Lecture-08

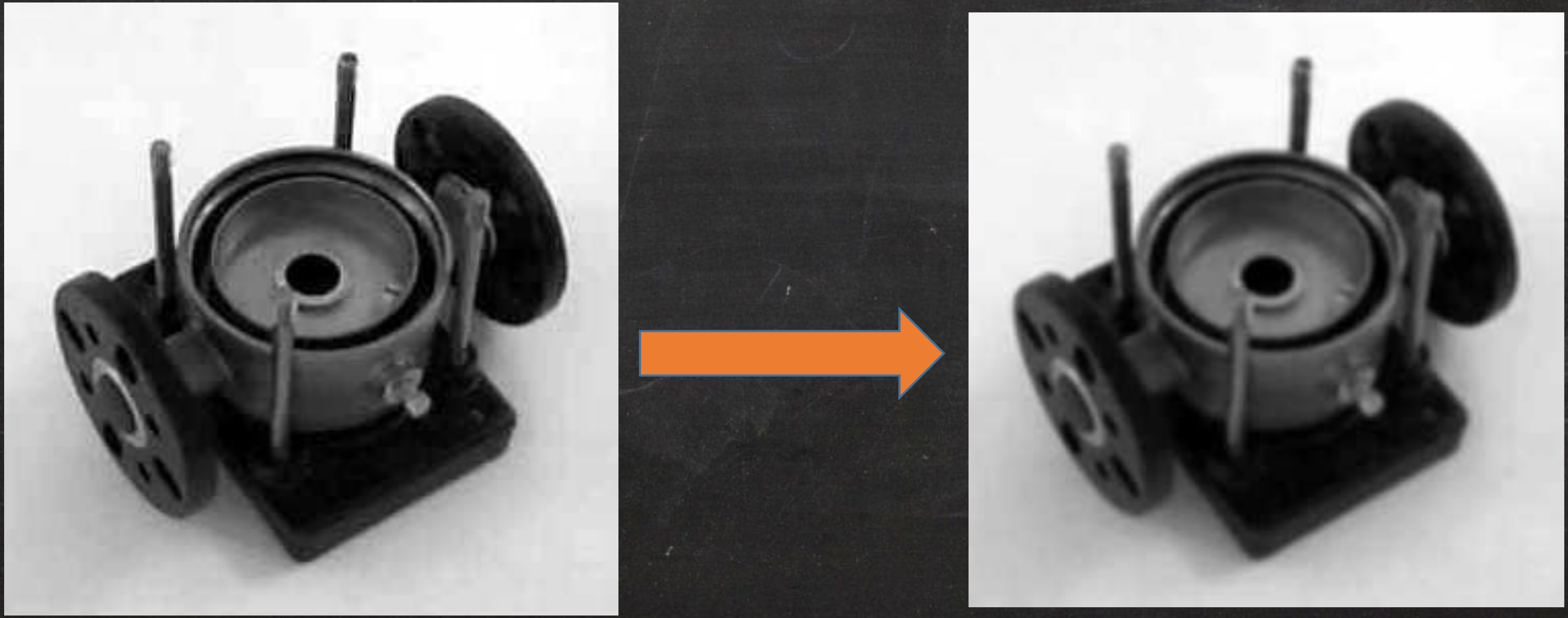
Feature Extraction

Canny edge detector

- The algorithm runs in 5 separate steps:
  - Smoothing: Blurring of the image to remove noise.
  - Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.
  - Non-maximum suppression: Only local maxima should be marked as edges.
  - Double thresholding: Potential edges are determined by thresholding.
  - Edge tracking by hysteresis: Final edges are determined by suppressing all edges that are not connected to a very certain (strong) edge.

