UNIVERSITY OF MALTA
DEPARTMENT OF COMMUNICATIONS AND COMPUTER ENGINEERING

Assignment: Video Tracking

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

Video tracking is the process of locating a moving object (or multiple objects) over time using a video camera. It has a variety of uses, some of which are: human-computer interaction, security and surveillance, video communication and compression, augmented reality, traffic control, medical imaging and video editing. Video tracking algorithms are quite mature and are able to track objects in real-world scenarios.

This assignment is to be attempted individually. Download and unzip the `./Data/` folder which contains the `traffic.mp4` video sequence. The Data folder must be placed in the current working directory. All code needs to be developed in Python 3 on a Ubuntu 18.04 environment. The student is requested to include the following files in a folder that will be zipped and uploaded on the VLE.

- A readme file including a list of packages needed to execute the code. The use of standard packages that are included in Anaconda is highly recommended.
- A Jupyter notebook(s) that allows the user to view how each question is addressed.
- A report (4 pages excluding references) describing the denoising algorithm in Part II and the experimental results.

Unless otherwise specified, the following questions need to be coded in a Jupyter notebook in a file named `video_tracking.ipynb`.

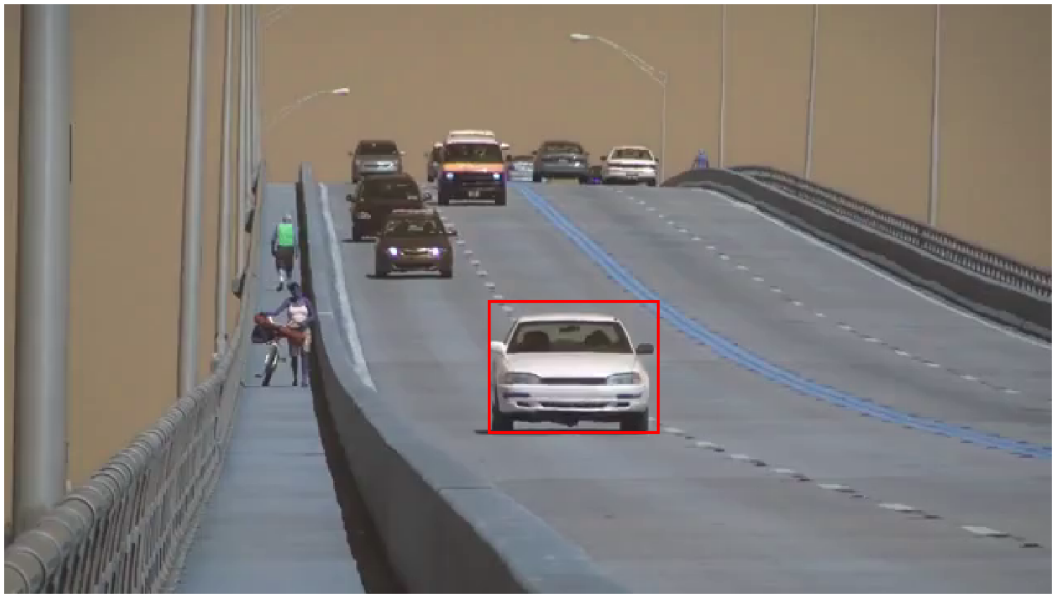


Figure 1: First frame with bounding box marked in red.

1. Part 1: Key Point Detection

Question 1: Use the `opencv` and `matplotlib` libraries to load and display the the first frame of the `traffic.mp4` video sequence. Display a bounding box $(296, 181)$ as top-left coordinates and $(399, 261)$ as bottom-right coordinates.

(5 marks)

Question 2: Use the `numpy` and `skimage` libraries to develop from scratch the Harris Corner Detection algorithm [1] over the region defined by the bounding box illustrated in Fig. 1. A sample results can be observed in Fig. 2.

(30 marks)

Question 3: Use the `numpy` and `skimage` libraries to develop from scratch the Horn and Schunck Optical flow algorithm [2] over the whole image. Show results computed using the first two frames of the video sequence.

