

Exercise 03 for MA-INF 2201 Computer Vision WS22/23
10.11.2022
Submission on 17.11.2022

1. Hough Transform for Circles

Read the image `billiards.png`.

- (a) Detect the circles by a Hough transform using `cv2.HoughCircles`.
Visualize the detections by drawing circles on the image.
- (b) Implement the function `myHoughCircles` and use it to detect the circles.
Visualize the detections and comment on how the result varies with different parameters.

(5 Points)

2. Mean Shift

Read the image `line.png` and use the given function `houghLines` to get the accumulator of the detected lines in the image. Then implement the mean shift algorithm to find the peaks in the accumulator. Visualize the accumulator and the lines corresponding to the peaks.

(For more details: *D. Comaniciu and P. Meer. Mean Shift: A Robust Approach Toward Feature Space Analysis. IEEE Transactions on Pattern Analysis and Machine Intelligence 2002.*)

(5 Points)

3. K-Means

Implement the function `myKmeans` and then use it to segment the image `flower.png` based on:

- (a) Intensity,
- (b) Color,
- (c) Intensity and (properly scaled) image position.

Visualize the results for all three cases with $k = 2, 4, 6$.

(5 Points)

4. Graph Cuts

Consider the graph shown in Figure 1 to answer the following questions:

- (a) Compute the eigenvector y corresponding to the second smallest eigenvalue of the following generalized eigenvalue problem

$$(D - W)y = \lambda Dy$$

where W is the affinity matrix of the graph and D is a diagonal matrix that contains the degrees of the vertices.

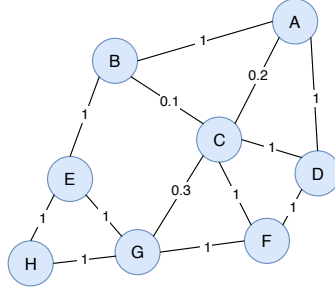


Figure 1: A simple graph. The weights are specified on the edges.

Hint: use `cv2.eigen` to solve the equivalent standard eigenvalue problem

$$D^{-\frac{1}{2}}(D - W)D^{-\frac{1}{2}}z = \lambda z ; \quad z = D^{\frac{1}{2}}y$$

- (b) Use the result of part (a) to find the minimum normalized cut $\text{NCut}(C_1, C_2)$. The sign of the values in the eigenvector computed in (a) determine the separation of the vertices into the two clusters C_1, C_2 . List the nodes in each cluster and compute the cost of the normalized cut.

(5 Points)