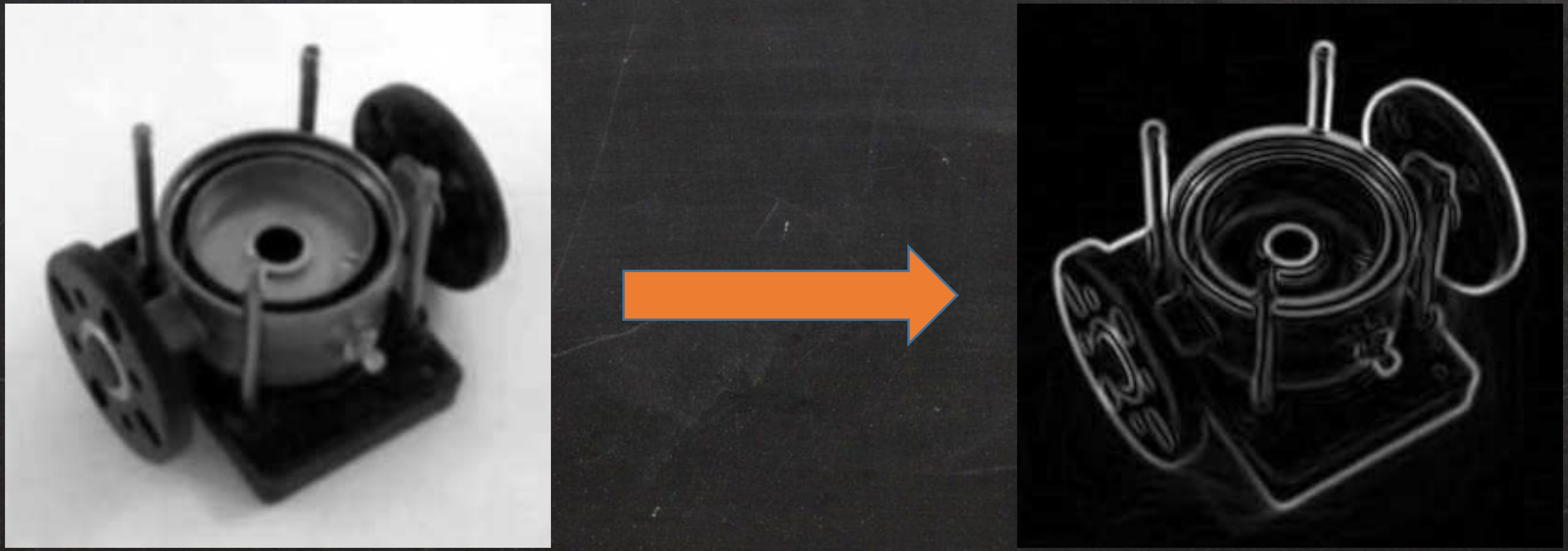
Canny edge detector

- Smoothing: Blurring of the image to remove noise.



Canny edge detector

- Finding gradients: The edges should be marked where the gradients of the image has large magnitudes.

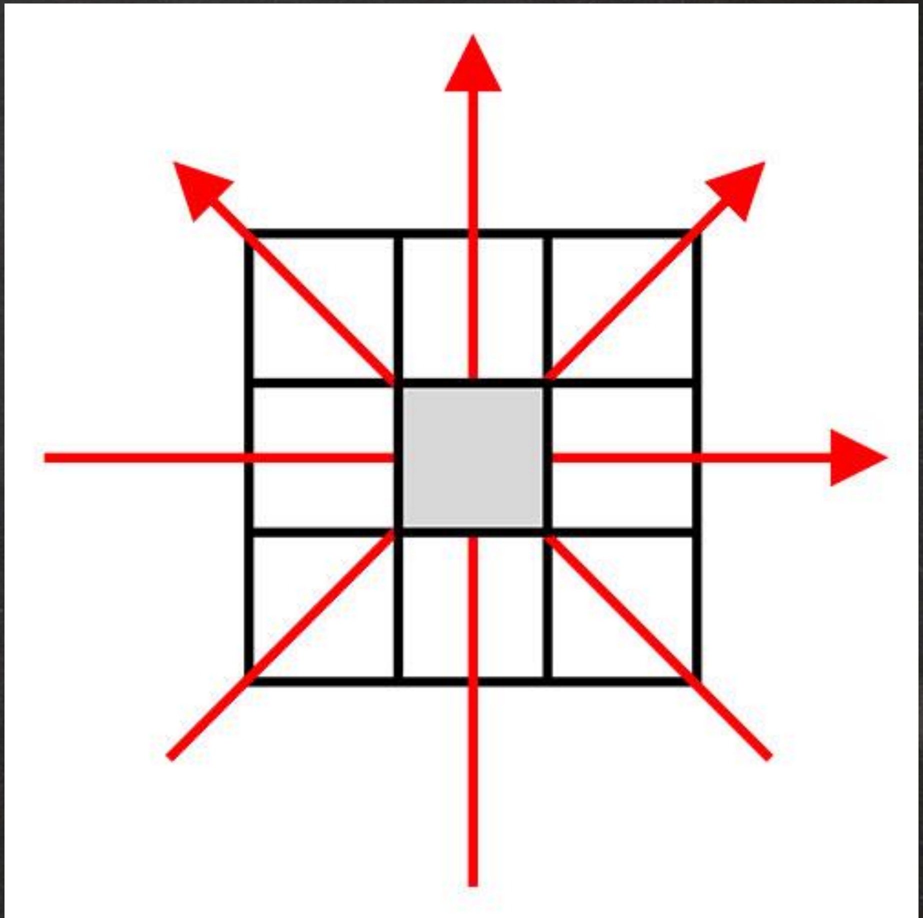


Canny edge detector

- Non-maximum suppression:
  - The purpose of this step is to convert the “blurred” edges in the image of the gradient magnitudes to “sharp” edges. Only local maxima should be marked as edges.
  - Round the gradient direction θ to nearest 45°, corresponding to the use of an 8-connected neighborhood.
  - Compare the edge strength of the current pixel with the edge strength of the pixel in the positive and negative gradient direction.
    - I.e. if the gradient direction is north (theta = 90 ◦), compare with the pixels to the north and south.
  - If the edge strength of the current pixel is largest; preserve the value of the edge strength. If not, suppress (i.e. remove) the value.

