Image Alignment

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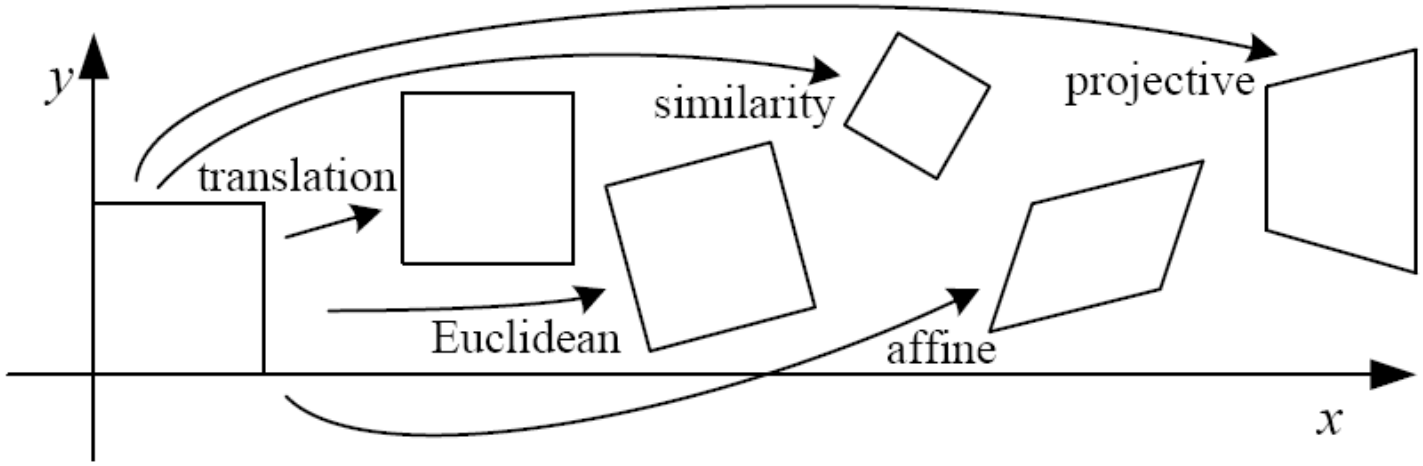
POSTECH

