

Camera Calibration using Vanishing Point Estimation

Image Analysis and Computer Vision Course

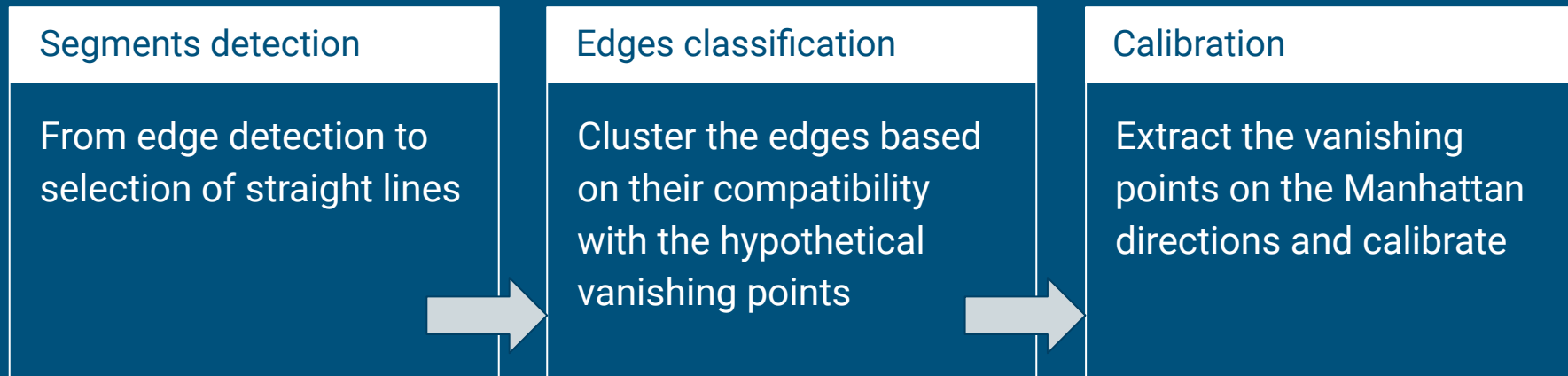
February 2022

Marzia Favaro

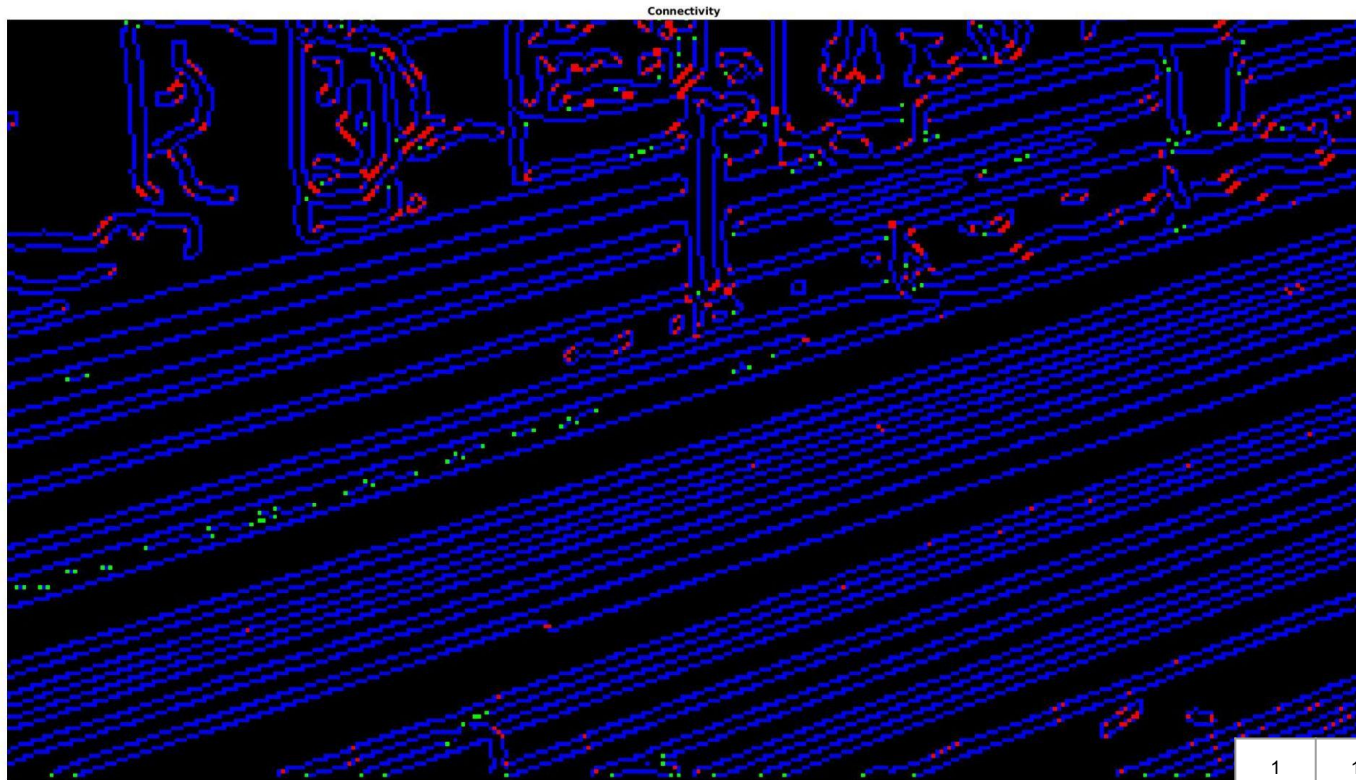
Ahmad Ataeighalehghasemi

Siddhant Samarth

