

# Virtual Line Descriptor and Semi-Local Matching Method for Reliable Feature Correspondence

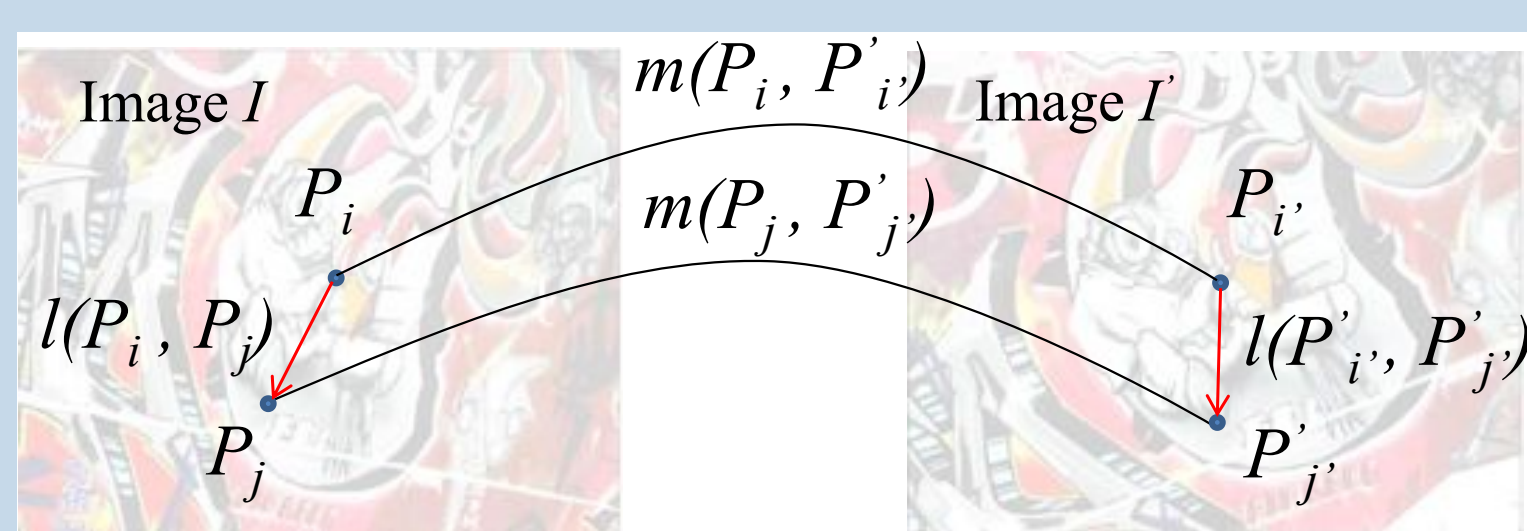
Zhe Liu and Renaud Marlet  
zhe.liu@enpc.fr, renaud.marlet@enpc.fr

## Abstract

Finding reliable correspondences between sets of feature points in two images remains challenging in case of ambiguities or strong transformations. We introduce a 2nd-order photometric descriptor for virtual lines joining two neighbouring feature points.