(30 marks)

Question 4: Use the developed optical flow to track the detected keypoints in Question 1 for the first 100 video frames. Fig. 3 illustrate some example of tracked key points.

(20 marks)

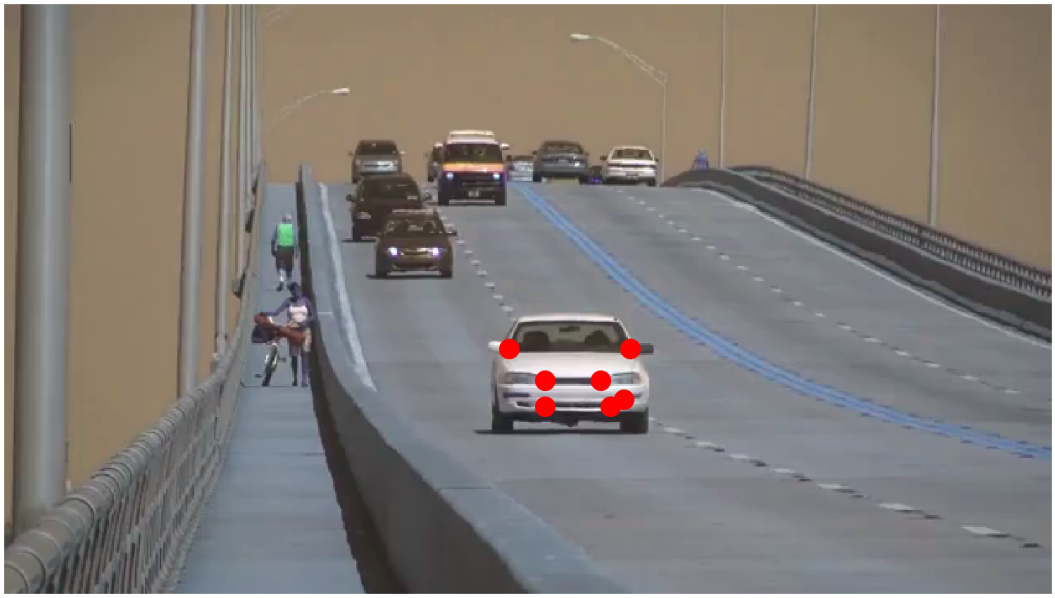
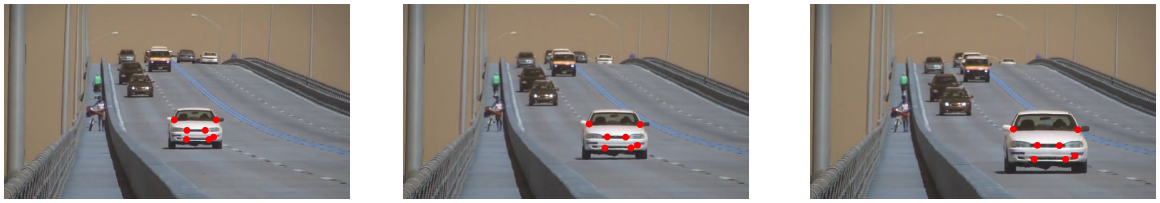


Figure 2: Feature points detected using Harris Corner Detection.



(a) Frame 10 (b) Frame 50 (c) Frame 90

Figure 3: Images restored using the BM3D algorithm [**?**].

Question 5: Plot the trajectory of the white car during the first 100 frames. Superimpose the trajectory on the first frame of the video.

(5 marks)

The remaining **10 marks** are used to grade the quality of the report i.e. language, organization, clarity of explanations and experimental results.

References

[1] C. Harris and M. Stephens, "A combined corner and edge detector," in *In Proc. of Fourth Alvey Vision Conference*, pp. 147–151, 1988.

[2] B. K. Horn and B. G. Schunck, "Determining optical flow," tech. rep., USA, 1980.