Overview

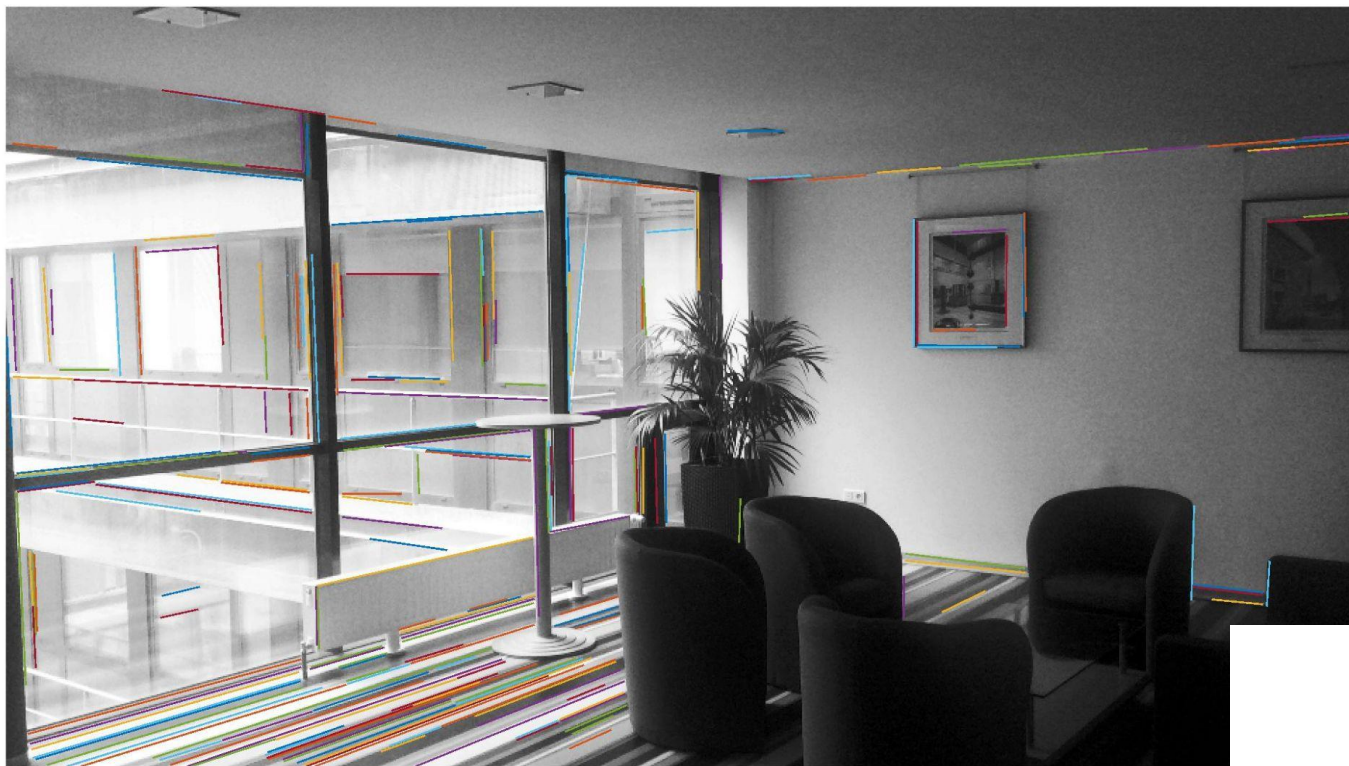


Segments detection

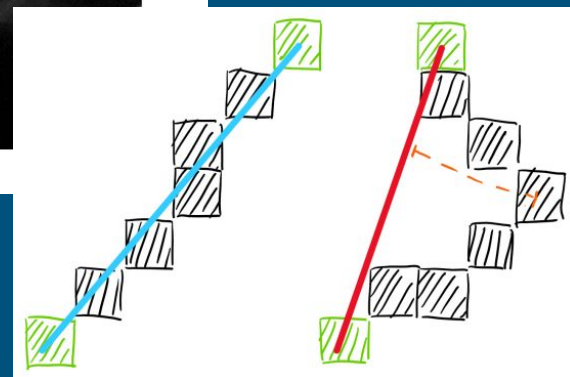


Edge detection and pixel classification

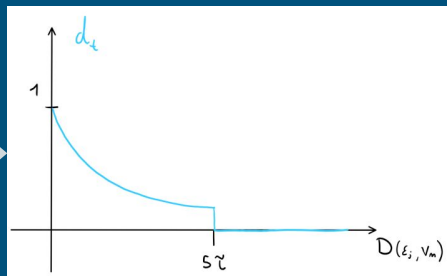
1	1	1
1	0	1
1	1	1



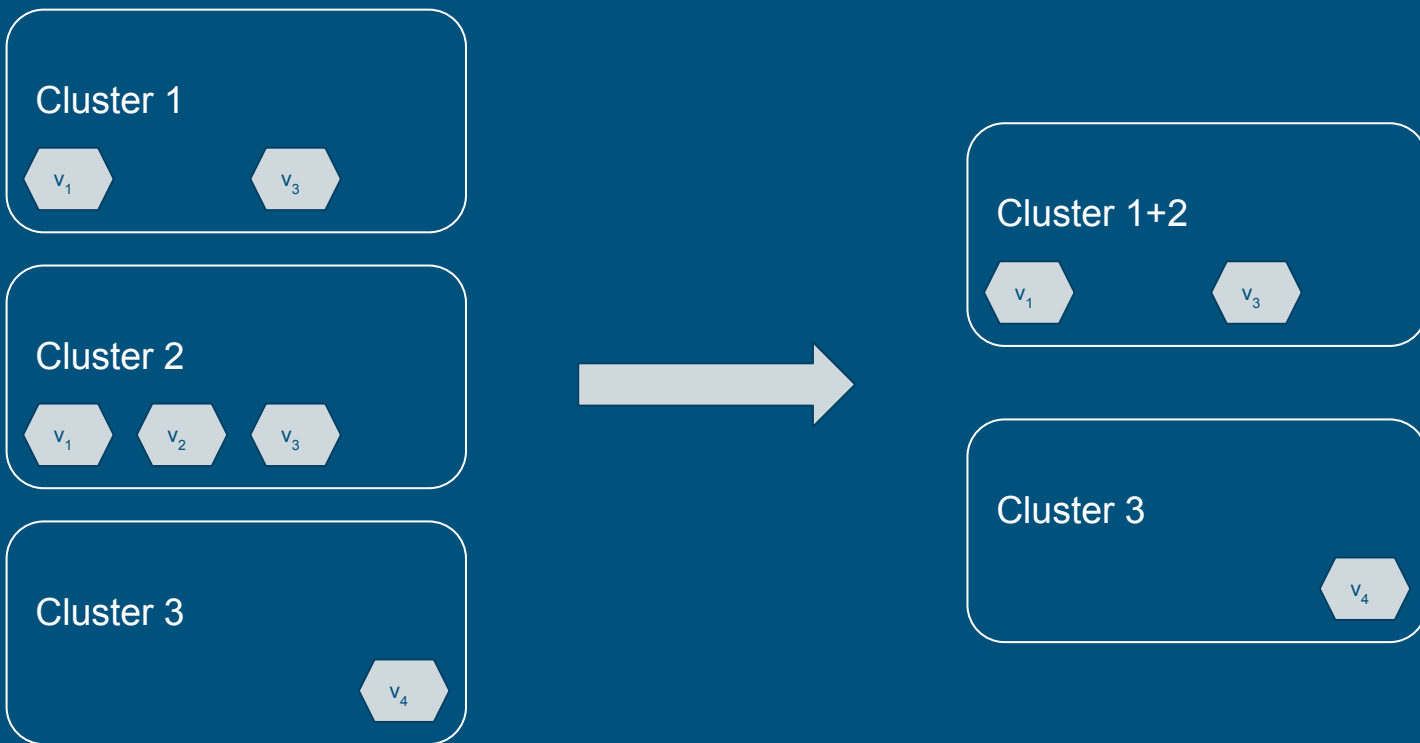