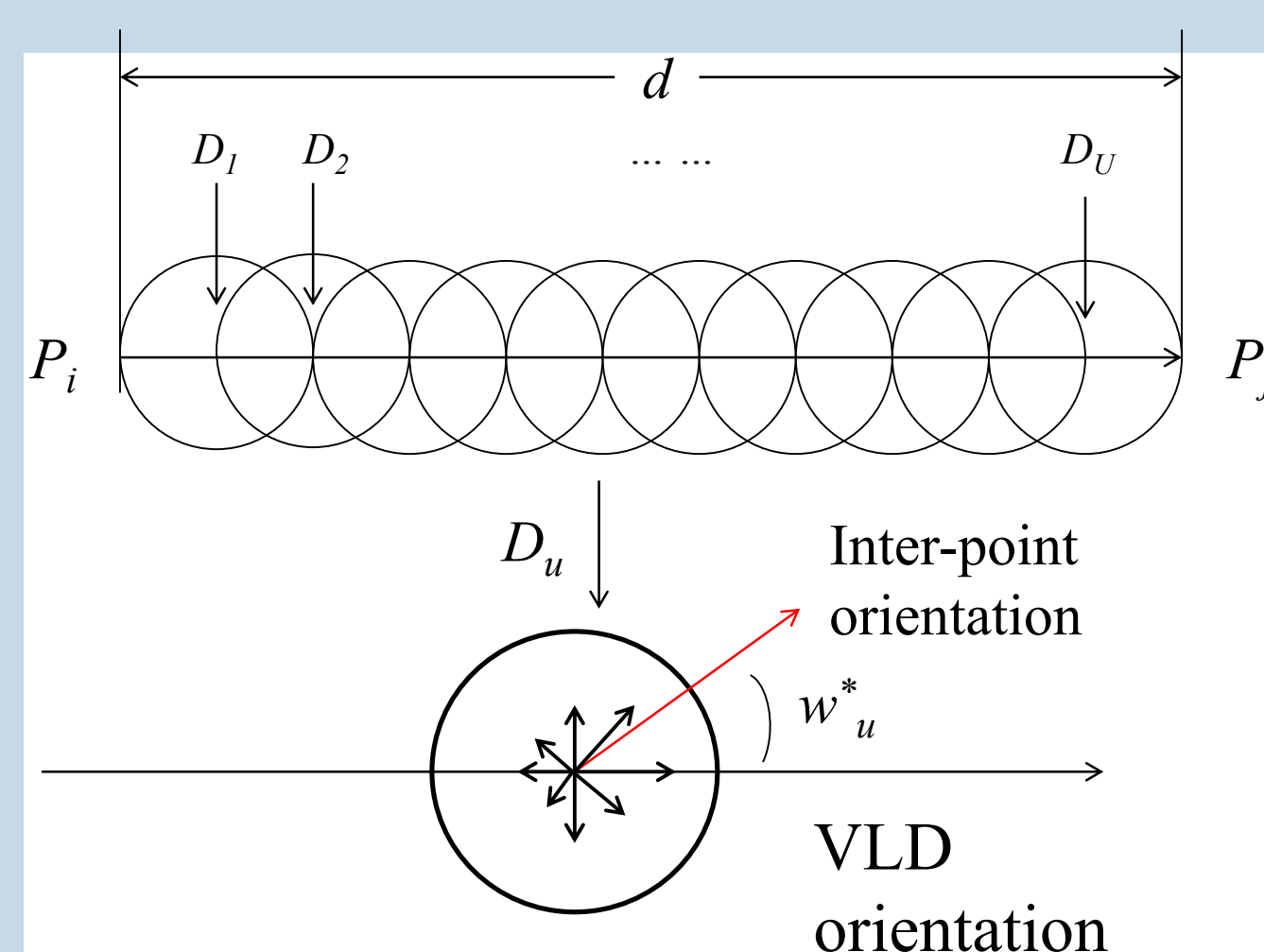
## Intuition

Our approach is based on the fact that, for any two points  $P_i, P_j$  in image  $I$ , and any two points  $P'_i, P'_j$  in image  $I'$ , it is unlikely to find similar photometric information around lines  $(P_i, P_j)$  and  $(P'_i, P'_j)$  unless both  $(P_i, P'_i)$  and  $(P_j, P'_j)$  are correct matches.



## Virtual Line Descriptor (VLD)

The virtual line for  $P_i$  and  $P_j$  in image  $I$  is covered by  $U$  disks  $D_u$  of radius  $r = \frac{dist(P_i, P_j)}{U+1}$ . Each disk is described by a SIFT-like descriptor. The global, virtual line descriptor is the concatenation of all disk descriptors.



## K-VLD matching method

We introduce a novel semi-local 2nd-order matching method. It considers both geometric and photometric consistency. The basic idea of K-VLD relies on the fact that, given a potential match  $(P_i, P'_i)$ , if there are in the neighborhood of  $P_i$  and  $P'_i$ , at least  $K$  other matches  $(P_{j_k}, P'_{j_k})_{k \in \{1, \dots, K\}}$  that are gVLD-consistent (g for geometrical-consistency) with  $(P_i, P'_i)$ , then  $(P_i, P'_i)$  is likely to be a correct match. The K-VLD algorithm starts with all the potential matches and iteratively removes matches that have less than  $K$  gVLD-consistent neighbors and matches that do not satisfy the extra geometric constraint, until no match is removed.

