

## Lab #3: Feature Detection

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Course: *Computer Vision (CCE5205)* – Lecturer: *Dr. Reuben Farrugia*

The aim of this laboratory session is to detect discriminative key-points. In this lab session you will implement the Harris Corner Detection [1] algorithm and test it on real-world images. Download the Data/ folder from the VLE. This folder contains three files: i) `chessboard.jpg` is the image that will be used in the first part of the experiment, ii) `image010.jpg` and `image012.jpg` that will be used in the final evaluation.

**Question 1:** Use the `opencv` library to read the image and display it using the `matplotlib` library.



Figure 1: Chessboard image that will be used in this experiment

**Question 2:** Use the `opencv` library to derive the image gradients  $I_x$  and  $I_y$ <sup>1</sup>. See Fig.2 as an example.

**Question 3:** Use the image gradients to derive  $I_{xx}$ ,  $I_{yy}$  and  $I_{xy}$ . See Fig. 3 as an example.

**Question 4:** Derive the corner heat map matrix  $\mathbf{R}$  using the `np.linalg.eigvals()` function to derive the eigenvalues of the structure tensors.

**Question 5:** Derive an algorithm that will detect a key-points from the matrix  $\mathbf{R}$ .

**Question 6:** Use the developed Harris Corner Detection algorithm to detect key-points from `image010.jpg` and `image012.jpg`. Comment on the accuracy of the result.

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<sup>1</sup>The sobel operator is a kernel that is generally adopted to derive the image gradients.

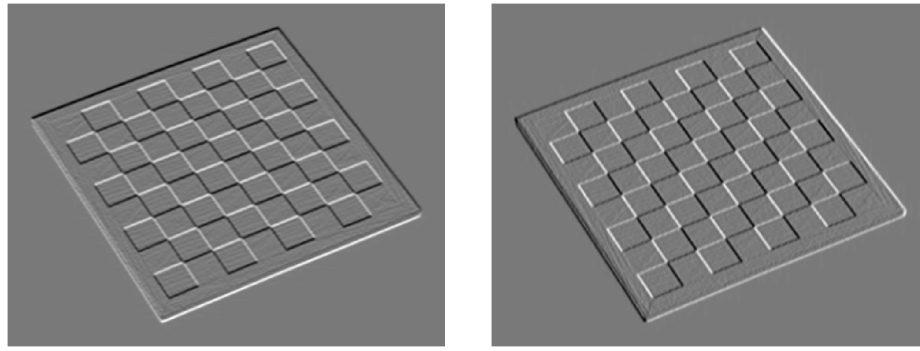
(a) Gradient image  $I_x$ (b) Gradient image  $I_y$ 

Figure 2: Image gradients.

