Increasing the Precision of Junction Shaped Features

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SFOP Feature Localization

- The **S**cale-invariant **F**eature **OP**erator [1] detects junctions
- Strategy: calculate precision [2] in DoG/LoG pyramid
- Detection: select fullpixel positions with locally maximal precision in each scale
- Localization: estimate subpixel/subscale using 3D quadratic approximation
  - **REF SFOP**

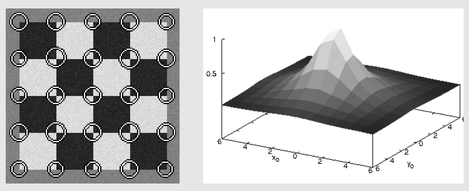


Fig.1: Detected junctions

Fig.2: The cyan colored junctions are better explained with the proposed localization technique.

Approach

- Exchange suboptimal subpixel/subscale localization
- Estimate subpixel/subscale using signal adapted approximation [3]:

$$D_{\mathbf{x_0},\sigma,l}(\mathbf{x}) = l \cdot \left(exp(-\frac{(\mathbf{x}-\mathbf{x_0})^2}{2\sigma^2}) - exp(-\frac{(\mathbf{x}-\mathbf{x_0})^2}{2\sigma_k^2}) \right)$$

- Increases precision in most cases
- Choose localization method (DoG, Quadr.) with larger precision
  - **DOG SFOP**

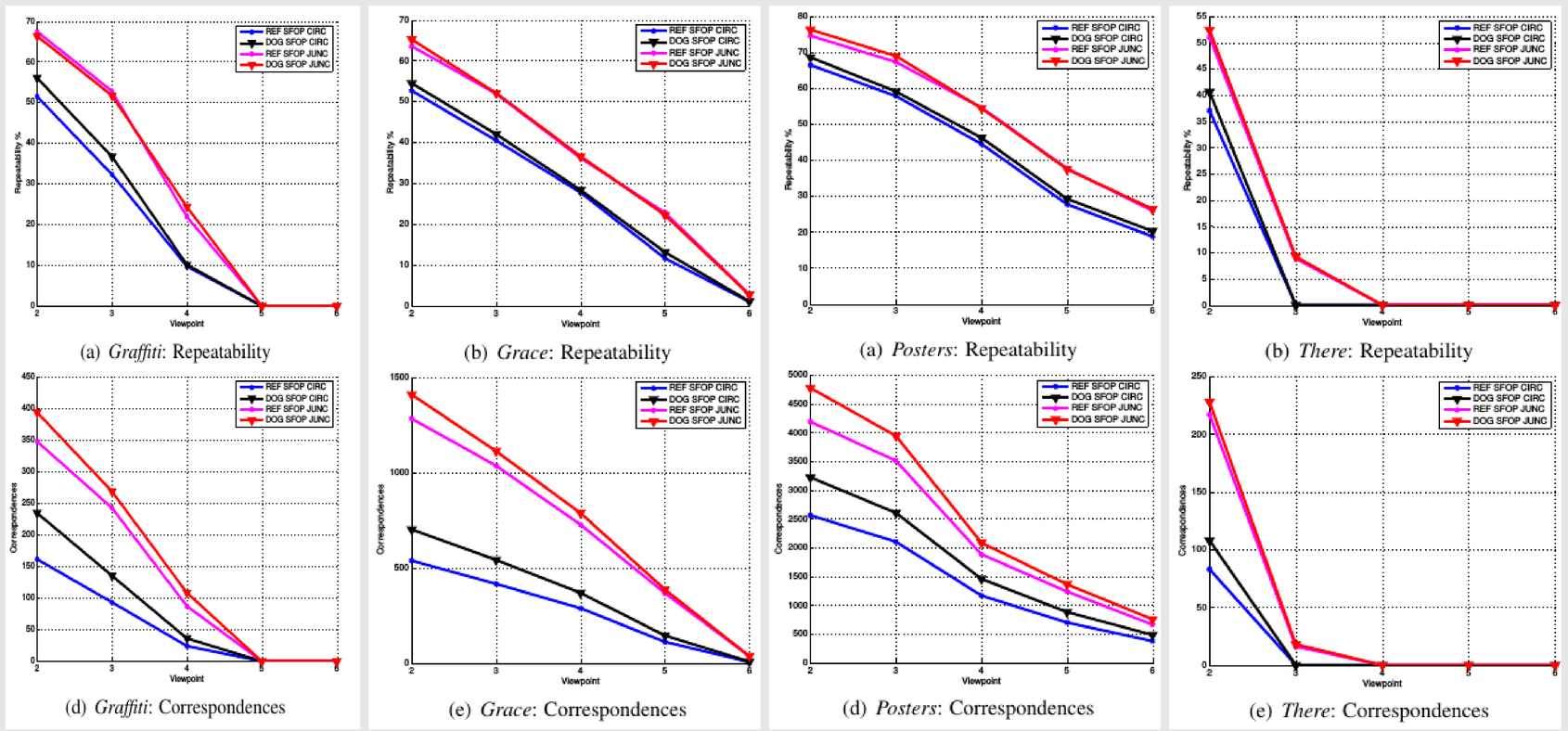
Tab.1: Numbers of detected junctions

Approach Localization	REF SFOP Quadr.	DOG SFOP Quadr.	DOG SFOP DoG
Graffiti	5008	1262	4347
Grace	15563	4337	12410
Underground	10382	3375	7998
Posters	35240	9733	29257
There	6885	3651	5349
Colors	7117	2034	5035
Σ	80195	24392	64396
		88788	

Evaluation: Repeatability

- Repeatability protocol [4]
- Data sets [4,5] provide:
  - Ground truth homography
  - Planar scenes
- DOG SFOP JUNC:
  - More features, incr. repeatability
- Similar results for SFOP CIRC

Fig.3: Repeatability results



(a) *Graffiti*: Repeatability (b) *Grace*: Repeatability (a) *Posters*: Repeatability (b) *There*: Repeatability

(d) *Graffiti*: Correspondences (e) *Grace*: Correspondences (d) *Posters*: Correspondences (e) *There*: Correspondences

Conclusions

- Proposed approach improves subpixel/subscale localization of SFOP feature detector
  - The DoG approximation function increases the precision for 72.5 % of the features (*cf. Tab. 1*)
  - The number of extracted feature pairs increases by up to 30 % and in every case (*cf. Fig. 3*)
  - Results are valid on circular symmetric features (SFOP CIRC) as well (*cf. Fig. 3*)

[1] W. Förstner, T. Dickscheid, F.Schindler: ”Detecting interpretable and accurate scale-invariant keypoints”, ICCV 2009
[2] T. Lindeberg: ”Feature detection with automatic scale selection”, IJCV 1998
[3] K. Cordes, O. Müller, B. Rosenhahn, J. Ostermann: ”HALF SIFT: High-accurate localized features for SIFT”, CVPRw 2009
[4] K. Mikolajczyk et. al: ”A comparison of affine region detectors”, IJCV 2005
[5] K. Cordes, B. Rosenhahn, J. Ostermann: ”High-resolution feature evaluation benchmark”, CAIP 2013

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