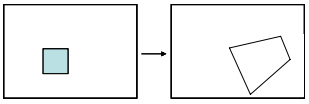
Invariant Local Features: Recap

Thursday, February 8

Classes of transformations

- **Euclidean/rigid**: Translation + rotation
- **Similarity**: Translation + rotation + uniform scale
- **Affine**: Similarity + shear
- **Projective**: Affine + projective warps

Projective transformation



Matching with Features

- Problem 1:
  - Detect the *same* point *independently* in both images

no chance to match!

We need a repeatable detector

[Slide from Frolova and Simakov]

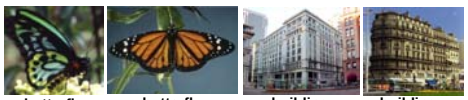
Matching with Features

- Problem 2:
  - For each point correctly recognize the corresponding one

We need a reliable and distinctive descriptor

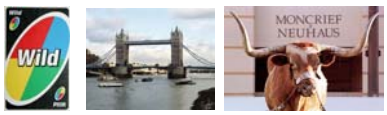
[Slide from Frolova and Simakov]

Recall "levels" of recognition



butterfly butterfly building building

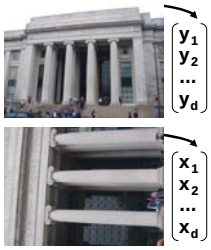
Categories



Wild card Tower Bridge Bevo

Specific

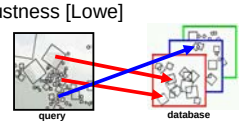
Recognition with invariant features



Recognition of specific objects

Common approach

- Vote with features independently
  - Ratio of distances to 1st and 2nd closest features may add robustness [Lowe]



- Geometric verification
  - Hough transform
  - RANSAC

Recognition of specific objects

Schmid and Mohr 1997

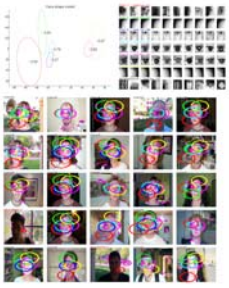
Sivic and Zisserman, 2003

Rothganger et al. 2003

Lowe 2002

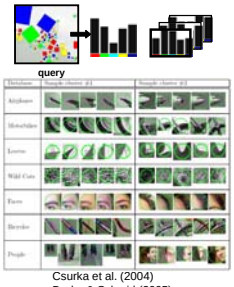
Recognition of categories

Constellation model



Weber et al. (2000)
Fergus et al. (2003)

Bags of words



Csurka et al. (2004)
Dorko & Schmid (2005)
Sivic et al. (2005)
Lazebnik et al. (2006), …

Issues

- Expense of detecting interest points
- For *specific-level* recognition – scaling the search?
  - Complexity
  - Distinctiveness
  - *Fast search techniques, possibly approximate*
  - *Exploit geometry*
  - *Novel feature descriptions?*
- For *category-level* recognition – are features appropriate?
  - Sparse
  - "Strict" appearance
  - Texture vs. shape
  - *Forget the interest operator, densely sample*
  - *Use complementary detectors*
  - *Learn class-specific features*
  - *Novel feature descriptions?*

Today

- **SIFT:** scale and rotation invariant detection and description [Lowe]
- **Harris-Affine detector** : affine invariant detection [Mikolajczyk and Schmid]
- **Evaluation** of invariant detectors and descriptors for 3D objects from different viewpoints [Moreels and Perona]

Next

- Discriminative approach for segmentation-based regions [Ren and Malik]
- Projects
  - Expectations for the proposal
  - Project ideas
  - Partners