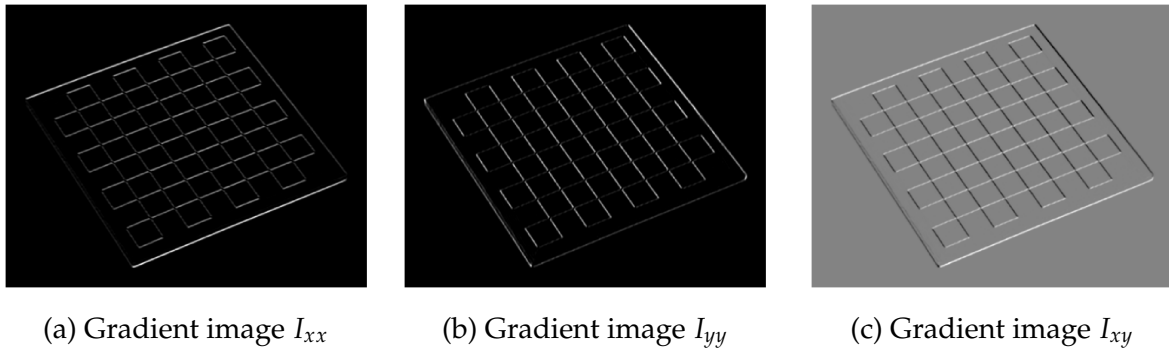
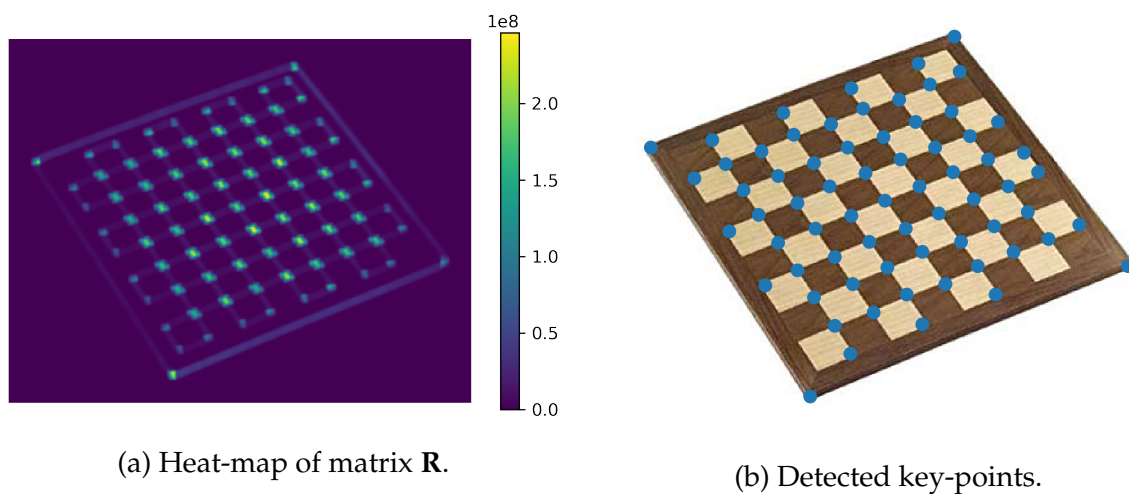
(a) Gradient image  $I_{xx}$ (b) Gradient image  $I_{yy}$ (c) Gradient image  $I_{xy}$ 

Figure 3: Image gradients.

(a) Heat-map of matrix  $\mathbf{R}$ .

(b) Detected key-points.

Figure 4: The heat-map of the matrix  $\mathbf{R}$  and the resulting key-points.

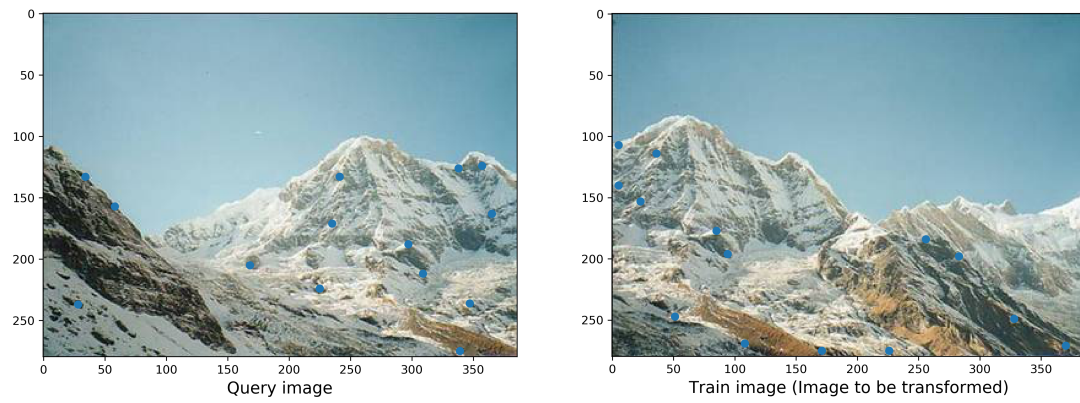


Figure 5: Key-points detected on two landscape images.

### References

- [1] C. Harris and M. Stephens, “A combined corner and edge detector,” in *Proceedings of the 4th Alvey Vision Conference*, pp. 147–151, 1988.