New Technologies for the Information Society
Research Center
University of West Bohemia in Pilsen

Selecting Keypoint Detector and Descriptor Combination for Augmented Reality Application

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Motivation

- Augmented Reality

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- Keypoint approach

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- Speed

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- Stability
- Goal: select the best KP Detector and Descriptor which perform the best on a selected criterion

Keypoint Detectors and Descriptors

- SIFT
- SURF
- BRISK
- KAZE
- AKAZE

Keypoint Detectors

- FAST
- AGAST
- CenSurE

Keypoint Descriptors

- BRIEF
- DAISY
- FREAK
- LUCID
- LATCH

Datasets

- Oxford dataset

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- 8 datasets – each contains 6 images

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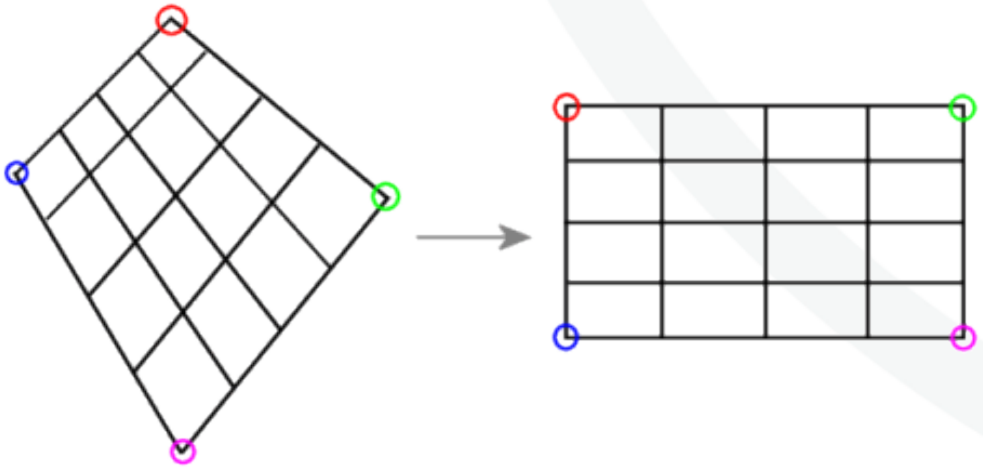
- 8 datasets – each contains 6 images
- each set contains 1st to 2nd, 1st to 3rd, ..., 1st to 6th Ground Truth Homography transformation matrix



Datasets

Figure : The example of the datasets (from top left):
boat: zoom+rotation, bark: zoom+rotation, graffiti: viewpoint change, wall: viewpoint change, bikes: image blur, trees: image blur, ubc: JPEG compression, leuven: light change.

Evaluation Criterion

- **The putative match ratio:**

$$Putative\ Match\ Ratio = \frac{\#Putative\ Matches}{\#Features} \tag{1}$$

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- **The precision:**

$$Precision = \frac{\#Correct\ Matches}{\#Putative\ Matches} \tag{2}$$

Evaluation Criterion

- **The matching score:**

$$Matching\ Score = \frac{\#Correct\ Matches}{\#Features} \tag{3}$$

Evaluation Criterion

- **The matching score:**

$$Matching\ Score = \frac{\#Correct\ Matches}{\#Features} \tag{3}$$

- **The recall:**

$$Recall = \frac{\#Correct\ Matches}{\#Correspondences} \tag{4}$$

Results

Average Putative Match Ratio

Detector	Descriptor	Average Putative Match Ratio							
sift	sift	0.112	**0.127**	**0.116**	0.204	0.128	0.050	0.262	0.294
surf	surf	0.077	0.050	0.053	0.092	0.197	0.061	0.325	0.262
brisk	brisk	0.036	0.037	0.030	0.035	0.067	0.020	0.193	0.131
kaze	**kaze**	**0.172**	0.074	0.099	**0.234**	0.364	**0.164**	**0.696**	**0.297**
akaze	akaze	0.060	0.030	0.029	0.083	**0.390**	0.096	0.573	0.281
orb	orb	0.052	0.021	0.022	0.026	0.136	0.040	0.446	0.098
star	surf	0.044	0.039	0.061	0.022	0.116	0.019	0.307	0.130
star	freak	0.019	0.021	0.018	0.017	0.101	0.017	0.340	0.096
agast	latch	0.000	0.000	0.001	0.009	0.044	0.009	0.137	0.153

Average Precision

Detector	Descriptor	Average Precision							
sift	sift	0.851	**0.940**	0.405	0.737	0.774	0.698	0.942	0.929
surf	surf	0.678	0.879	0.288	0.675	0.798	0.633	0.908	0.874
brisk	**brisk**	**0.894**	0.931	**0.583**	0.648	0.754	**0.708**	0.955	**0.950**
kaze	kaze	0.858	0.923	0.518	**0.796**	0.838	0.685	0.964	0.905
akaze	akaze	0.503	0.726	0.276	0.514	**0.884**	0.586	0.948	0.910
orb	orb	0.719	0.600	0.329	0.726	0.850	0.660	**0.978**	0.920
star	surf	0.486	0.656	0.226	0.466	0.669	0.433	0.908	0.726
star	freak	0.003	0.683	0.000	0.461	0.009	0.007	0.186	0.021
agast	latch	0.000	0.000	0.000	0.001	0.000	0.000	0.007	0.002

Average Matching Score

Detector	Descriptor	Average Matching Score							
sift	sift	0.106	**0.119**	**0.089**	0.194	0.107	0.042	0.255	**0.276**
surf	surf	0.062	0.043	0.031	0.082	0.169	0.047	0.309	0.233
brisk	brisk	0.034	0.034	0.026	0.033	0.056	0.017	0.190	0.126
kaze	**kaze**	**0.161**	0.066	0.082	**0.218**	0.323	**0.125**	**0.677**	0.272
akaze	akaze	0.041	0.025	0.020	0.068	**0.356**	0.065	0.555	0.261
orb	orb	0.048	0.014	0.018	0.024	0.123	0.033	0.442	0.091
star	surf	0.029	0.027	0.024	0.016	0.087	0.011	0.293	0.101
star	freak	0.000	0.017	0.000	0.014	0.002	0.000	0.084	0.002
agast	latch	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000

Average Recall

Detector	Descriptor	Average Recall							
sift	sift	0.226	**0.358**	**0.189**	0.310	0.580	0.106	0.423	**0.652**
surf	surf	0.142	0.136	0.070	0.148	0.373	0.101	0.436	0.437
brisk	brisk	0.043	0.073	0.038	0.045	0.259	0.029	0.241	0.225
kaze	**kaze**	**0.237**	0.220	0.133	**0.316**	**0.583**	**0.255**	**0.764**	0.527
akaze	akaze	0.060	0.069	0.027	0.088	0.559	0.125	0.608	0.532
orb	orb	0.062	0.049	0.022	0.040	0.168	0.073	0.482	0.155
star	surf	0.072	0.127	0.055	0.028	0.307	0.031	0.369	0.336
star	freak	0.000	0.075	0.000	0.024	0.004	0.001	0.101	0.007
agast	latch	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001

Conclusion

- The paper presents the problem of AR by using KP
- Oxford dataset was described
- A list of existing KP detectors and descriptor combinations was presented
- Experiments were conducted to determine the best combination based on the chosen criterion

Thank you for your attention