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Dimension Reduction for SIFT descriptors to improve matching efficiency

Jicheng Gong

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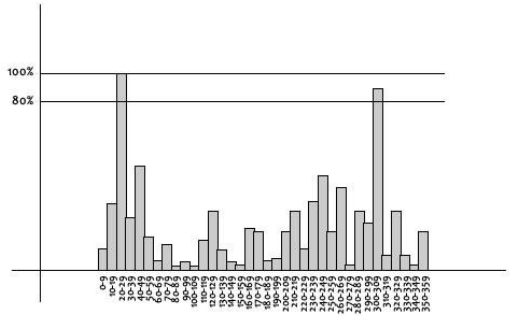
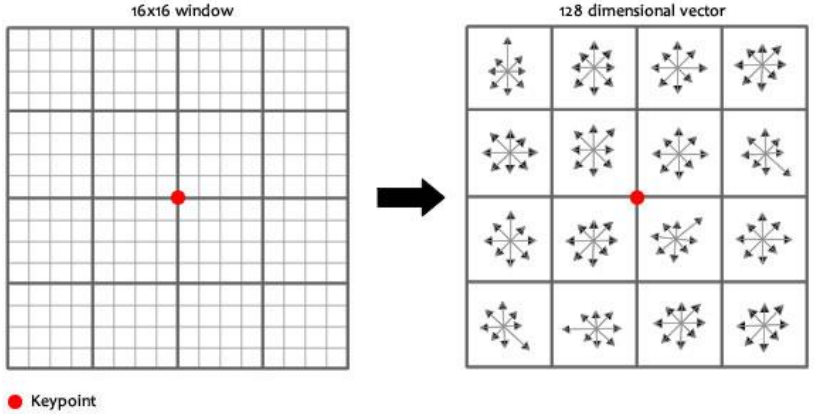
SIFT (Scale-Invariant Feature Transform)

- Scale space peak selection
- Key point localization
- Orientation Assignment
- Key point descriptor





Key point descriptor

- Create a set of orientation histograms on 4x4 pixel neighborhoods with 8 bins each.
- Histograms are computed from magnitude and orientation values of samples in a 16 x 16 region around the key point.