Straight lines detection



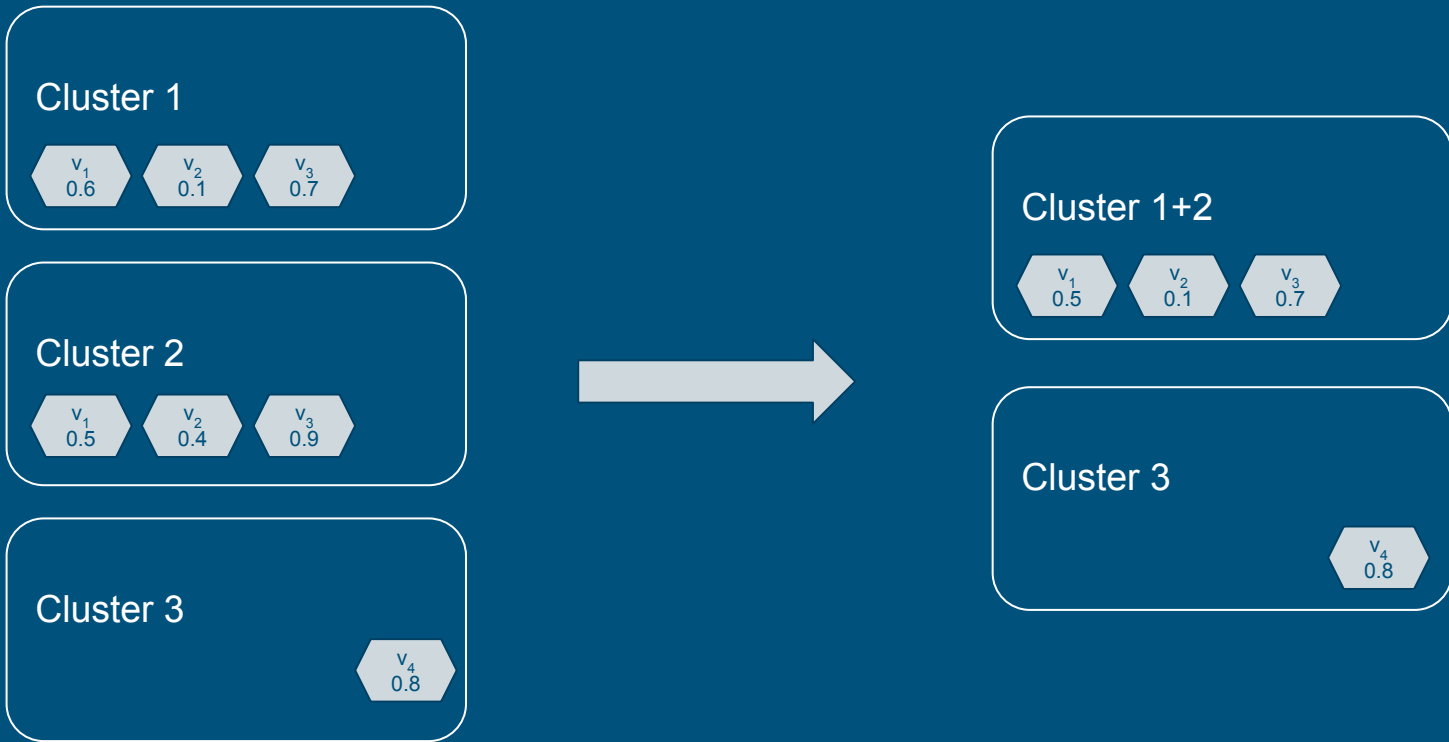
Edges classification



Preference matrix



Clustering - Jaccard

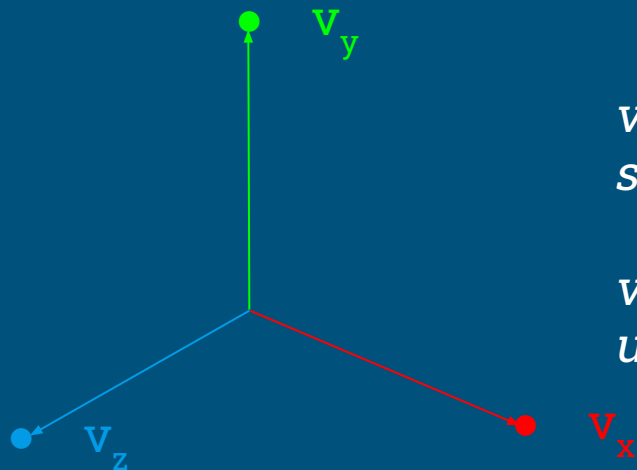


Clustering - Tanimoto

Calibration

$$\omega = (K K^T)^{-1}$$

