Computer Vision: Lab 7
Image Matching and Retrieval

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1 Introduction

The goal of this lab is to assess different strategies for image retrieval, practicing with their use and observing differences among them. We focused our work on visual recognition that consist in find similarities between images and objects in them.

2 Image matching

Features matching, or generally image matching, consist in finding correspondences between two images of the same scene or object. In this section we used the given code $Labo8\_part1.m$ which it implements a solution for image matching. Given a template image, the goal is to find the key points of the template in another wider and complex image. The key points are taken in corners and edges of the object. The points are selected in a way to have a unique matching. We tried with two different methods:

- Euclidean distance with Normalized-Cross Correlation (NCC)
- Scale-Invariant Feature Transform descriptors (SIFT).

The difference between this methods is how they compute the match between points. For the tests required for this section of the lab we used pairs of images that are a section of an image and the image itself or two similar images taken from a different point of view. Using the provided code, we started several tests with different values as parameters of the functions.

2.1 NNC

We set the standard deviation sigma as 1, since sigma has pixels as unit measure, and the threshold to 0.5. We found 60 features matches, but not all of them are perfectly matched. Here the most relevant results of our tests done by changing sigma and threshold:

Sigma	Threshold	Matches
1	0.5	60
1	0.75	28
2	0.75	14

When we increased the value of sigma the number of identified features diminishes as we can see in the images obviously also increasing the the percentage of threshold less feature were taking into account.

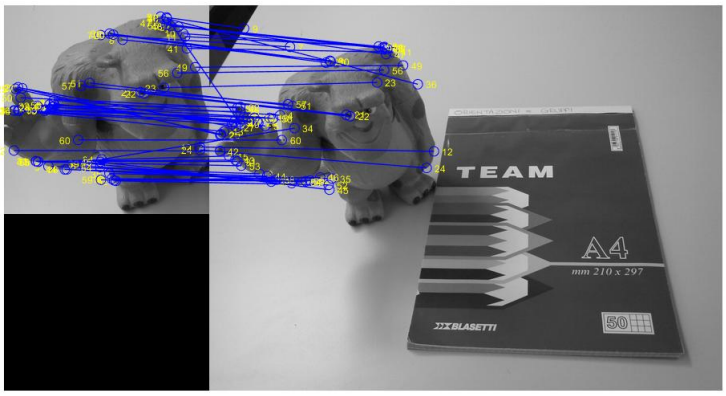

Figure 1: sigma=1 threshold=0.50

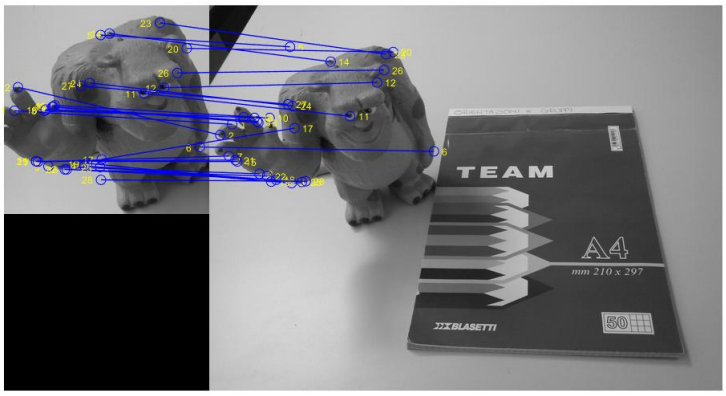

Figure 2: sigma=1 threshold=0.75

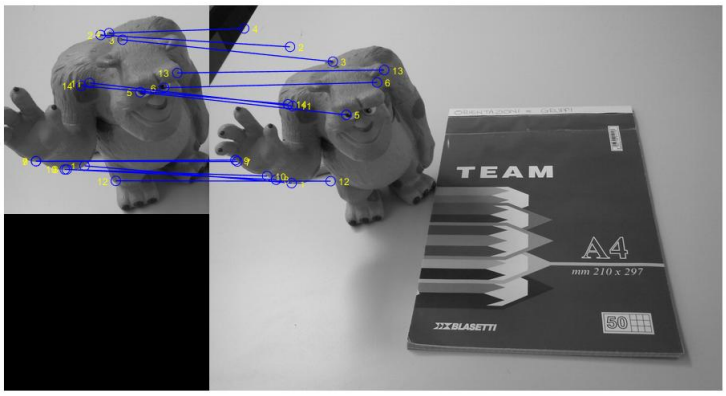

Figure 3: sigma=2 threshold=0.75

2.2 SIFT

We set the standard deviation sigma to 1 and the threshold to 0.50. We found 43 matches and approximately all of them are well paired. Here the most relevant results of our tests done by changing sigma and threshold:

Sigma	Threshold	Matches
1	0.5	43
0.5	0.5	45
0.80	0.5	47

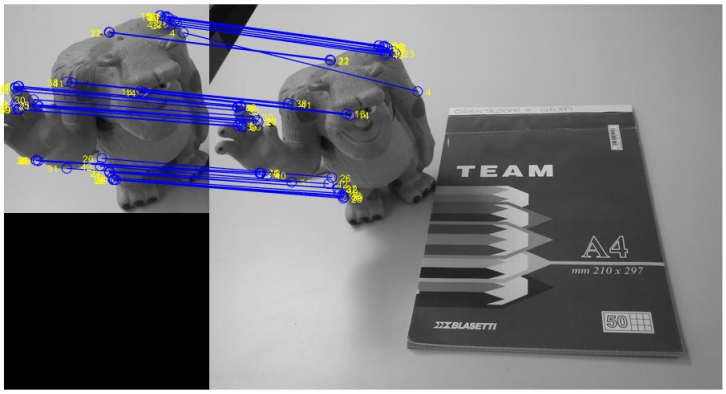

Figure 4: sigma=1 threshold=0.50

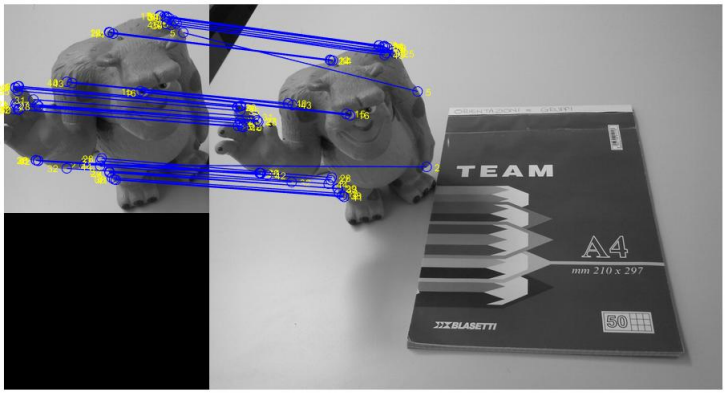

Figure 5: sigma=0.50 threshold=0.60

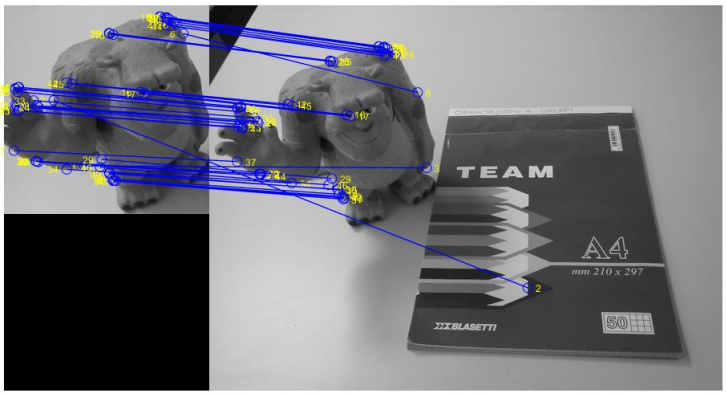

Figure 6: sigma=0.8 threshold=0.50

All the result obtained with the SIFT were more precise than the NCC ones, almost all pairs of points were corresponding.

3 Image retrieval

The file *Labo8_part2.m* implements a solution for image retrieval using a representation based on SIFT descriptors and the bag-of-keypoints paradigm. The SIFT descriptors are used in order to find similarities in a set of different sample images (more or less related) called dictionary. The main goal is to take a query image and order the gallery by similarity with respect to the chosen one. In our case the dictionary was created by the given code. An image is selected as query among 32 possible choices. The code finds 10 images that are more similar to the pattern and orders them by similarity matches. We made two test with different images and, as can be seen below, some of the images are completely different from the template but the algorithm is able to find resemblances.