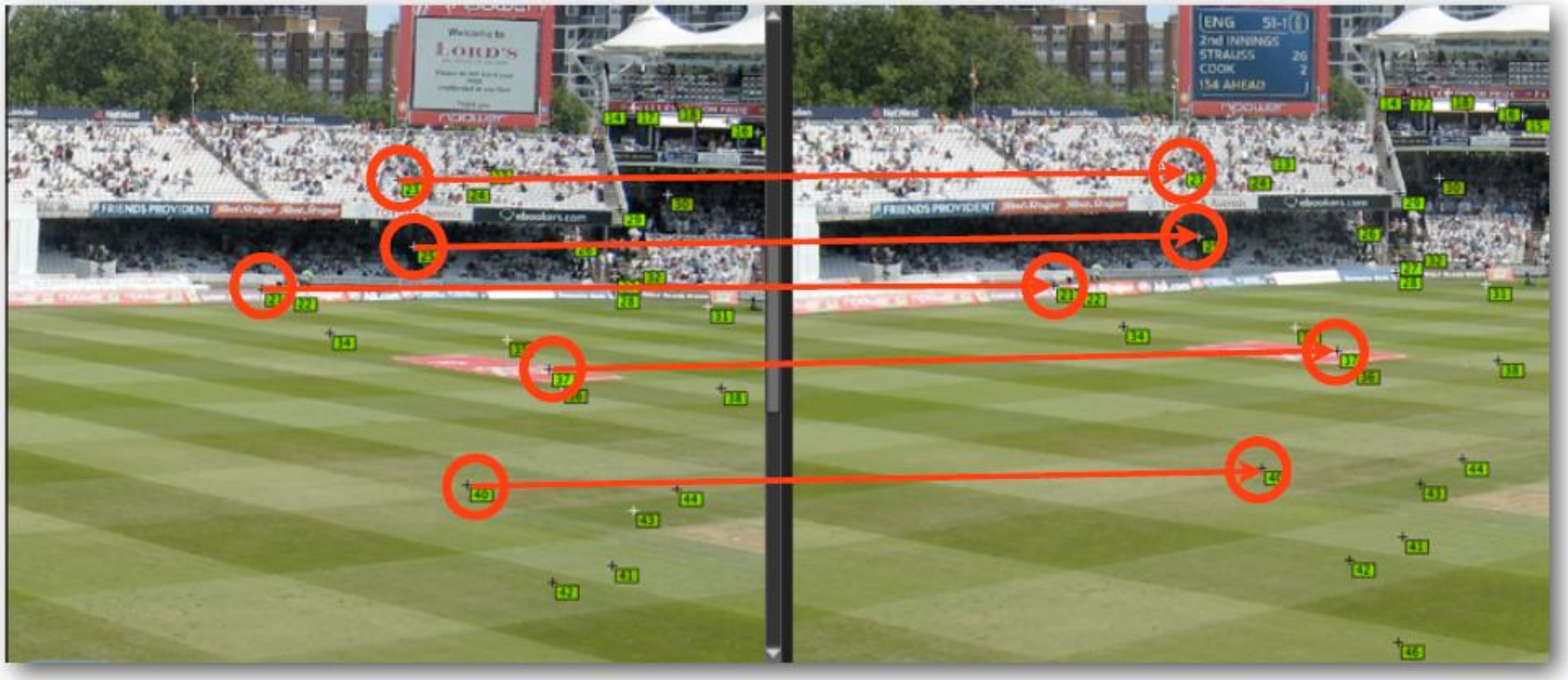
2D image transformations



Name	Matrix	#D.O.F. (# params)	Preserves
Translation	$\begin{bmatrix} \mathbf{I} & \mathbf{t} \\ \mathbf{0} & 1 \end{bmatrix}$	2	Orientation + …
Rigid (Euclidean)	$\begin{bmatrix} \mathbf{R} & \mathbf{t} \\ \mathbf{0} & 1 \end{bmatrix}$	3	Lengths + …
Similarity	$\begin{bmatrix} s\mathbf{R} & \mathbf{t} \\ \mathbf{0} & 1 \end{bmatrix}$	4	Angles + …
Affine	$\begin{bmatrix} a & b & c \\ d & e & f \\ 0 & 0 & 1 \end{bmatrix}$	6	Parallelism + …
Projective	$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & 1 \end{bmatrix}$	8	Straight lines