$$K = \begin{bmatrix} f & 0 & u_o \\ 0 & f & v_o \\ 0 & 0 & 1 \end{bmatrix}$$



$$v^T \omega u = 0 \quad \forall \quad v' \perp u' \\ \text{s.t.}$$

v is the image of v'
u is the image of u'

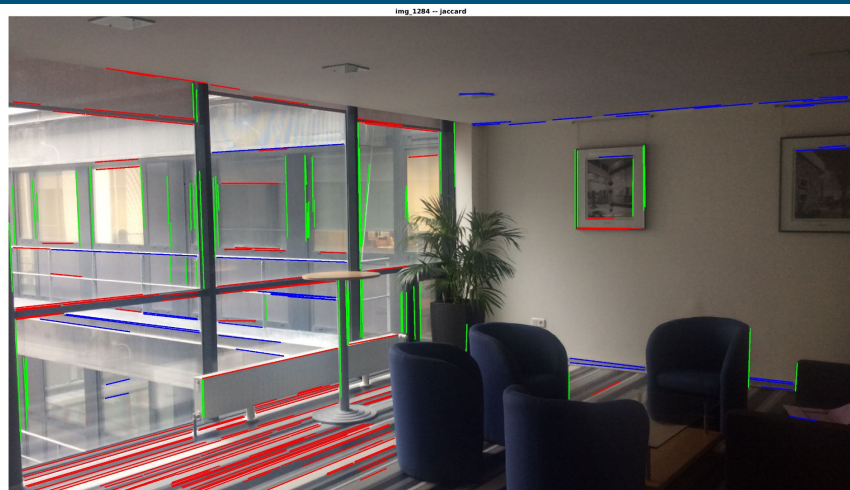
Orthogonality constraints

Assumptions:

