

Laboratory Session 7

Computer Vision - Università Degli Studi di Genova

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Abstract—The aim of this lab is to study the effect of the variable sigma and the threshold on the similarity on the image matching NCC and SIFT algorithms. Also, to observe the effect of using dictionaries of different size for the image retrieval algorithm.

Index Terms—Image Matching, Image Retrieval, NCC, SIFT, Bag of Keywords

I. INTRODUCTION AND PROCEDURE

The scripts for all the algorithms to be studied were provided beforehand; however, they are executed continuously to different image pairs while making small changes each time in their parameters in order to evaluate the effect of it in the results.

II. RESULTS AND ANALYSIS

A. Analysis 1 - Image Matching

1) *NCC-Sigma Value*: The first parameter that we decided to play with was the sigma function for the NCC image matching. This sigma value will change the Euclidean distance, which essentially changes which features are considered matched. When sigma was at a value of 0.1, it found a lot of matches, but many of them were inaccurate, as seen in Fig. 1.

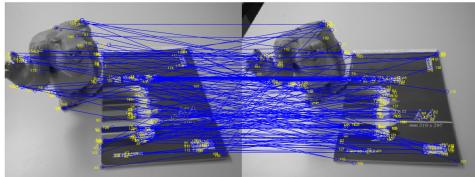


Fig. 1: Results when sigma = 0.1, delta=1 and no threshold; 175 features matched Source: Own Elaboration

When the value of sigma is 1.0, the matches remaining become more accurate, as seen in Fig. 2.

As the value of sigma increases, the new matches are more inaccurate, as seen in Fig. 3.

2) *NCC-Delta Value*: The next parameter to change will be the delta. The delta changes the patch size. The default delta was 1, and we decided to test it with 2 and 5 get different results. All the following tests were run with a sigma of 1.

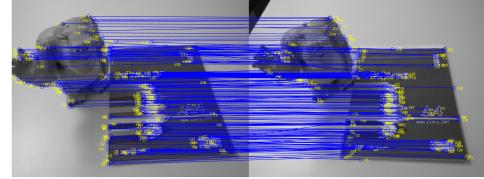


Fig. 2: Results when sigma = 1.0, delta=1 and no threshold; 221 features matched Source: Own Elaboration

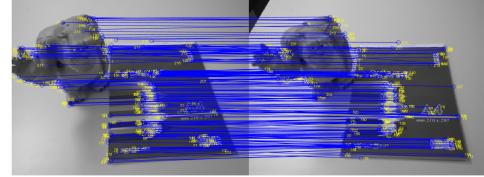


Fig. 3: Results when sigma = 10, delta=1 and no threshold; 219 features matched Source: Own Elaboration

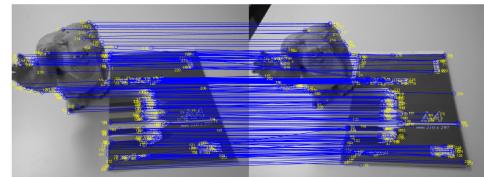


Fig. 4: Results when sigma = 1, delta=1 and no threshold; 221 features matched. Source: Own Elaboration

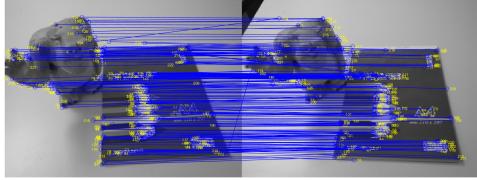


Fig. 5: Results when sigma = 1, delta=2 and no threshold; 223 features matched. Source: Own Elaboration

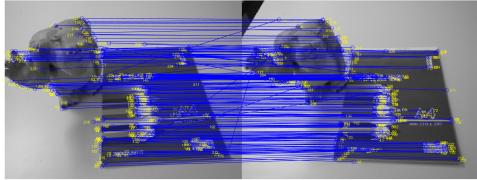


Fig. 6: Results when sigma = 1, delta=5 and no threshold; 225 features matched. Source: Own Elaboration