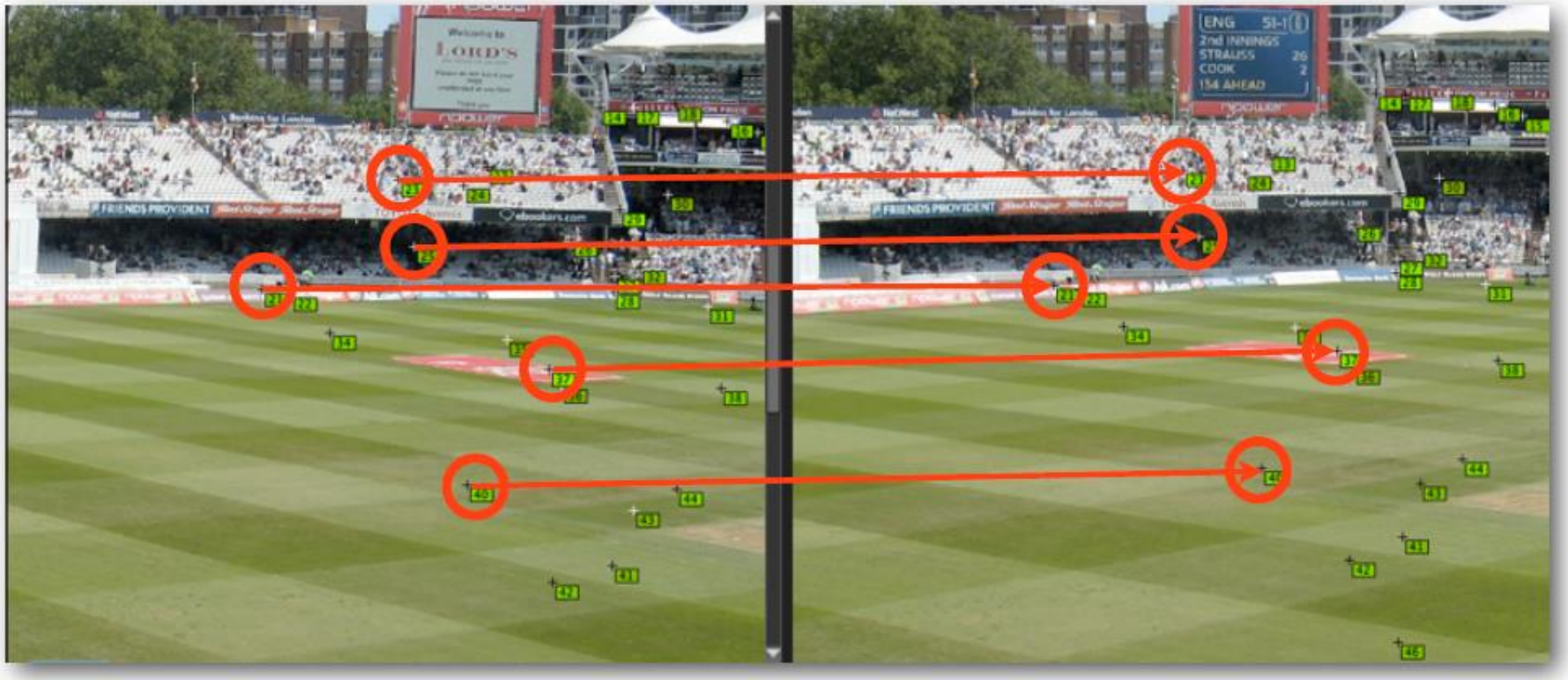
Feature-based alignment

- Procedure
  - Find a few important feature points (a.k.a interest points)
  - Match them across two images
  - Compute image transformation from the matches (e.g., homography)



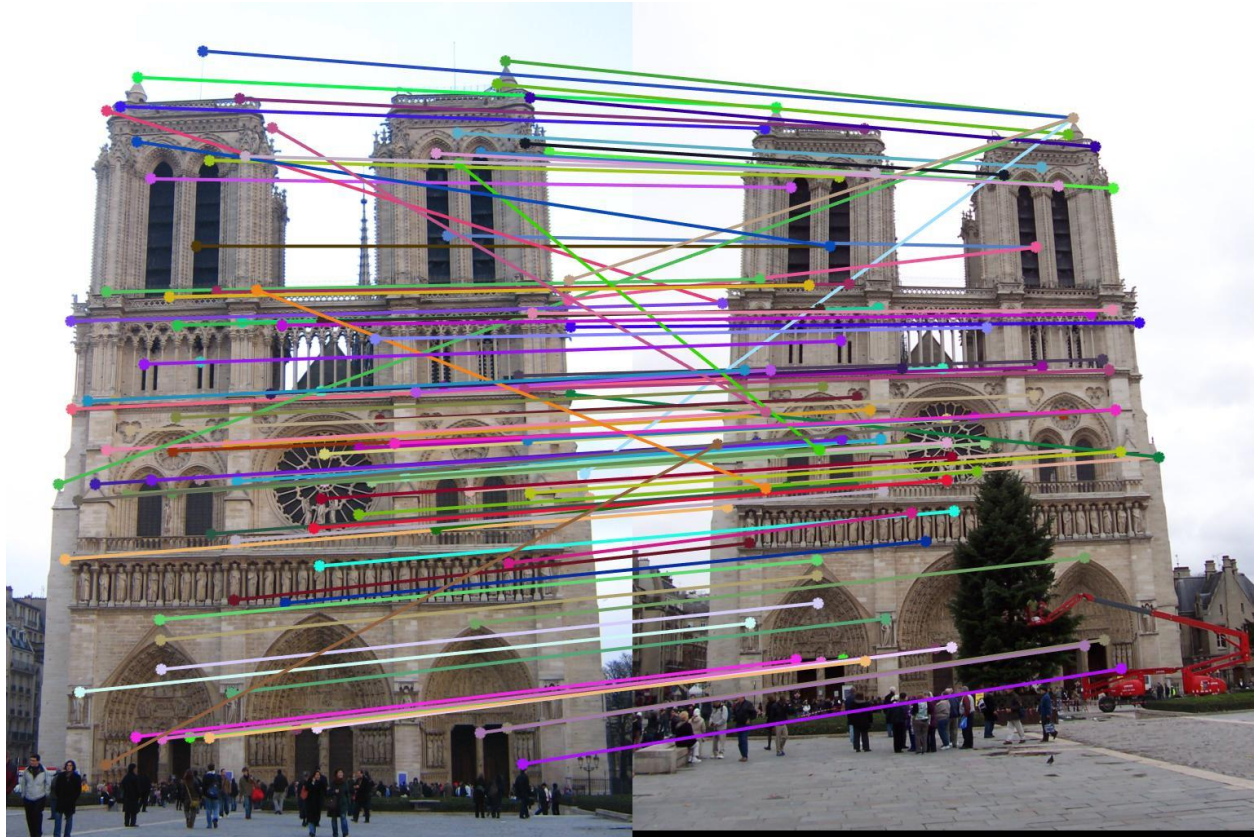
Feature detection

- Goal – Find points in an image that can be:
  - Found in other images
  - Found precisely – well localized
  - Found reliably – well matched



Feature matching

- We have matches now.