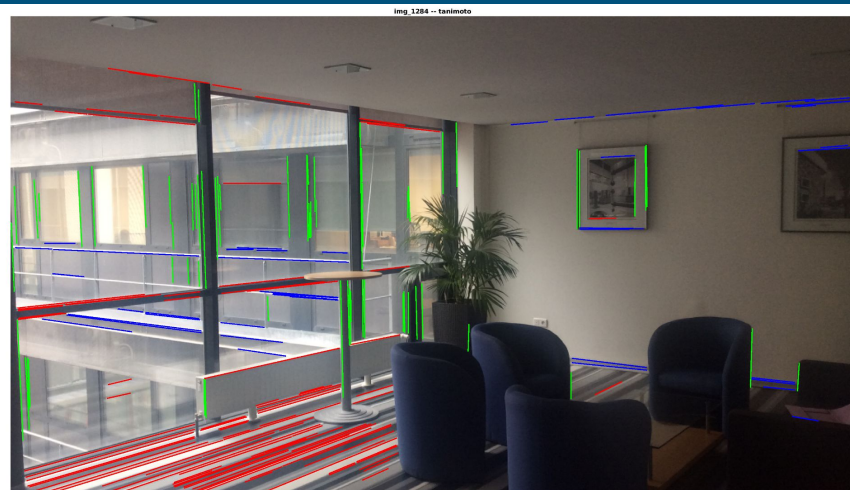
- $f_x = f_y = f$
- no skew

Results

Jaccard



Tanimoto



Classified edges

Jaccard

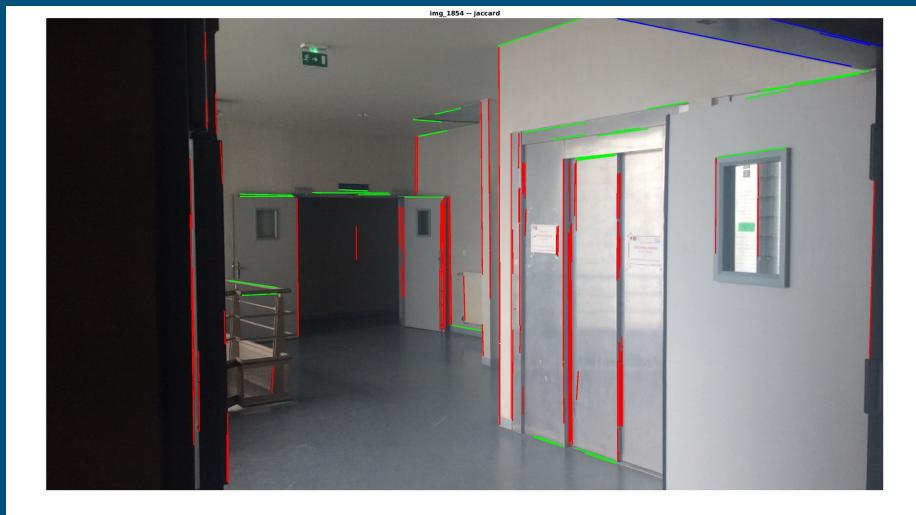


Tanimoto

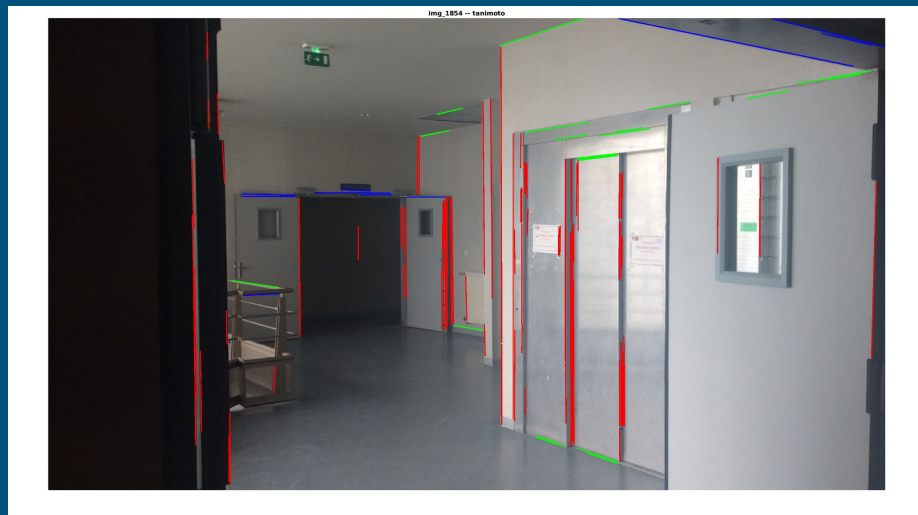


Classified edges

Jaccard



Tanimoto



Classified edges

Vanishing Points quality assessment