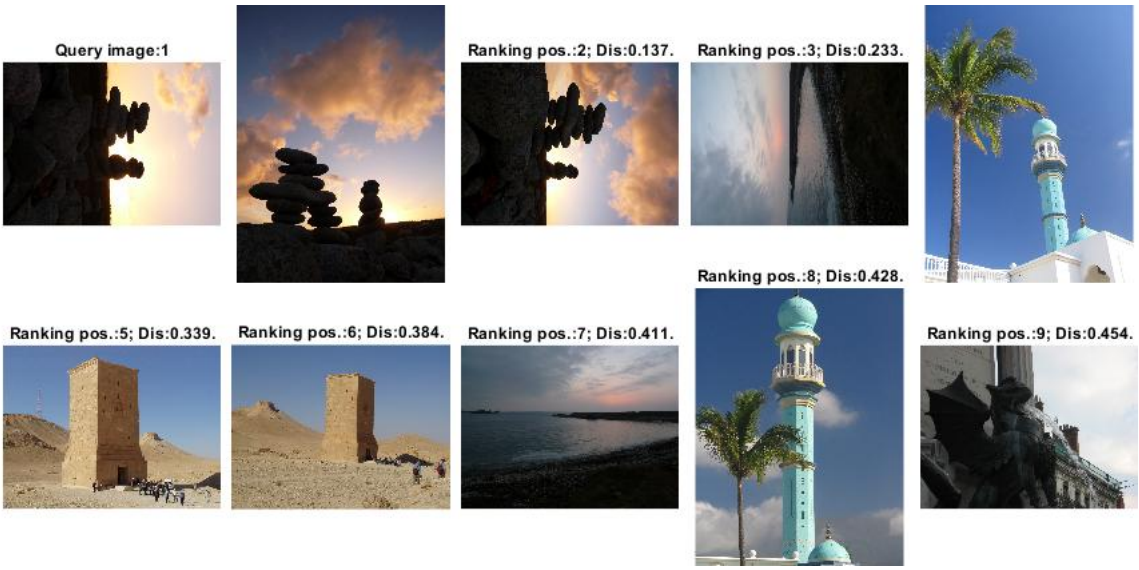

Figure 7: Dictionary clusters= 100

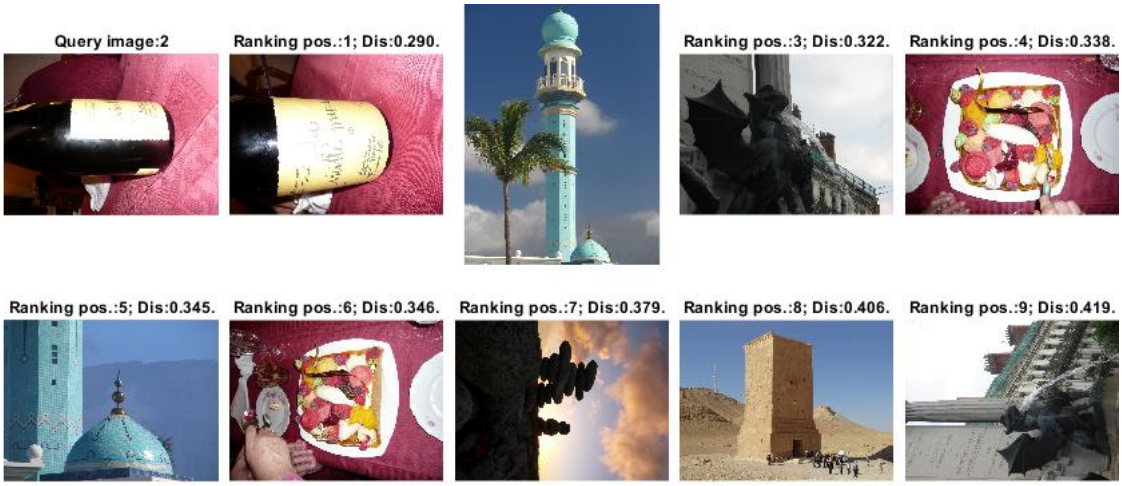

Figure 8: Dictionary clusters= 100

We made other tests with a different dictionary clusters. We noticed that by increasing the number of clusters the images are much more similar to the query image, but the computational time of the code linearly increase with the number of the clusters.

Figure 9: Dictionary clusters= 500