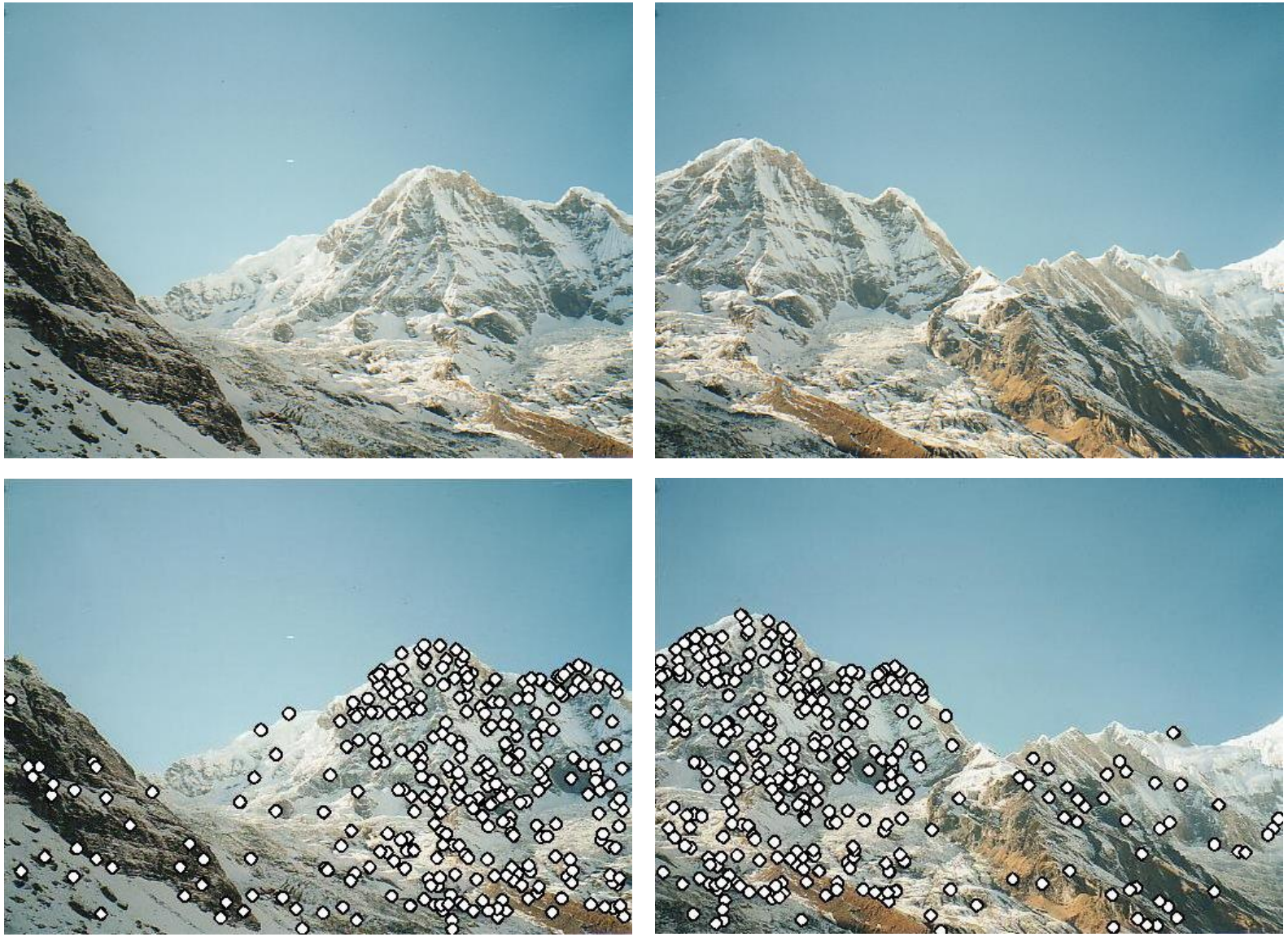


- Can we estimate a transformation now?
  - No. Because of outliers (wrongly matched pairs)