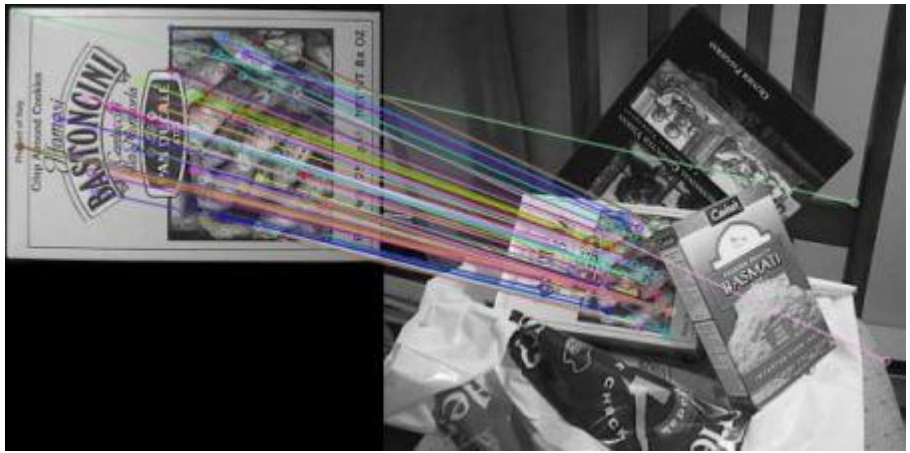


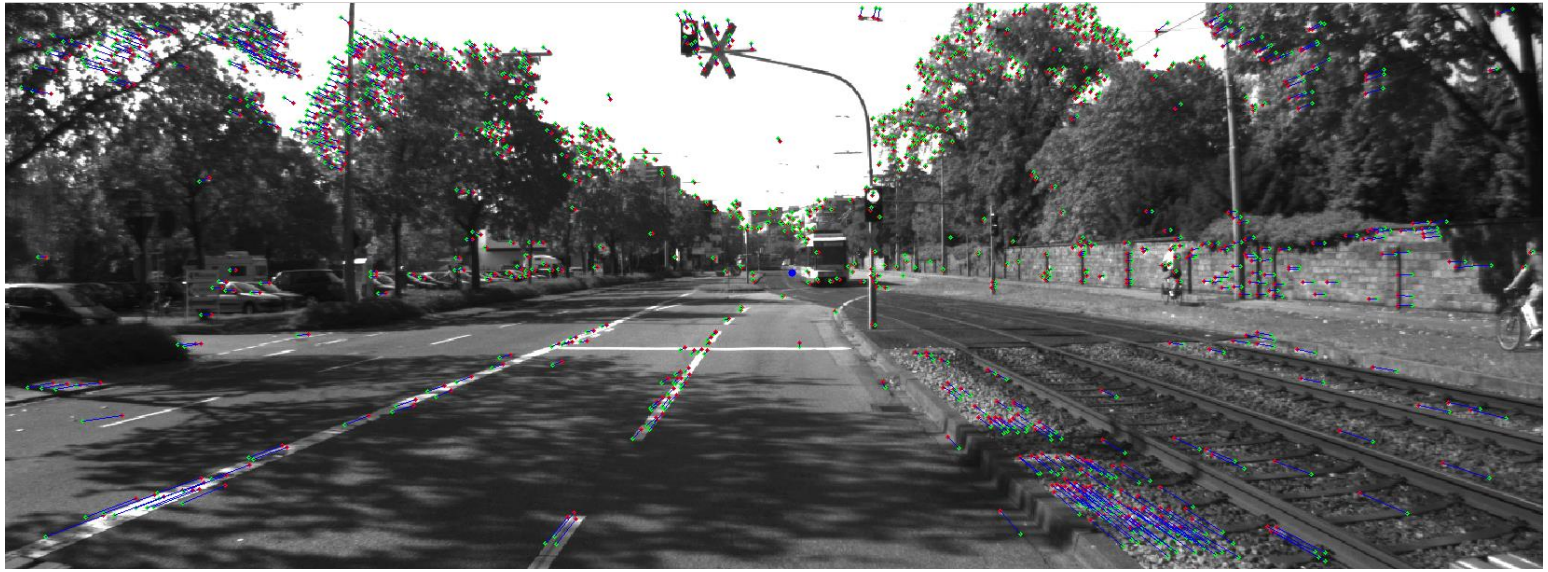
Image set

Image set

Image set

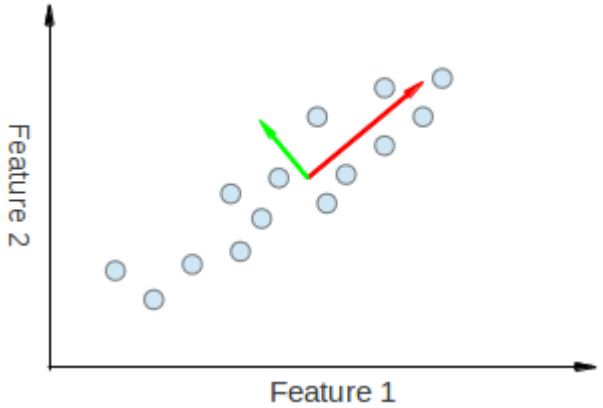
Image set

Image Matching



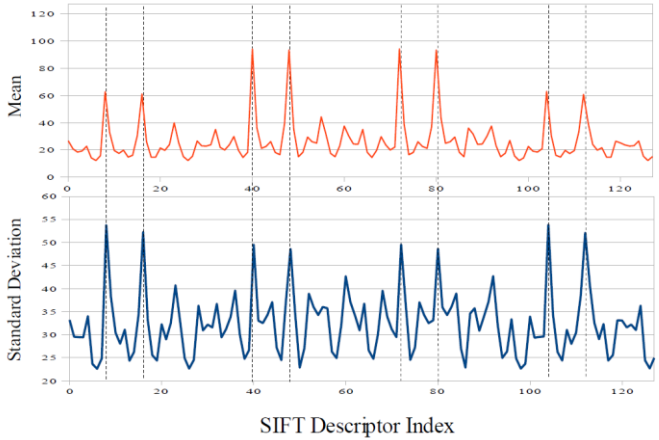
PCA (Principal Component Analysis) SIFT

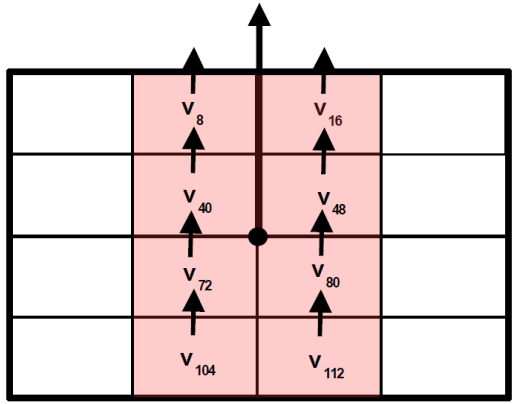
- Can reduce dimension to 64 or 32 with a good accuracy



SIFT-HHM

- 8 mean and standard deviation peaks
- Corresponding descriptor vectors are in line with key point's orientation



