UNIVERSITÀ DEGLI STUDI DI PADOVA

Feature matching

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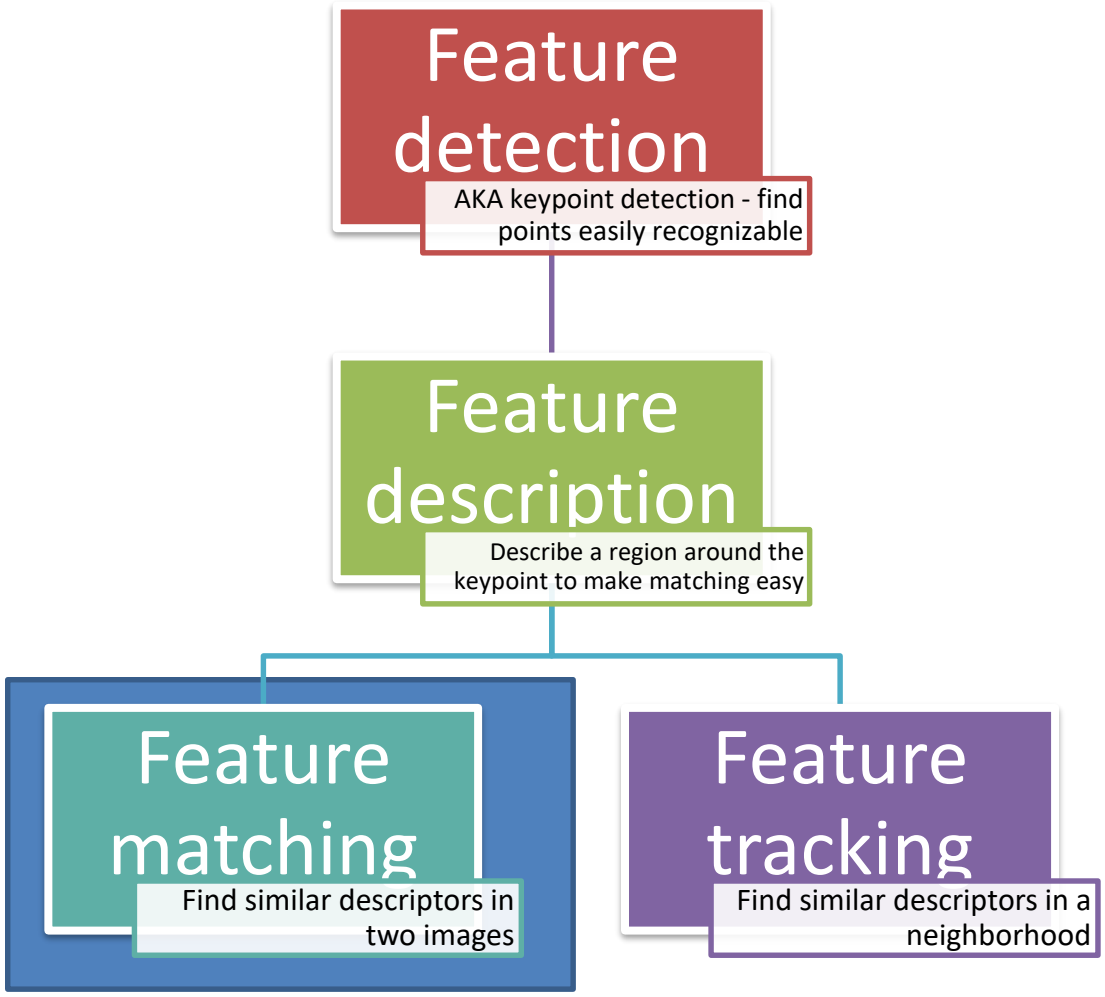
Agenda

- Feature matching
- Matching strategies
- Performance metrics
- Performance comparison

Feature pipeline

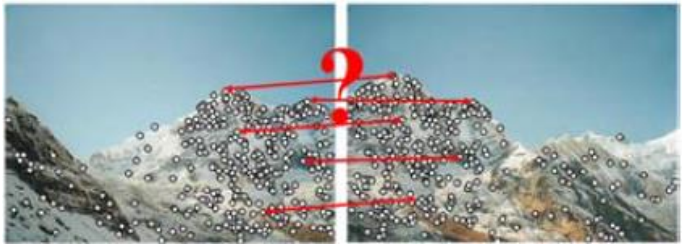


Feature matching

- Features found in images are often matched
- Matching strategy
  - What features to compare?
- Match evaluation
  - Assign a number to the match
  - Usually: Euclidean distance or Hamming distance

Matching strategy

- Matching strategy depends on the application at hand
  - Similar features can be in similar positions or not
  - There can be many matches or not
- Example
  - How many matches in these two cases?
    - Image stitching
    - Object detection in clutter



Matching strategies

- Several strategies are possible
- **Strategy 1**: maximum distance
  - Match against all features within a geometric distance
  - But: it is difficult to set the threshold
- Check the Brute Force (BF) matcher in OpenCV
  - How does it work?
  - Pros/cons?