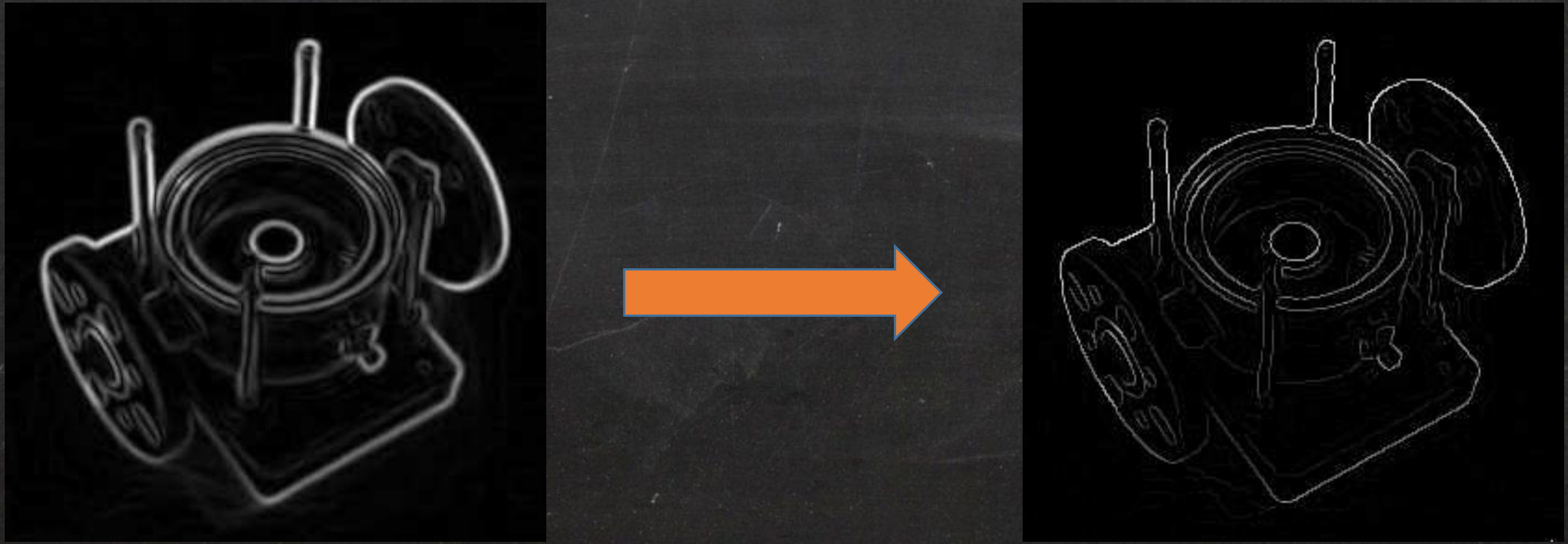
Canny edge detector

- Non-maximum suppression:
  - A pixel can have total 4 directions for the gradient since there are total 8 neighboring pixels.
  - We want to make sure no adjacent pixels are representing the same edge
  - we want to compare the Magnitude of the gradient between one pixel and it’s neighboring pixels along the same direction and select the pixel whose magnitude is the largest.