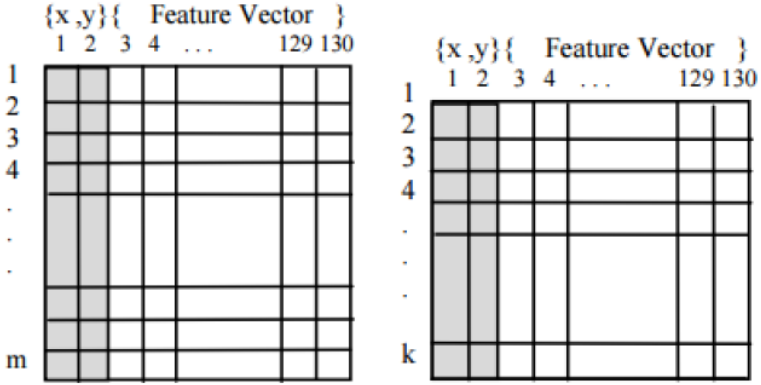


Euclidean Distance Vs Inner Product

- The original matching method in SIFT is calculating the smallest and second smallest Euclidean distance between two vectors. If the distance_1/distance_2 is smaller than a threshold such as 0.8 or 0.65, we will mark the pair as a good match pair.

$$L_o = \sqrt{\sum_{i=1}^{n} \left(x_i - y_i \right)^2}$$

SIFT



$$P = M \cdot K^T$$

$$Recall = \frac{Correctmatchesretrieved}{Totalnumberofcorrectmatches}$$

$$1 - Precision = \frac{Incorrectmatchesretrieved}{Totalofmatchesretrieved}$$

Results

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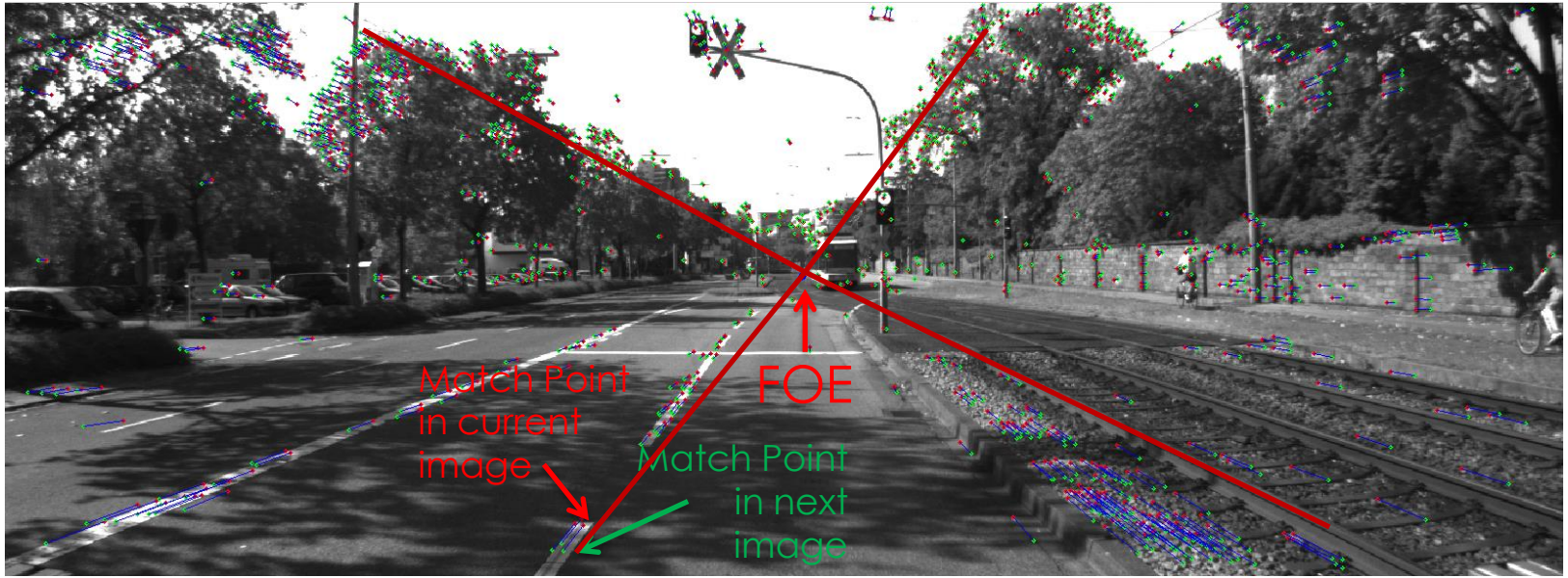
	Inner Product	PCA-80	PCA-64	PCA-32	PCA-16
Recall	90%	25%	50%	25%	8%
Error Rate	5%	5%	10%	10%	5%

Image Matching



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Thank You!

Jicheng