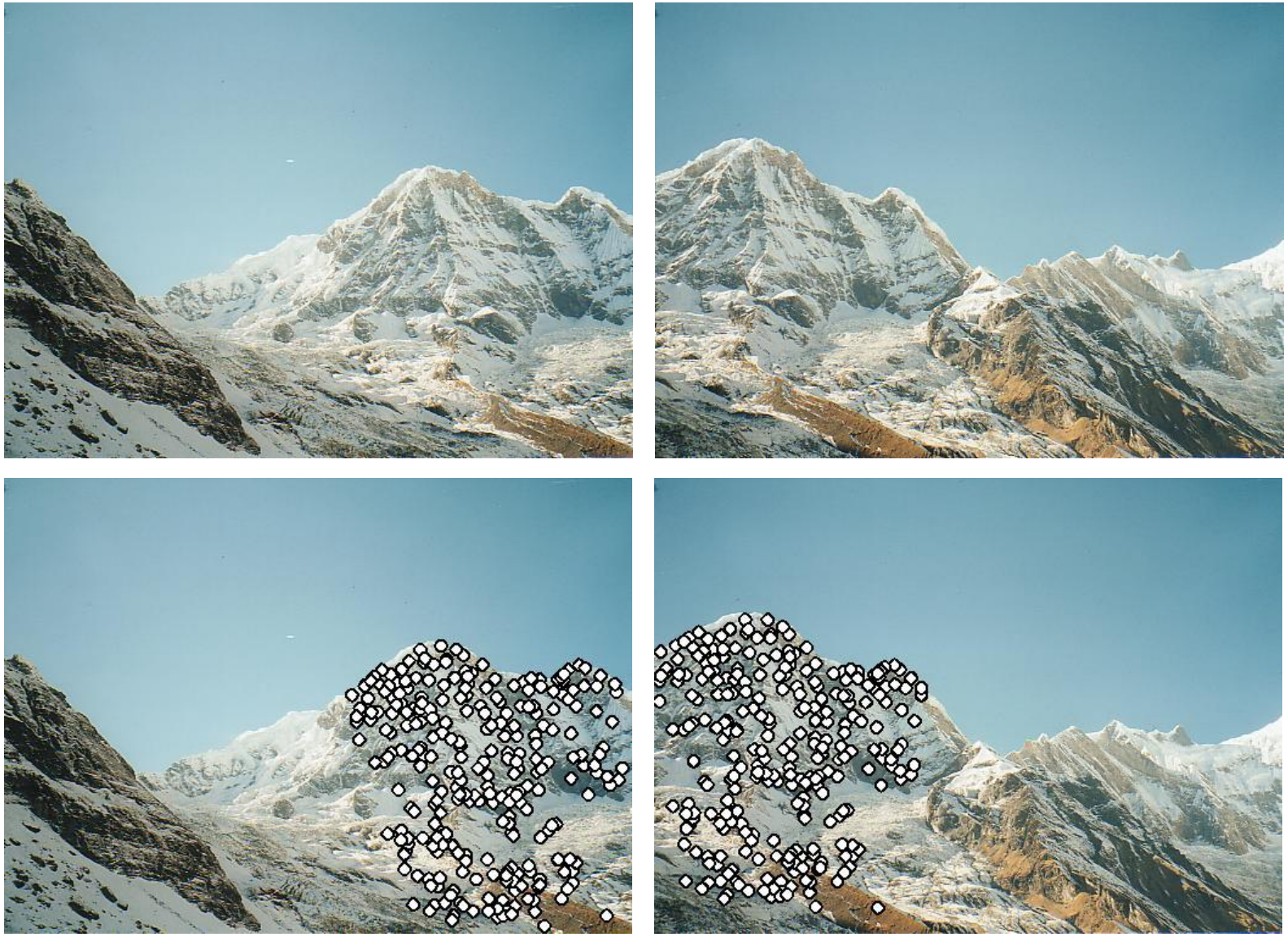
Outlier rejection

- We have to exclude outliers from estimating a transformation
- How?
- RANSAC
  - **RAN**dom **SA**mple **C**onsensus
  - Most widely used outlier rejection method

Example – feature detection



Example – feature matching & homography estimation using RANSAC



Example – align two images using estimated homography