

Evaluation and Improvements of Image Interest Region Detectors and Descriptors

Karel Lenc (2013), Master's thesis, supervised by Prof. Jiří Matas

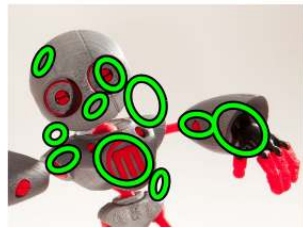


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Interest image region



- An image pattern which differs from its immediate neighbourhood
- Accurate location over time, distinguishable neighbourhood

Local image descriptor

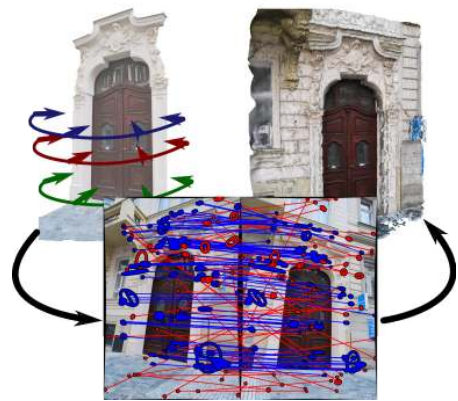
- Robust image patch representation, invariant to geometric and photometric transformations



Use of image features

- Each use-case puts different demands on extracted features

Structure from motion



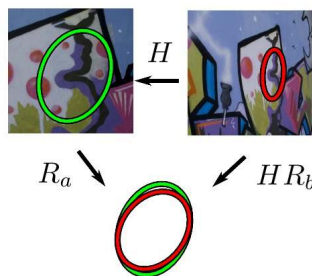
- Reconstruction of a scene, 3D model from set of images
- Demands accurate feature localisation

Image retrieval



- Given image of an object, find all of its instances in the DB
- Demands high distinguishability of extracted features

Standard evaluation protocols



- Measurement of geometric overlap of detected image regions
- Ground truth limited to planar scenes, no occlusions, planar surfaces only
- Limited number of datasets leads to detectors with good performance on particular images

Main contributions

- Improved and released the first public version of open-source project VLbenchmarks
- VLbenchmarks project has been presented to the computer vision community at a major European computer vision conference
- Using new benchmarks, performance of several feature detectors has been improved by employing new strategies for setting their internal parameters
- Extended emulated feature detectors and improved their classification speed

VLbenchmarks project

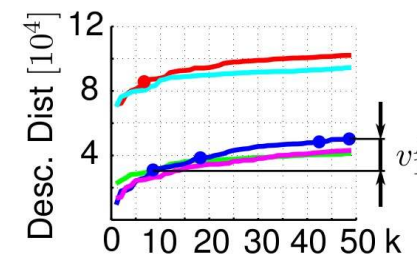
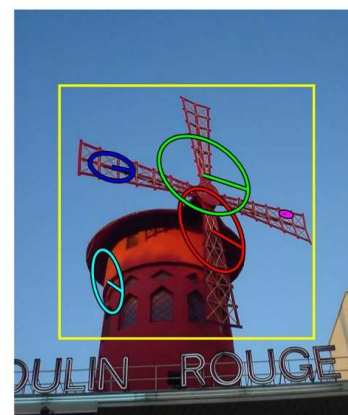
- Open source Matlab framework [1] for testing image feature detectors and descriptors. Development lead by A. Vedaldi

Contributions to the project

- Implemented existing evaluation protocols speeding-up their evaluation time, proposed new evaluation protocols
- Newly designed interface which supports parallelisation and caching of intermediate results

Retrieval benchmark

- Direct evaluation of feat. detectors in image retrieval tasks
- Based on normalised distance of K-Nearest neighbour descriptors
- Performance measured on standardized datasets with 55 test queries over database of 5k testing images



$$\sum_{i=1}^{n_I} v_i^I > \sum_{i=1}^{n_J} v_i^J > \sum_{i=1}^{n_K} v_i^K$$



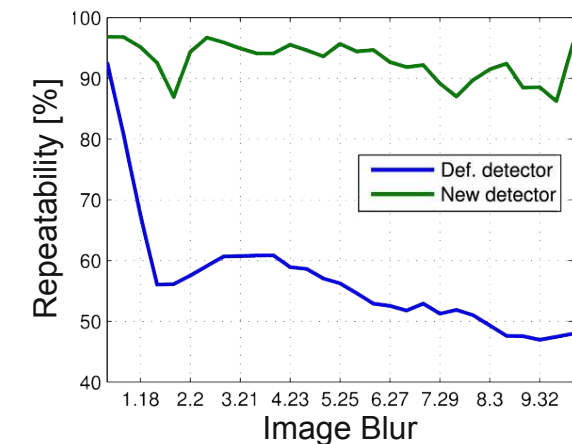
Experiments with detector parameters

Initial scale

- Improved Scale-Space building algorithm for any nominal image blur

Num. of det. features

- Proposed a new protocol for impacting the number of detected features per use-case of the det.



Measurement region

- Measured significance of descriptor measurement region in case of non-planar scenes
- Proposed a robust method of calibration of existing detector implementations for fair comparison

Extension of emulated feature detectors

- Trained new emulators of feature detection process based on WaldBoost sequential classifier, employed in sliding window framework [2]. Measured performance of emulated detectors in more real-world use-cases
- Improved the classification time making the emulated detectors faster than SURF detector

Detector	Image (0.3MPx) Avg. time [ms]	Image (21MPx) Avg. time [s]
Emul. orig.	19 ± 12	3.7 ± 2
Emul. fast	16 ± 4.4	1.3 ± 0.31
OpenSURF	35 ± 1.5	2.7 ± 0.11

References

- [1] VLbenchmarks, <http://www.vlfeat.org/benchmarks/>
- [2] Šochman, Jan, and Jiří Matas. "Learning fast emulators of binary decision processes." IJCV (2009)