## Reference

- [1] Moulon, P. Synthetic images for testing ASIFT. In IPOL 2012. [http://www.ipol.im/pub/demo/my\\_affine\\_sift/archive?key=0DA014C43786492B0A854FAD5DE5EACD](http://www.ipol.im/pub/demo/my_affine_sift/archive?key=0DA014C43786492B0A854FAD5DE5EACD)
- [2] Strecha, C; von Hansen, W; Van Gool, L; Fua, P; Thoennessen, U. Benchmarking Camera Calibration and Multi-View Stereo for High Resolution Imagery. In CVPR 2008.
- [3] CMP, Czech Technical University, Prague. Dětenice fountain dataset 2008. <http://cmp.felk.cvut.cz/projects/is3d/Data.html>
- [4] Moisan, L; Moulon, P; Monasse, P. Automatic homographic registration of a pair of images, with a contrario elimination of outliers. In IPOL 2012.
- [5] Yu, G; Morel, J. ASIFT: An Algorithm for Fully Affine Invariant Comparison. In IPOL 2011

## Filtering matches

We show the capacity of K-VLD in filtering matches. First we test a pair of synthetic images where nearest neighbour and geometric information are not sufficient [1] (Fig 1, 2). Second we test K-VLD as a pre-filter to RANSAC-based calibration (ORSA [4]) using Strecha's castle dataset [2]. Fig 3 visually illustrates improvement by K-VLD, and angle errors are measured after one round (Fig 4).

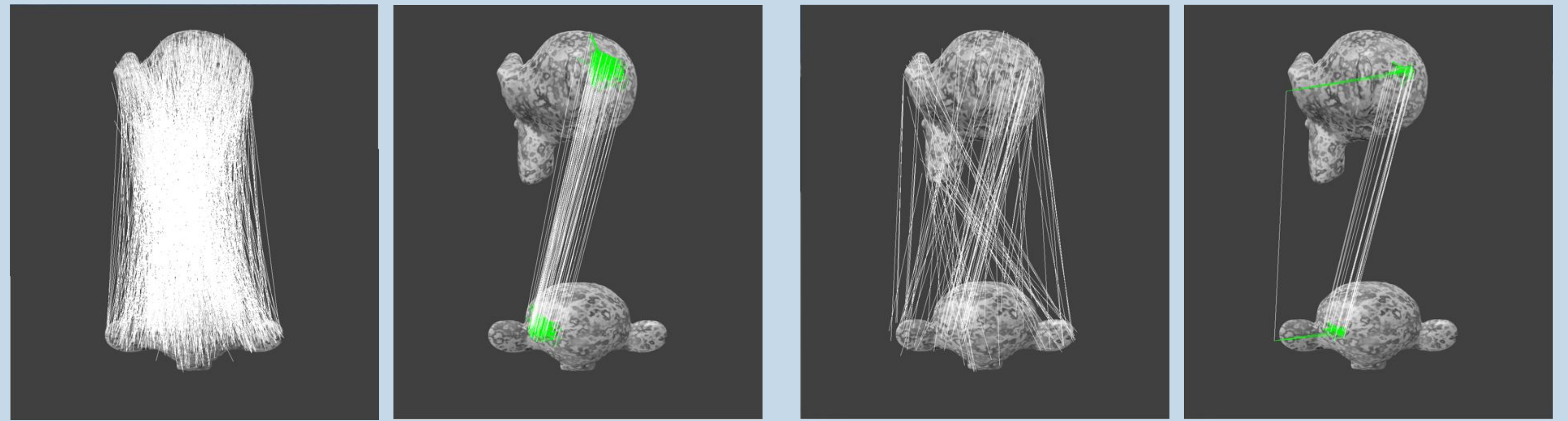


Fig 1. SIFT (Low score=0.99, no symmetry) then filtered by K-VLD.

Fig 2. ASIFT (Low score=0.73 no symmetry) then filtered by K-VLD.