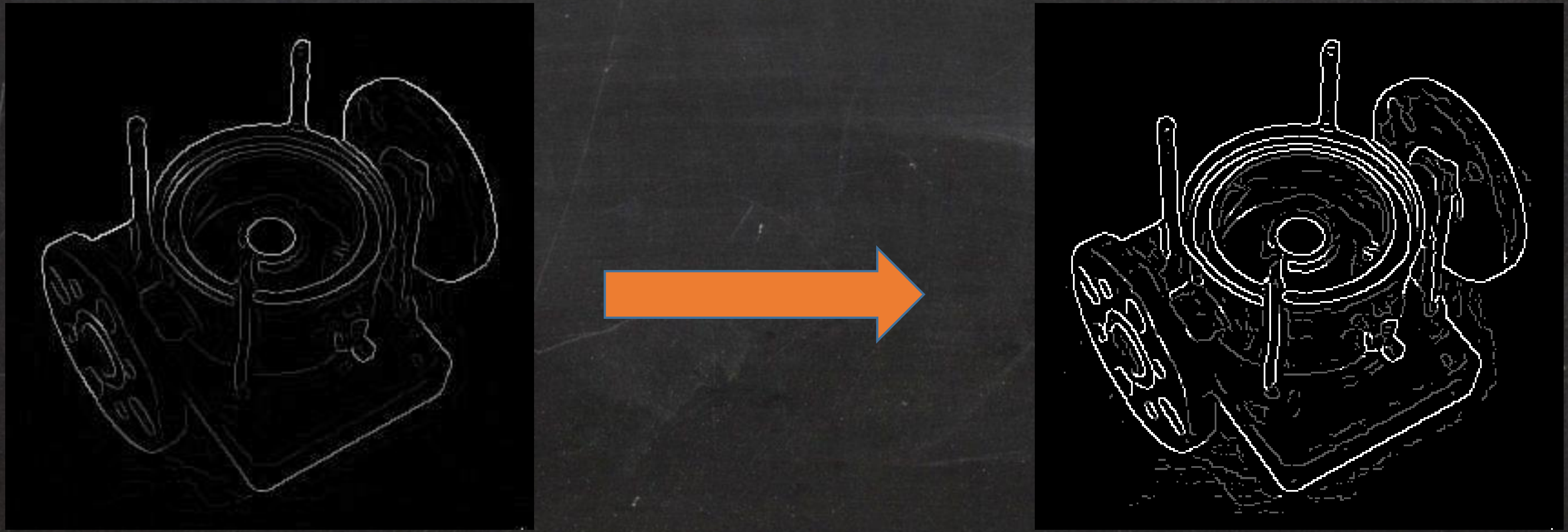
Canny edge detector

- Non-maximum suppression: Only local maxima should be marked as edges.



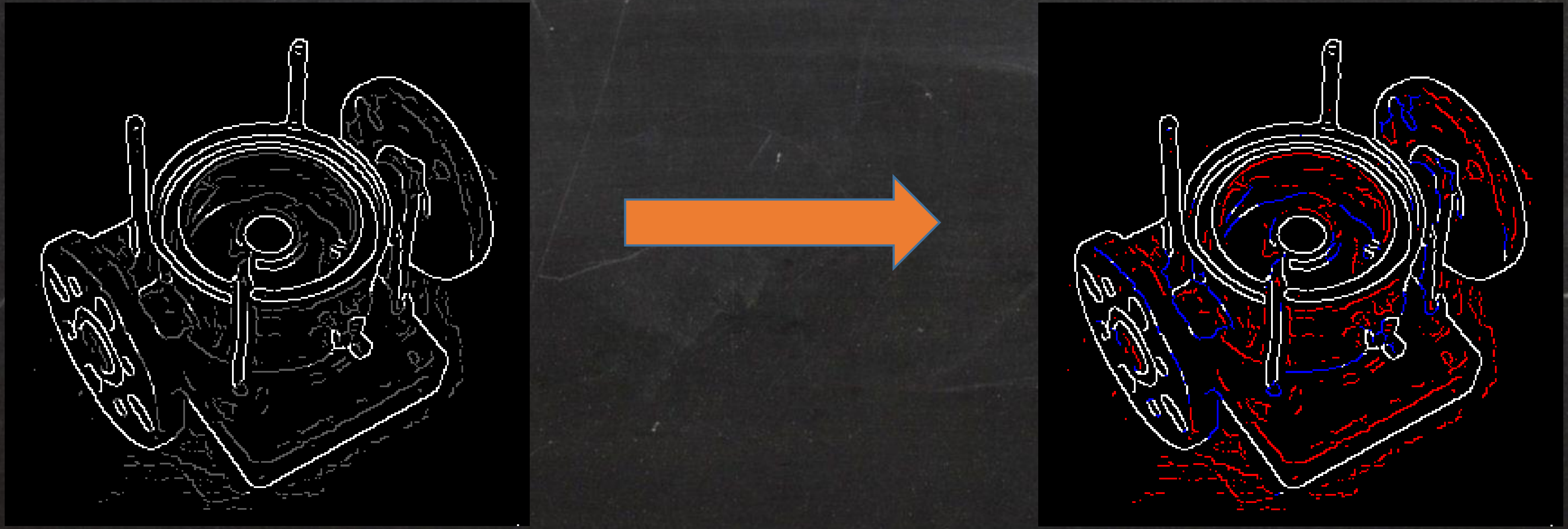
Canny edge detector

- Double thresholding: our objective is to produce clear edges (all the edge pixel will be 255).



Canny edge detector

- Edge tracking by hysteresis: The objective of the hysteresis function is to identify the weak pixels which can be edges and discard the remaining..



Canny edge detector

- Obvious question is how to determine which pixels are part of real edges?
  - We want to find out whether a selected pixel is connected to the already defined edge pixels, if so we can consider this pixel also to be part of an edge.
  - The simple solution is to find out whether any given pixels neighbors has value equal to 255, if yes then change the value of the pixel to 255, otherwise discard the pixel by setting the value to 0.

Canny edge detector