Lab11
Image Filtering and Corner Detection
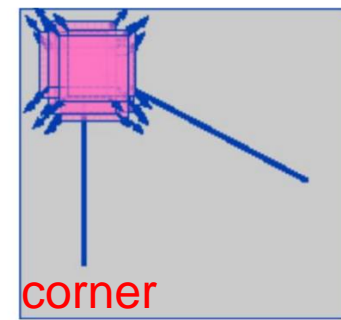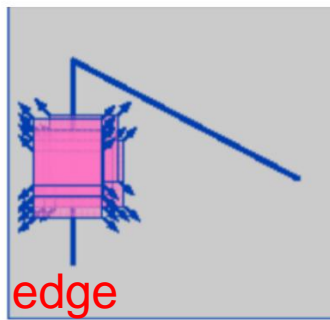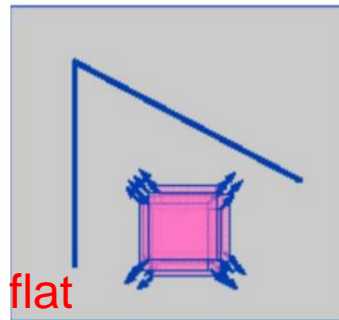
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2022/12/05

Introduction

- Corner: Drastic pixel value changes in all direction

flat

edge

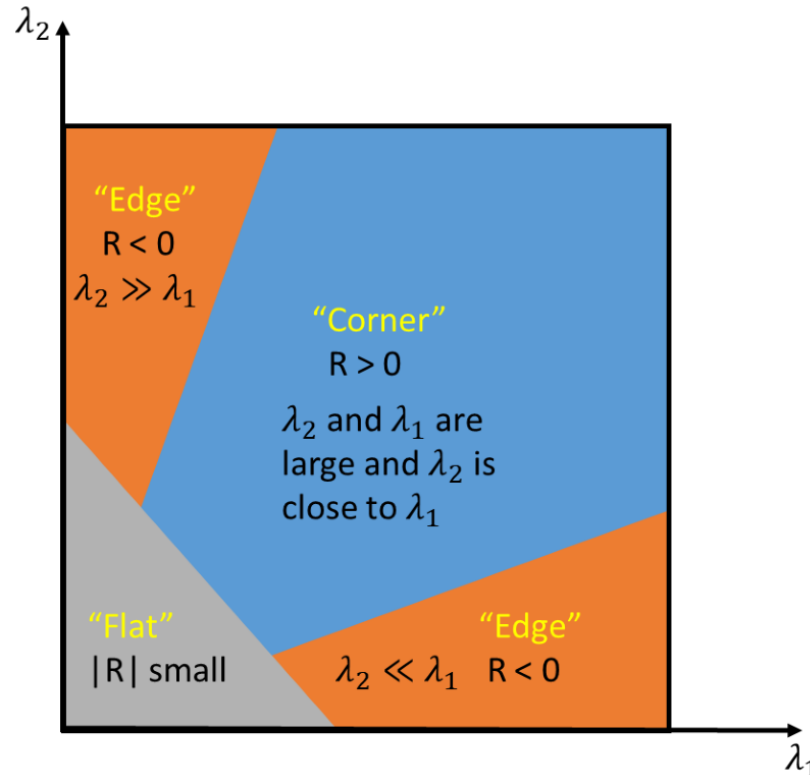corner

Harris Corner Detector

About Lab11

- TO-DO
  - In-Class Demo: show your results to TAs today or next week (12/12 Mon.) in class
  - Report

Find Corners (1/3)

- Definition of Corner: Response of each pixel is larger than a threshold

Find Corners (2/3)

(u, v)

$$E(u, v) = \sum_{x,y} w(x,y)|I(x+u, y+v) - I(x,y)|^2$$

Intensity (i.e. pixel value)
changes along direction (u, v)