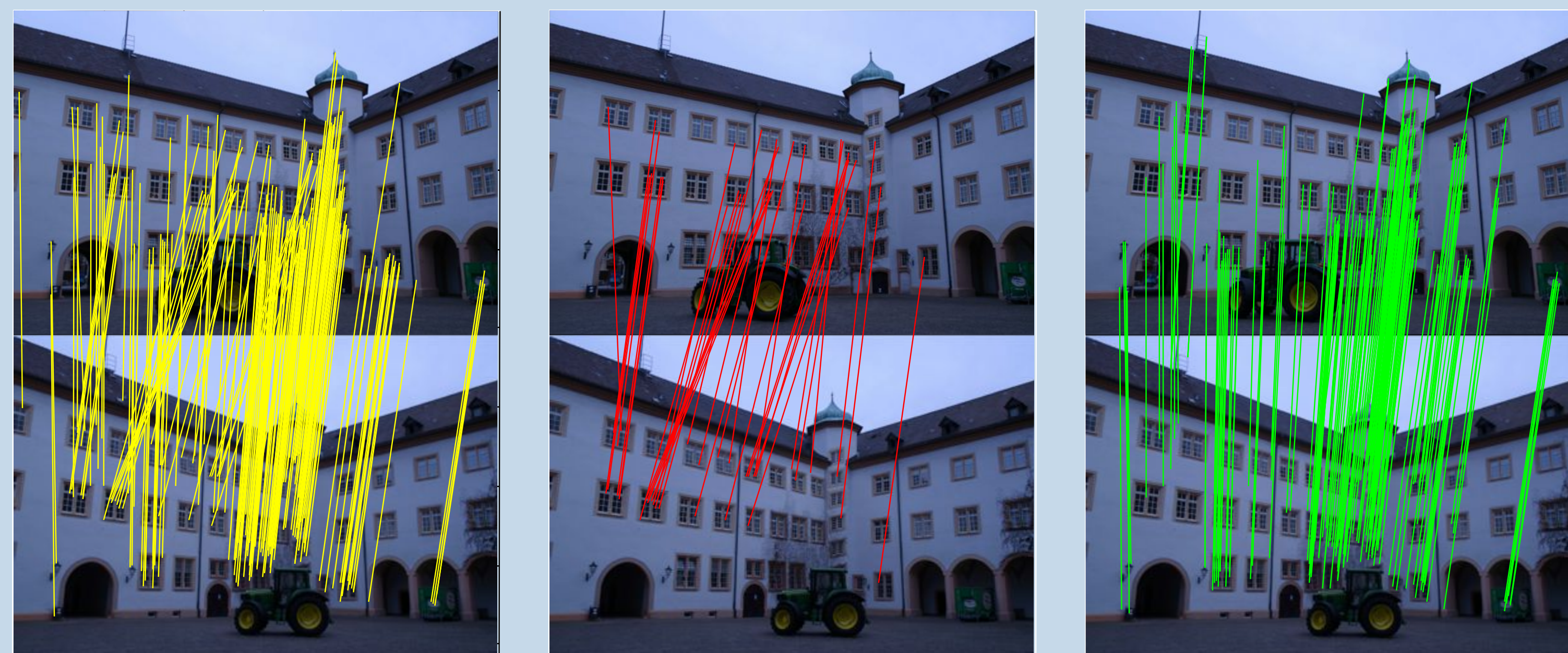


Fig 3. The castle dataset. Left: inliers by ORSA. Middle: false matches near epipolar lines by ORSA, rejected by K-VLD. Right: inliers by K-VLD + ORSA.

