Extending the SGLOH descriptor

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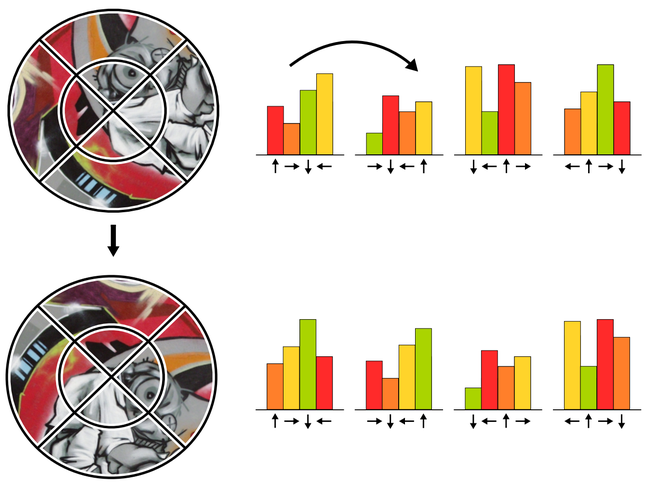
The SGLOH descriptor

The sGLOH descriptor is a SIFT-like robust and efficient keypoint descriptor which uses a circular grid to incorporate more descriptor instances of the same patch at different orientations into a single feature vector, accessible by a simple cyclic shift of the feature vectors.



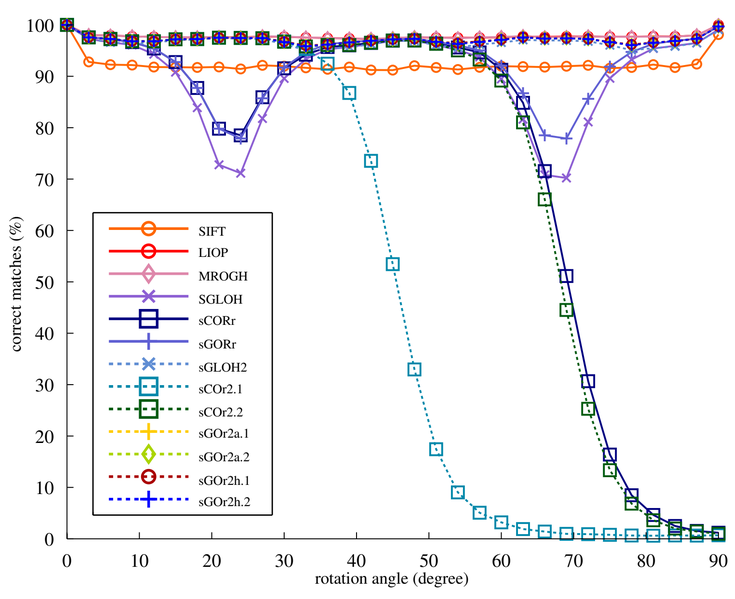
The matching distance $\widehat{\mathcal{D}}$ between two SGLOH descriptors H and $\overline{H}$ is given by the minimum distance among all the possible distances $\mathcal{D}$ obtained for the m different instances $\overline{H}_k$ of the $\overline{H}$ vector at different orientations derived by a cyclic shift of the descriptor vector elements.

$$\widehat{\mathcal{D}}(H,\overline{H}) = \min_{k=0,\dots,m-1} \mathcal{D}(H,\overline{H}_k)$$

Further improvements can be obtained by limiting the range of allowable orientations according to the scene context. Two matching strategies can be derived, namely sCOr and sGOr, respectively when the orientation range constraint is defined a priori by the user or obtained without user intervention by finding the best global orientation.

Proposed extension

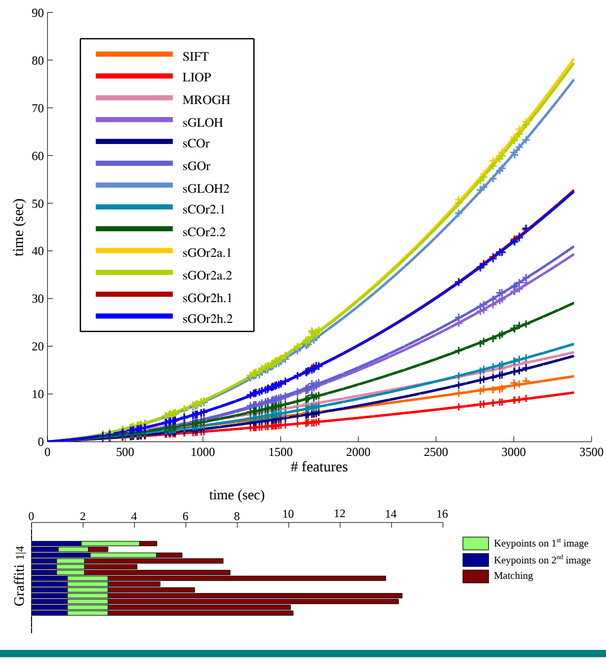
The sGLOH descriptor, especially if coupled with the sCOr and sGOr matching strategies, obtains results comparable with state-of-the-art descriptors, but can suffer to performance degradations when the relative rotation between the patches approaches that between two discrete sGLOH rotations.