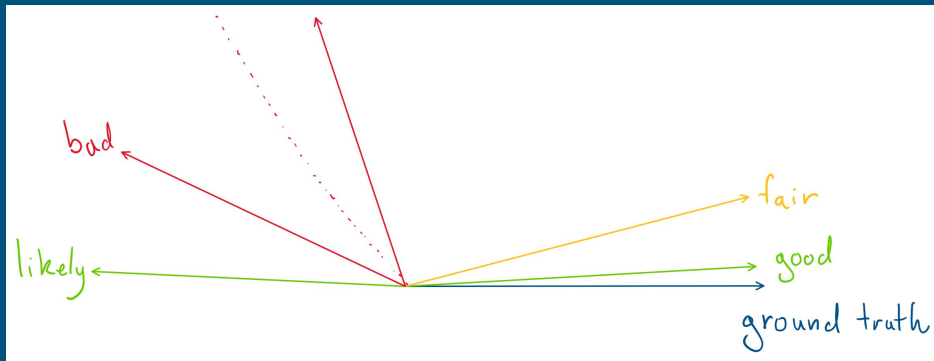
Problems

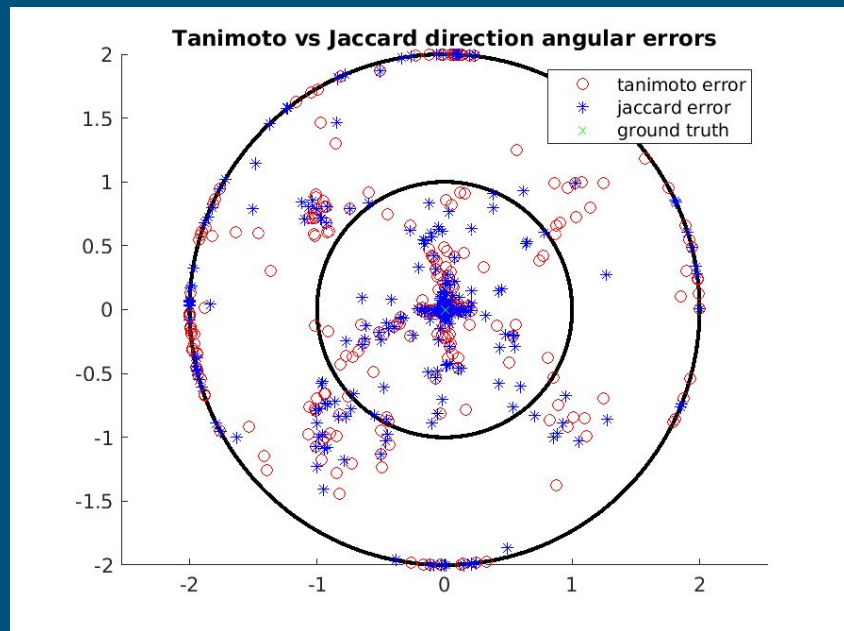
- The farther the VP, the more likely it is to get it wrong
- Associate our VPs with the ground truth ones correctly
- Slight errors in the lines' slopes can cause vanishing points to end on the opposite side of the image