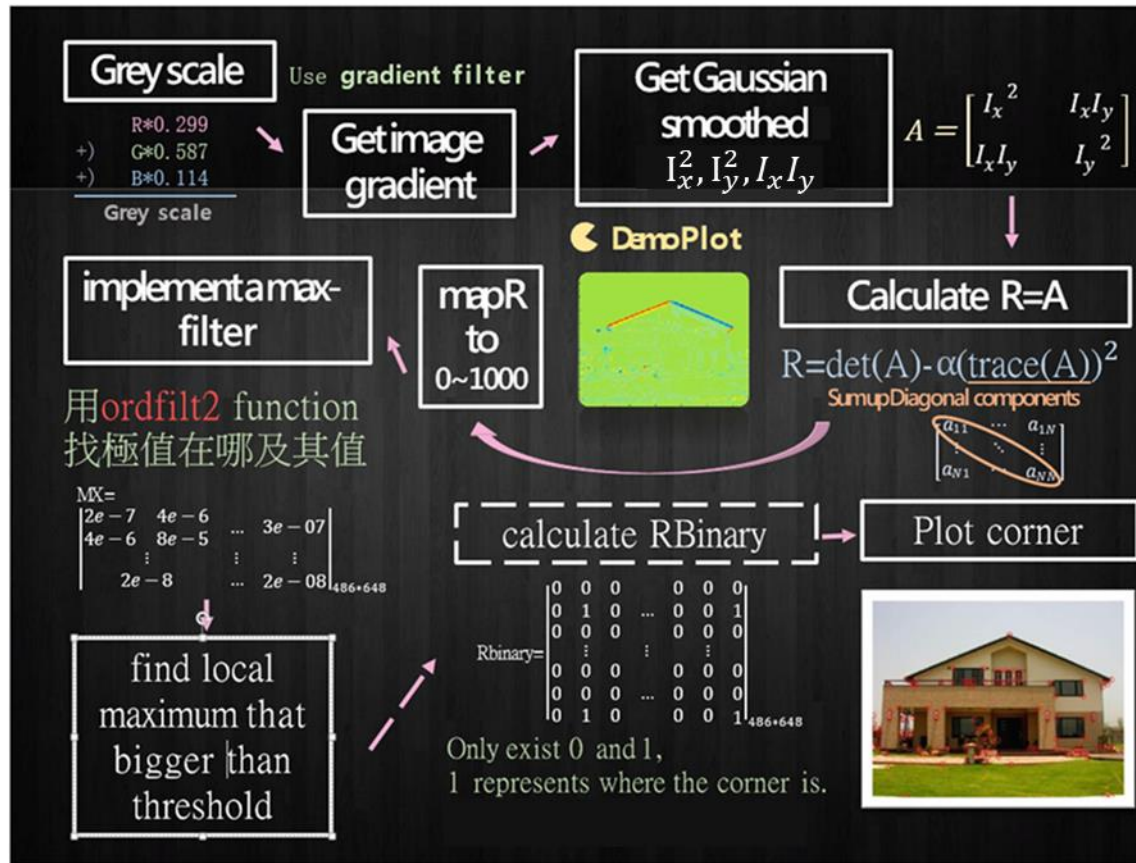$$E(u, v) = \sum_{x,y} (u \ \ v)w(x,y)\begin{pmatrix} I_x^2 & I_xI_y \\ I_xI_y & I_y^2 \end{pmatrix}\begin{pmatrix} u \\ v \end{pmatrix}$$