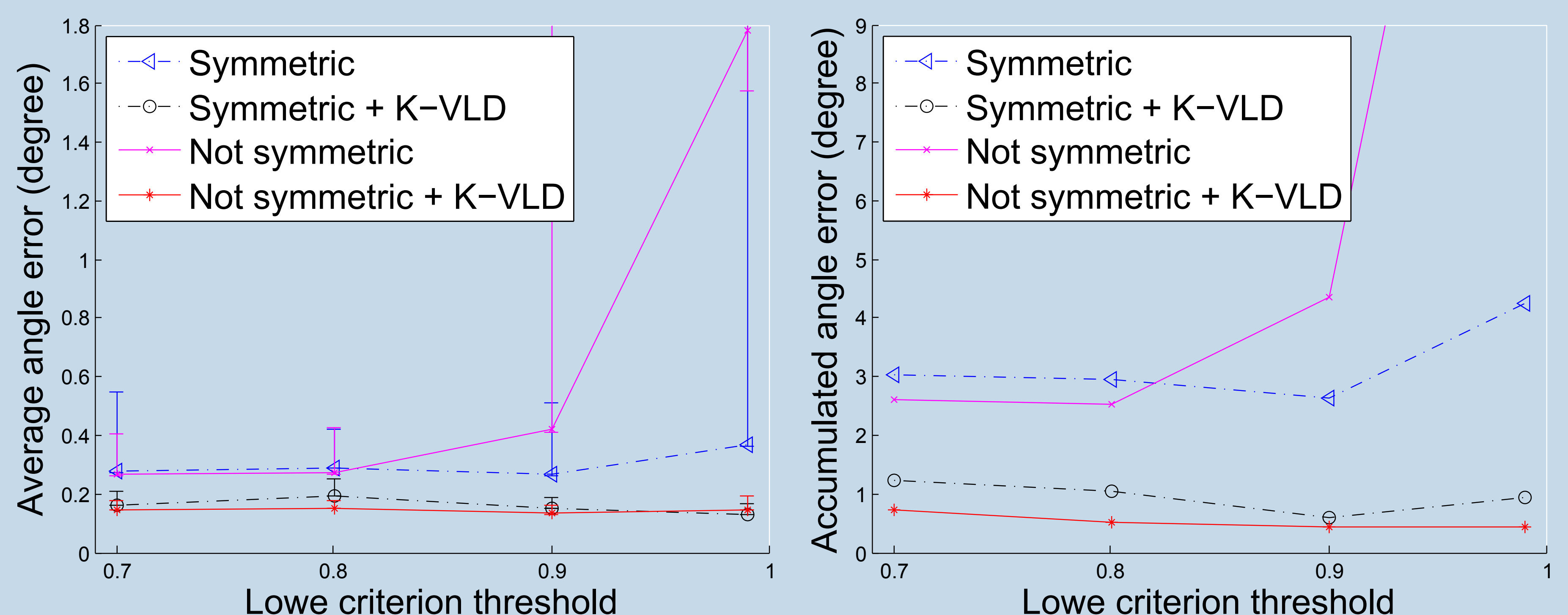


Fig 4. Angle error on the castle dataset. Left: average error over 19 image pairs. Right: accumulated error after one loop.

## Comparison with graph matchers

We experimented with various matching methods: probabilistic hypergraph matching (HGM), tensor matching, hypergraph matching via reweighted random walks, spectral matching (SM) / integer projected fixed point, and game-theoretic matching. We also augmented methods SM and HGM with our VLD. And we compared with K-VLD. We evaluated matching accuracy w.r.t. changing imaging conditions with Mikolajczyk's dataset. We also evaluated the case of strong occlusion with Dětenice fountain's dataset (Fig 5).

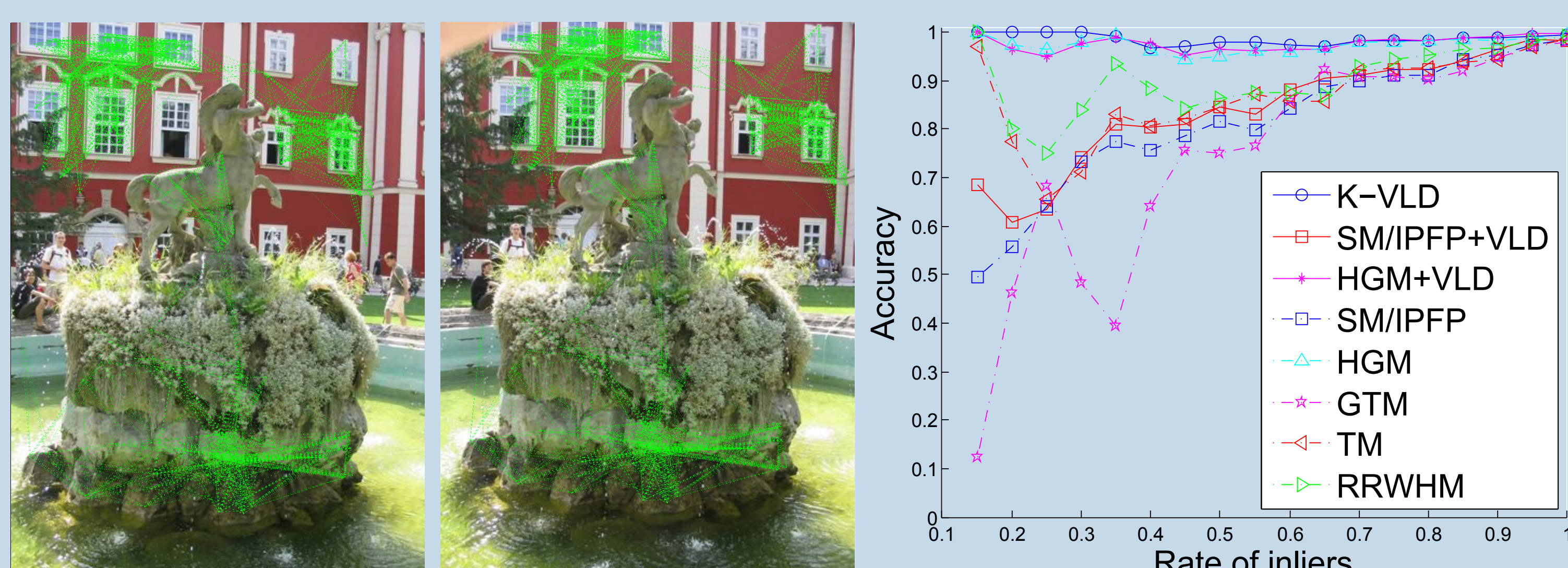


Fig 5. Dětenice fountain: K-VLD clusters & average accuracy.