Advanced Topics in Computer Vision

Local Descriptors Practice

For this practice it is proposed to implement the BRIEF descriptor defined at

BRIEF: Binary Robust Independent Elementary Features

Michael Calonder, Vincent Lepetit, Christoph Strecha, and Pascal Fua *ECCV* 2010.

A random set of pixel-difference pairs will be used as proposed by the paper. However, every team must compare against other pixel-pairs arrangement, in particular, against an ordered pattern proposed by themselves.

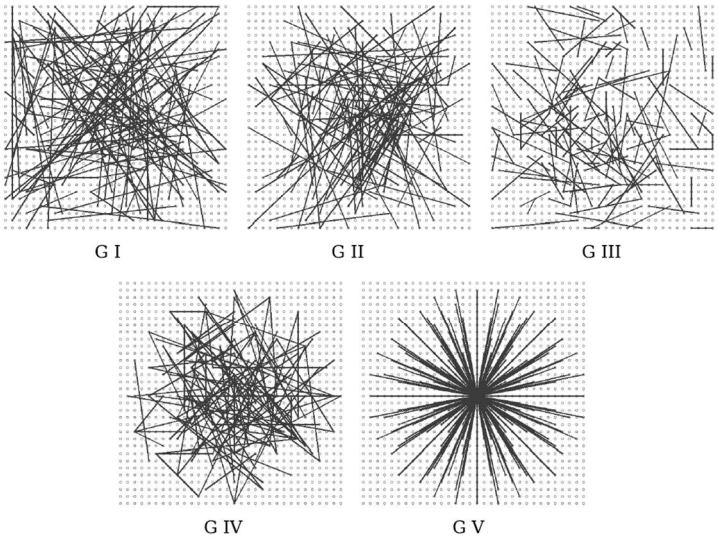


Fig. 2. Different approaches to choosing the test locations. All except the rightmost one are selected by random sampling. Showing 128 tests in every image.

When creating such descriptors, the only choices that have to be made are those of the kernels used to smooth the patches before intensity differencing and the spatial arrangement of the (x, y)-pairs.

Convenient tests must be designed and implemented to validate the correctness of your code after each step. Once finished the whole implementation, the descriptor will be test in front of different challenging image patches.

Optimized implementations in order to perform a faster computation will be appreciated (sometimes accepting some loss of discrimination power that must be evaluated).

1. Evaluation of BRIEF arrangements as a keypoint descriptor:

To this end, we'll use the ***Wall*** dataset. It contains five image pairs, with the first image being the same in all pairs and the second image shot from a monotonically growing baseline, which makes matching increasingly more difficult.

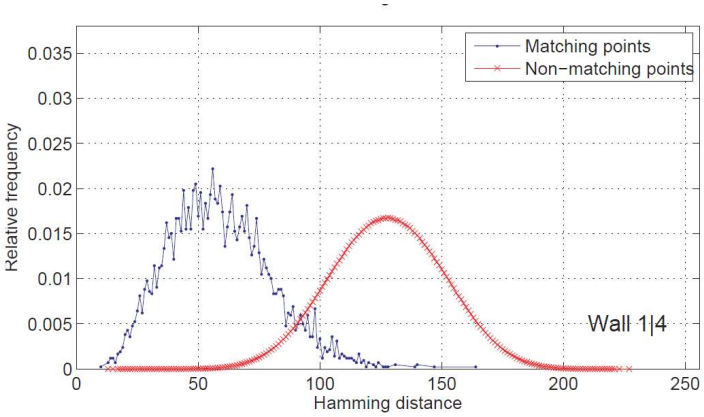
To compare the pertinence of the various potential choices, we'll use as a quality measure the recognition rate in image pairs. In short, for both images of a pair and for a given number of corresponding keypoints between them, it quantifies how often the correct match can be established using BRIEF for description and the Hamming distance as the metric for matching.

This rate can be computed reliably because the scene is planar and the homography between images is known. It can therefore be used to check whether points truly correspond to each other or not.

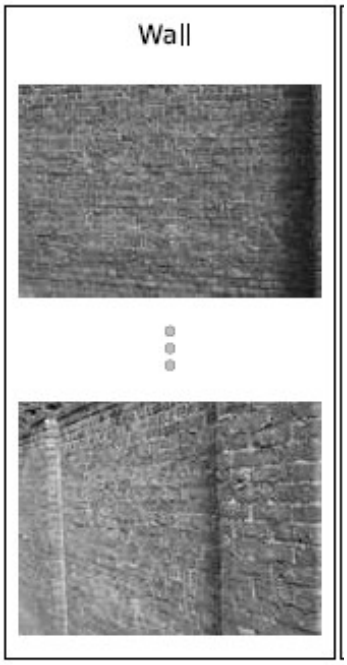
Therefore, given an image pair, the recognition rate for the different descriptors must be computed as follows:

a) Pick N interest points from the first image, infer the N corresponding points in the other from the ground truth data, and compute the 2N associated descriptors using the method under consideration.
b) For each point in the first set, find the nearest neighbor in the second one and call it a match.
c) Count the number of correct matches nc and take the recognition rate to be r = nc/N.

Calculate the histogram of the obtained error (distance) of the correct matches and the wrong ones:



From this distribution ROC curves can be obtained in function of the selected threshold.



2. Evaluation of BRIEF arrangements as a general path descriptor:

Now we will see the description power of the descriptors against a set of selected patterns, corresponding to some traffic signs models that will act as class representatives (gold standard)

Generate the class distance matrices for every descriptor:

1. For every model, compute the associated descriptors using the methods under consideration.
2. Calculate the distance between the descriptors for every pair of models.
3. Locate the closer and farther model for each one.