3) *NCC-Threshold Value*: The threshold value set a lower bound limit for the quality of the matches, so it only allows detected matches that has a similarity value higher than the value. It is expected to result with a less number of matches; however, they should be the better ones, as shown in the Fig.7

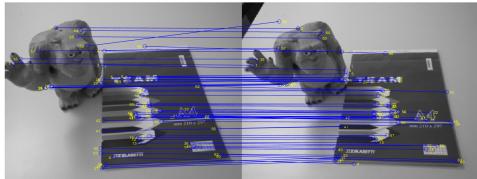


Fig. 7: Results when sigma = 1, delta=2 and threshold=0.9; 67 features matched. Source: Own Elaboration

4) *SIFT-Sigma Value*: The team decided to try the SIFT algorithm with a different pair of images since these show a more severe view-point change. The algorithm was executed with a sigma equal to 0.1, 0.5 and 1, while leaving the threshold value set in 0.9. As seen in the Fig.8 and the Fig.9 the smaller the sigma value is, more matches are found. And when the sigma value gets bigger, the less matches are found. Even though the SIFT algorithm is more robust for similar images with more visible changes, the results obtained weren't as expected, since the match between points of the images

aren't correct. This is probably due the image pair used since with the image of the monster used for NCC worked well. However, it can be noticed that the algorithms used aren't perfect and even though the threshold is high, a lot of errors are made depending on the quality of the image and how similar they are, regarding the scale, rotation and view-point changes.

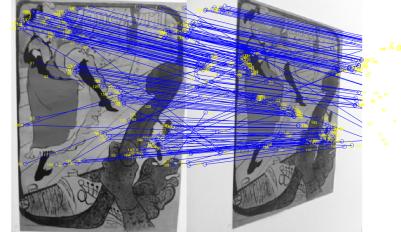


Fig. 8: Results when sigma = 0.1 and threshold=0.9; 198 features matched. Source: Own Elaboration

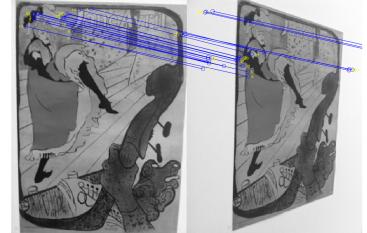


Fig. 9: Results when sigma = 1 and threshold=0.9; 23 features matched. Source: Own Elaboration

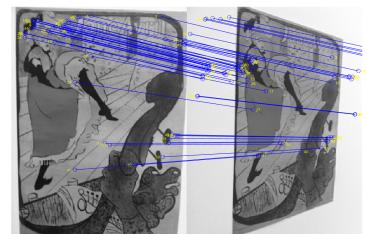


Fig. 10: Results when sigma = 0.5 and threshold=0.9; 61 features matched. Source: Own Elaboration

B. Analysis 2

For this analysis, the team decided to try changing the sizes of the library used to do the image retrieval. The code utilizes a content based image retrieval approach using SIFT descriptors and Bags of Keywords. They tried a size of 30, 300, and 1000. With a larger dictionary, the code is able to differentiate different bags of words, which helps it identify key features

in the query image. As can be seen, with larger dictionaries, the results become more accurate. For example, in Fig. 11, the images in pos 6 and 7 contain reds not found in the original image. However, in Fig. 12 and Fig. 13, the images retrieved all contain a similar colour palette.



Fig. 11: 30 cluster dictionary size. Source: Own Elaboration



Fig. 12: 300 cluster dictionary size. Source: Own Elaboration



Fig. 13: 1000 cluster dictionary size. Source: Own Elaboration

III. CONCLUSIONS

- NCC and SIFT algorithms are reliable methods for image matching. However, they are susceptible of the degree of scale, rotation and view-point changes. Tuning the values of sigma, delta and the threshold a better matching can be obtained for each image pair.
- Using the Bag of Keywords approach is a robust method for image retrieval. However, the results get more accurate as the dictionary size increases. This will increase runtime though.

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