Matching strategies

- **Strategy 2**: Nearest Neighbor (NN)
  - Consider only the nearest neighbor in **feature space**
  - A threshold is also used (the nearest neighbor may be distant – consider occlusions)

Matching strategies

- **Strategy 3**: Nearest Neighbor Distance Ratio (NNDR)

$$NNDR = \frac{d_1}{d_2}$$

Where d_1 is the nearest distance, d_2 the second nearest distance

Matching performance

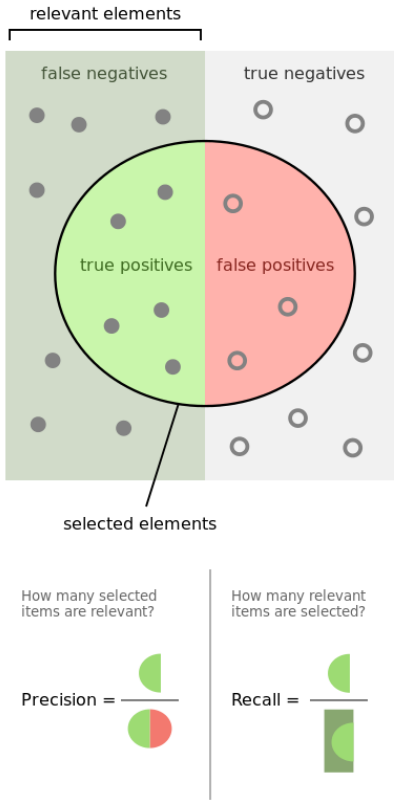
- It is usual to measure performance using the following indicators:
  - TP: True Positives, number of correct matches
  - TN: True Negatives, number of correct non-matches
  - FP: False Positives, number of non-matches that were wrongly matched
  - FN: False Negatives, number of matches that were wrongly missed

Matching performance

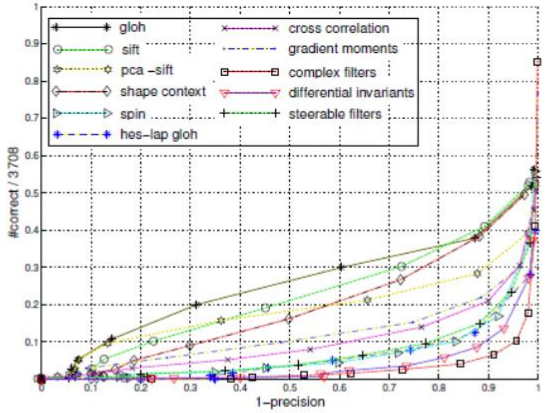
- Precision and recall are also used

$$\text{precision} = \frac{TP}{TP + FP}$$

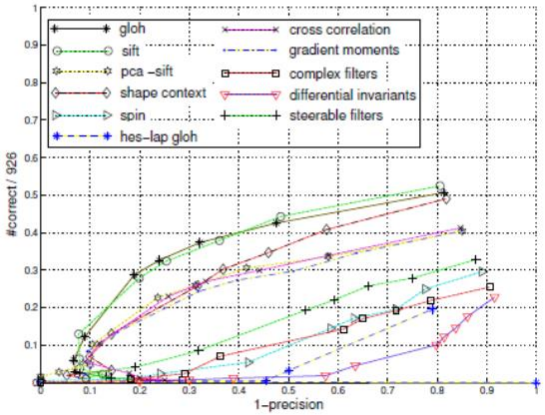
$$\text{recall} = \frac{TP}{TP + FN}$$



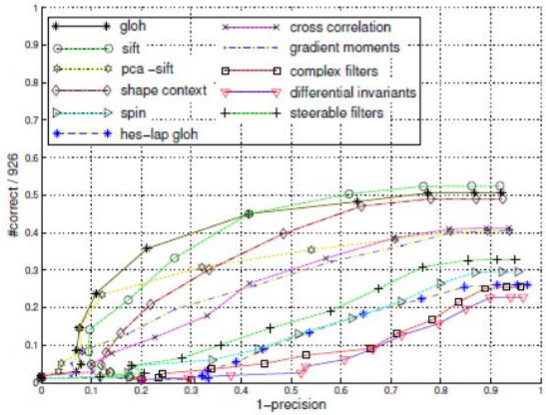
Matching performance



(a)



(b)



(c)

Fig. 4. Comparison of different matching strategies. Descriptors computed on Hessian-Affine regions for images from figure 3(e). (a) Threshold based matching. (b) Nearest neighbor matching. (c) Nearest neighbor distance ratio matching. is the GLOH descriptor computed for Hessian-Laplace regions (cf. section IV-A.4).

Mikolajczyk, K., & Schmid, C. (2005). A performance evaluation of local descriptors. *IEEE transactions on pattern analysis and machine intelligence*, *27*(10), 1615-1630.

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