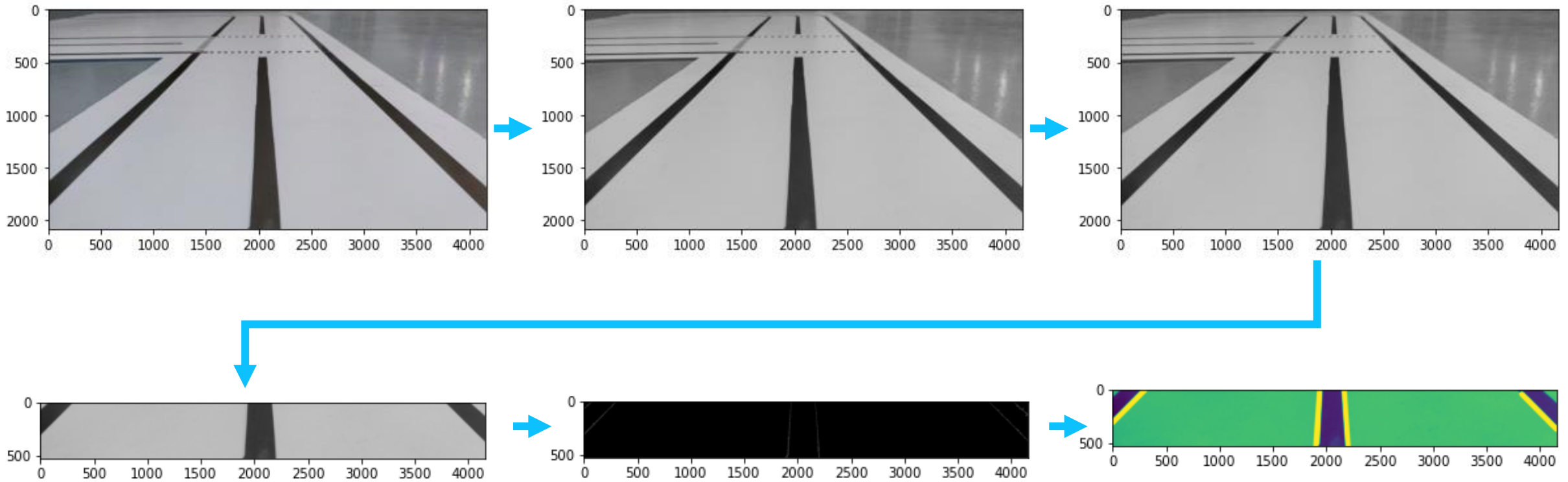
# Solution 3

## Hough Lines

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# Hough Lines

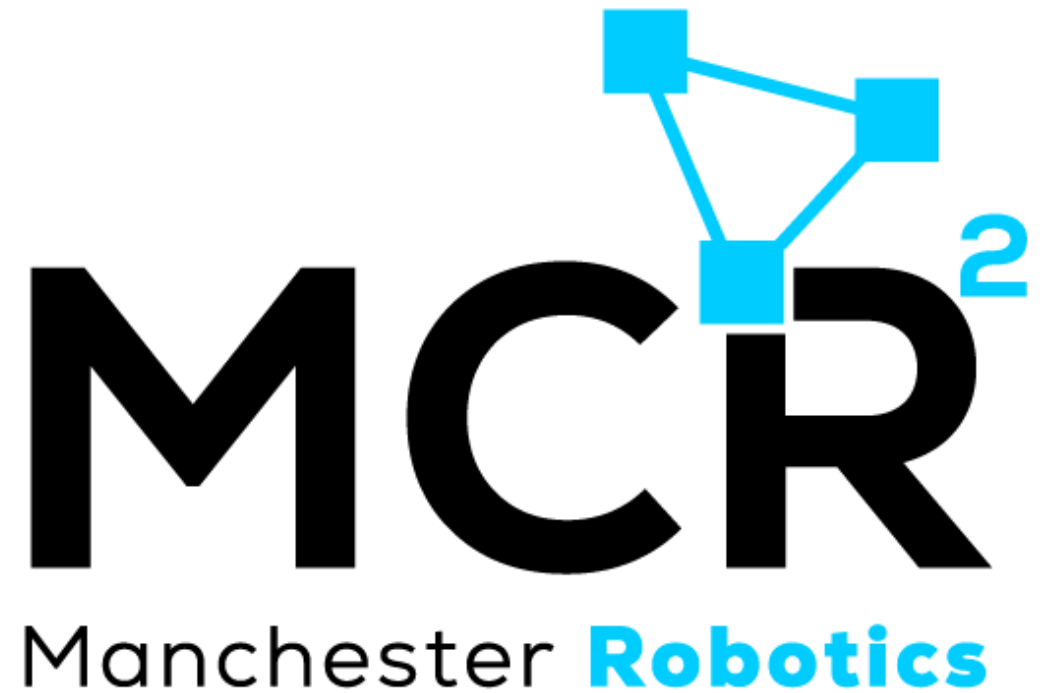


- What is the setpoint?

# Thank You

*Robotics For Everyone*

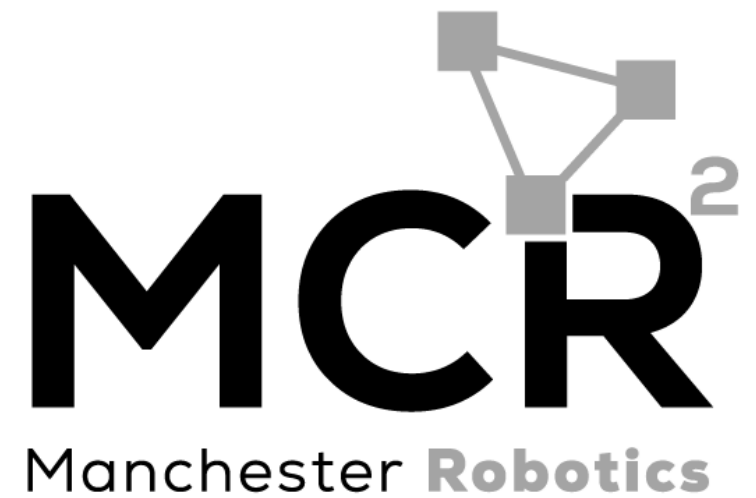
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# T&C

*Terms and conditions*

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