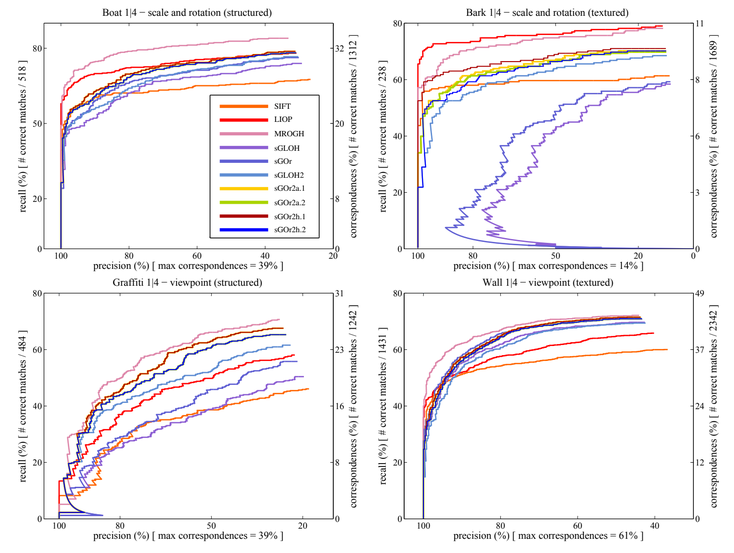
In order to solve this issue, we define a novel sGLOH2 descriptor $H^\star$, obtained by concatenating two sGLOH descriptors H^1 and H^2 of the same patch, where H^1 is the standard sGLOH descriptor of the patch, while H^2 is is obtained after applying a rotation equal to half of the sGLOH handled discrete rotation, leading to $2m$ different available discrete orientation of the keypoint patch.
In analogy with the sCOr and sGOr matching strategies, the relative rotation to check in the matching distance can be constrained to the first or the second successive orientations, while all the $2m$ orientations can be used for the estimation of the global reference orientation (sGOr2a strategy) or only the m orientations belonging to the first concatenated sGLOH descriptor H^1 (sGOr2h strategy), leading to different but similar matching strategies.

Results

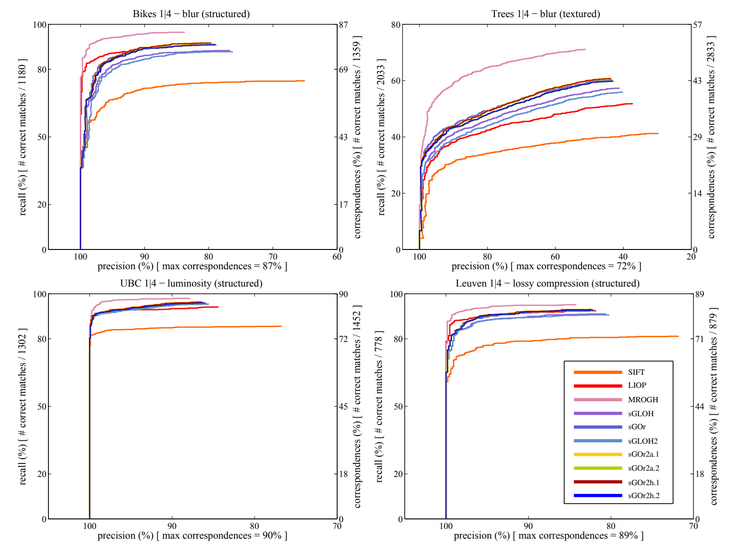
Both the proposed sGLOH2 and its derived matching strategy improve on the original sGLOH versions with more remarkable and effective improvements in the case of challenging geometric transformations.
Furthermore, results are quite comparable with the state-of-the-art descriptors.
About the running time, although it increases linearly with the numbers of orientations to check, it is still reasonable in a lot of applications as it can be adjusted according to the required task by choosing the right matching strategy.
Moreover, a fast distance check to discard very probable bad matches is planned as future work.



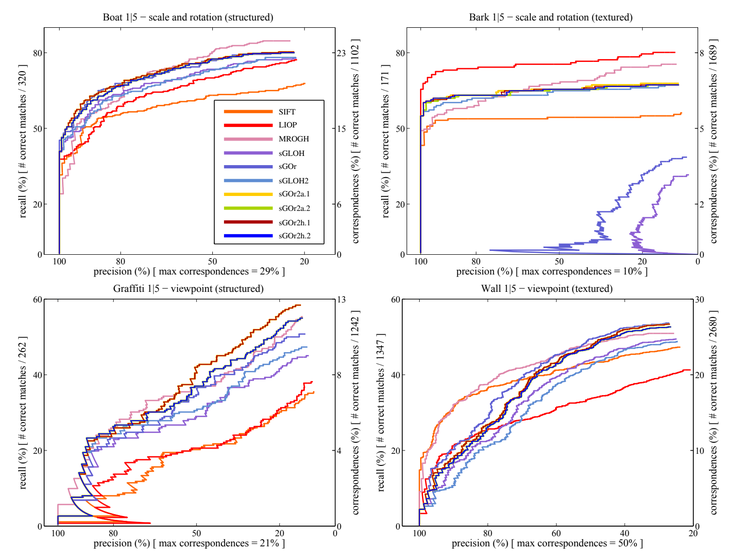
Results: Oxford dataset



Geometric transformations



Other transformations



Challenging geometric transformations

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References

1. F. Bellavia, D. Tegolo and C. Valenti, “Keypoint descriptor matching with context-based orientation estimation”, Image and Vision Computing (2014).

2. K. Mikolajczyk and C. Schmid, “A performance evaluation of local descriptors”, TPAMI (2005).