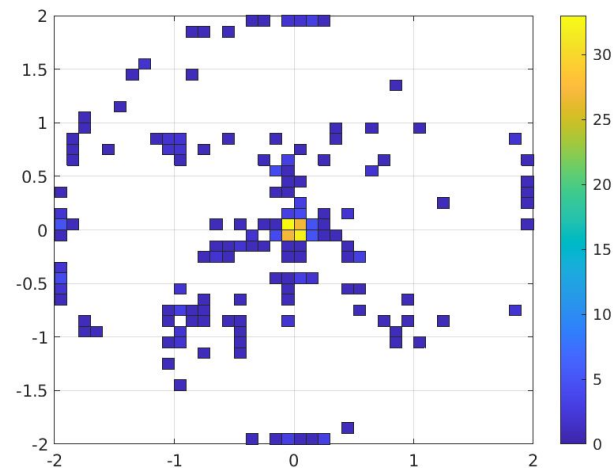
Solution

- Compare their directions

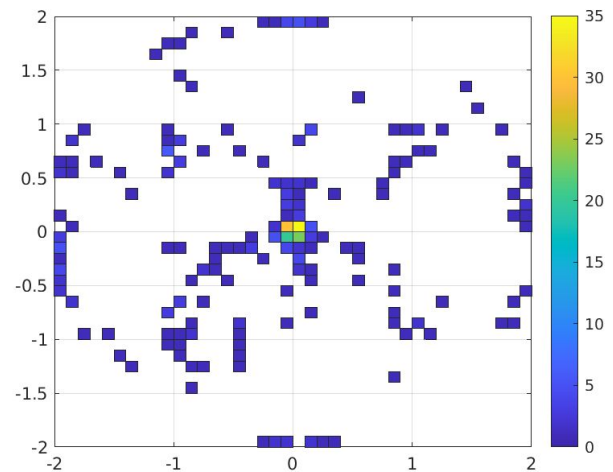




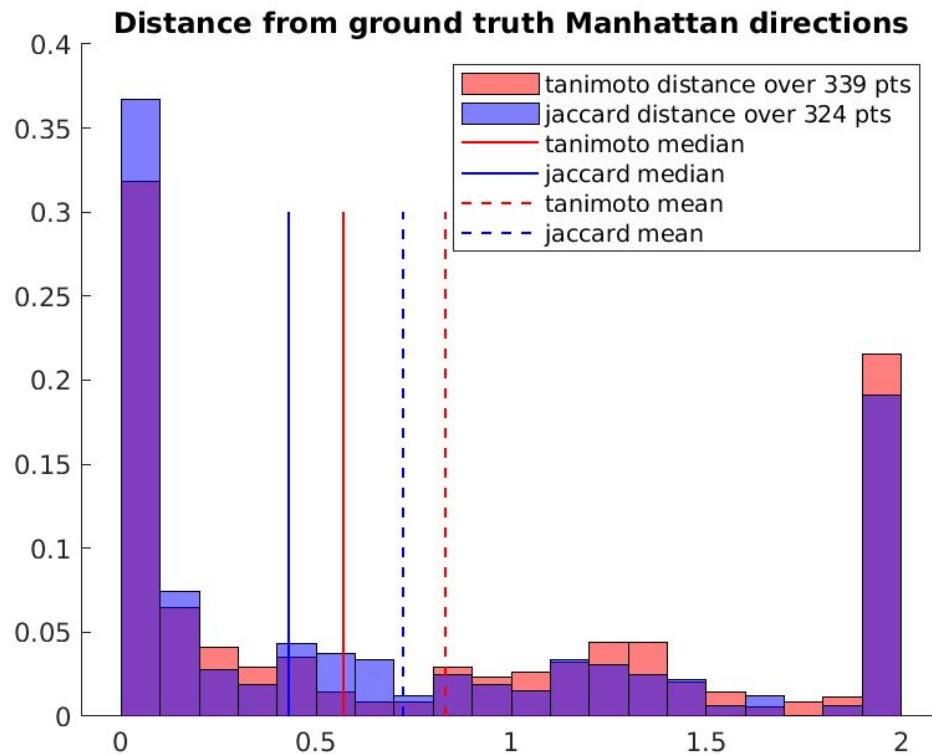
Jaccard



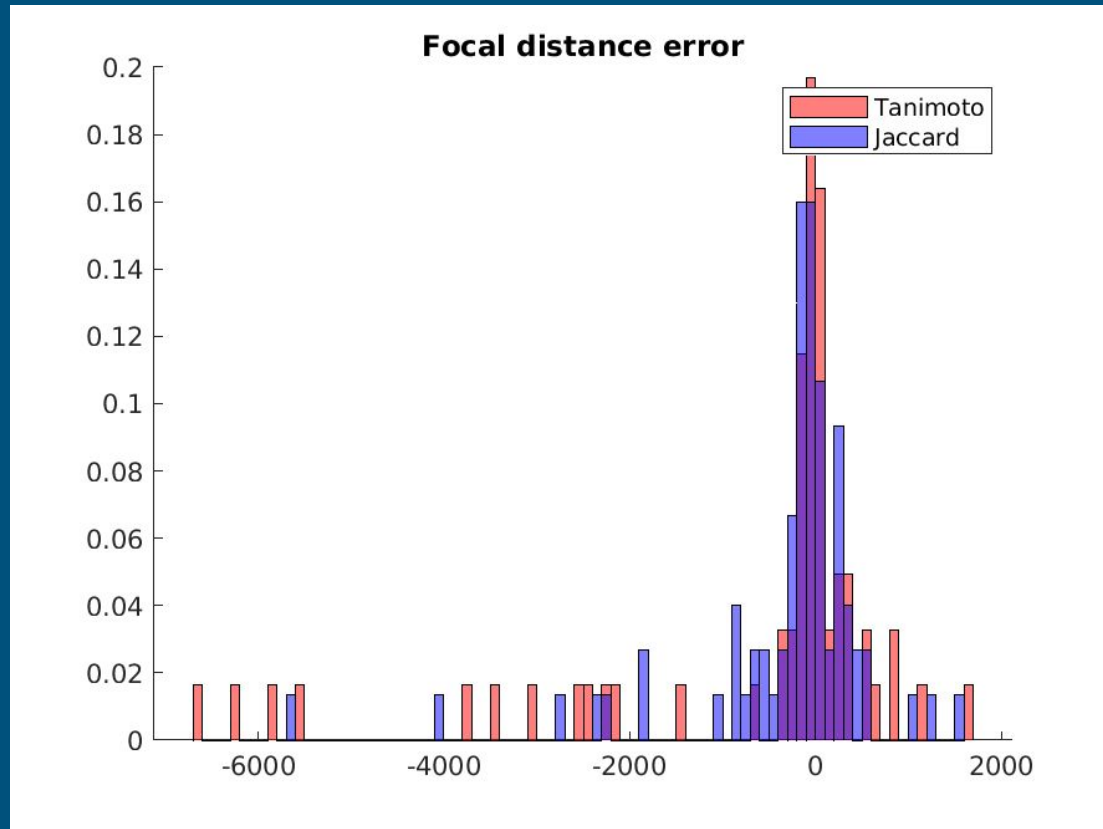
Tanimoto