A: Harris matrix

$$R = \det(A) - k(\text{trace}(A))^2 = \lambda_1\lambda_2 - \alpha(\lambda_1 + \lambda_2)^2$$
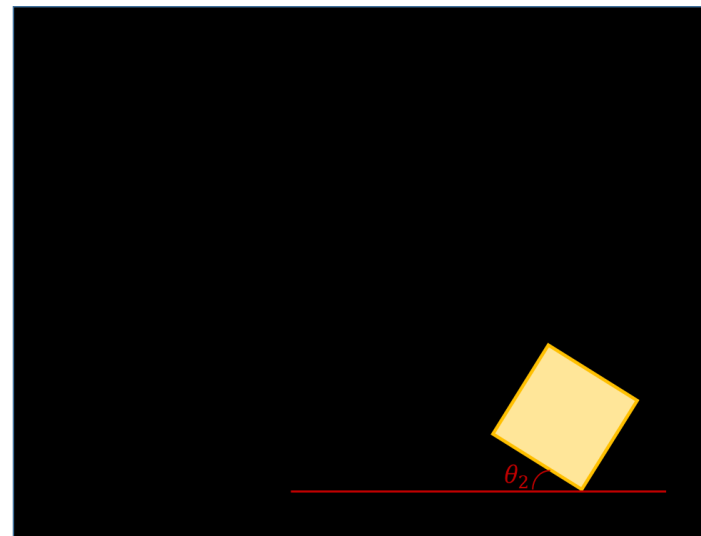
Find Corners (3/3)
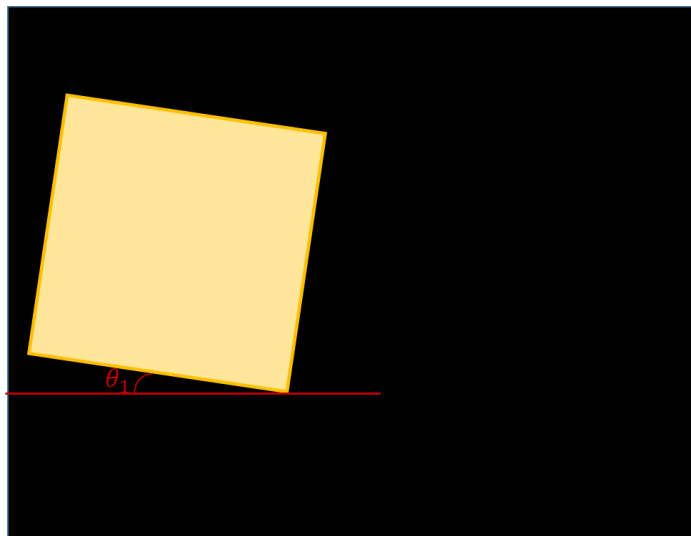
- Implement Harris corner detector in `FindCorners.m`

Built-in functions (e.g. imfilter, filter2) are welcomed to use

Demo Checklist

1. Calculate and plot Gaussian smoothed I_{xy}

2. Generate the image with corner detection

3. Use Harris corner detector to find corners and estimate yellow object's rotation degree (i.e. $\theta_2 - \theta_1$ in the figure below)

Report (1/2)

1. Show at least two different corner image generation results and each needs to contain the input image, Gaussian smoothed Ixy and corner detection result.

2. Please refer to the definition of **"edge"** to find edge in the given image, Im.jpg (put your code in **Lab11/code/FindEdge.m**). An example output is given below.

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Report (2/2)

3. Analyze the result of using Rectangular window function and try to discuss the differences between Rectangular window function and Gaussian window function. Besides, please try your own window function and explain the reason why you choose it.

4. What if we don't use any window functions to smooth Ix, Iy, IxIy?

5. Analyze the corner detection results using Prewitt and Scharr gradient filter. Besides, please try to discuss the differences and similarities between Prewitt and Scharr gradient filter.

Submission

- Deadline
  - 12/12 (Mon.) 23:59

- Submit to eeclass
  - Make sure the file delivery and organization meet the requirement
  - Wrong file delivery or organization will get up to 5% punishment

- If you have any question, feel free to
  - Ask on eeclass discussion (maybe other students also have the same question !)
  - Do not show your code on eeclass discussion or email your code to TA. Coding and debugging by yourself !