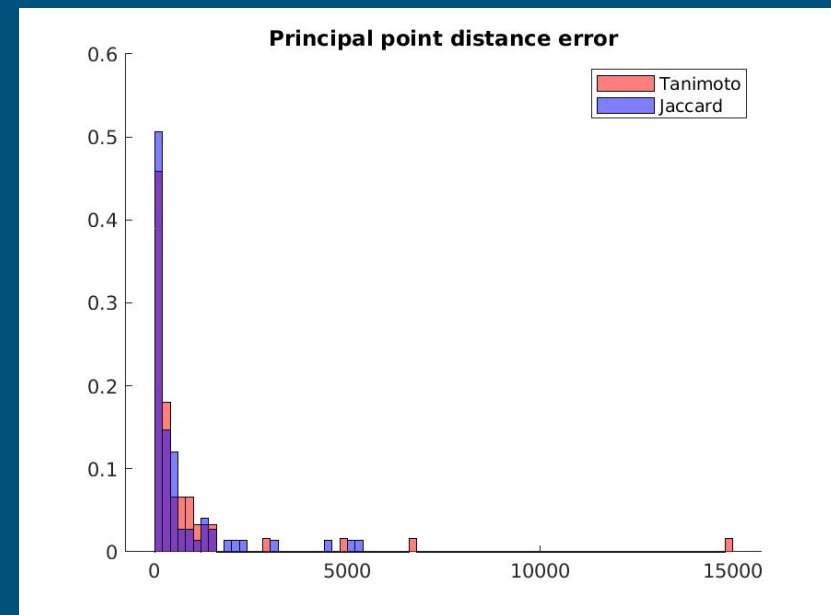
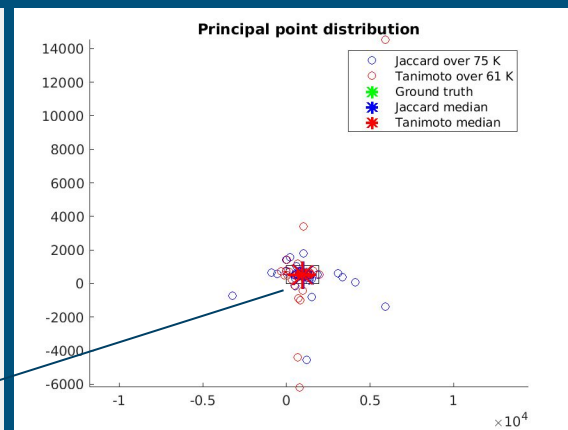
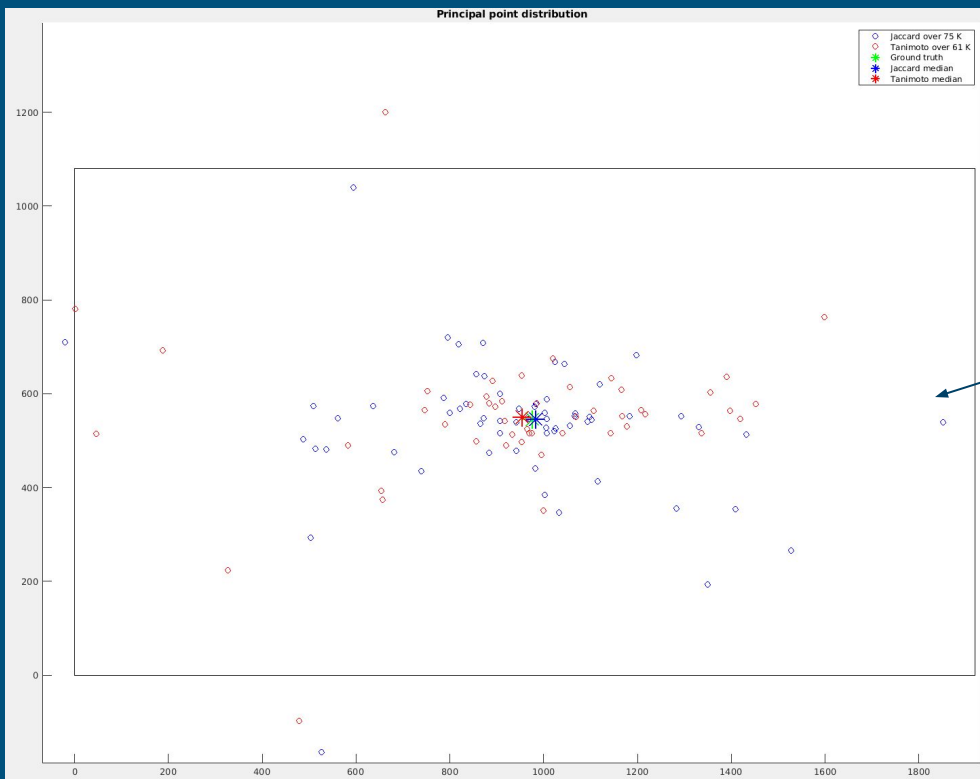
Angular errors of the vanishing points



Vanishing points angular error distribution



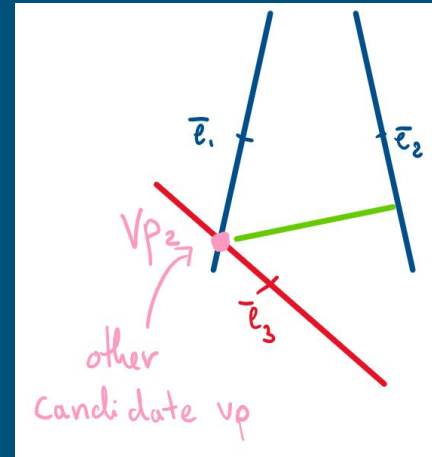
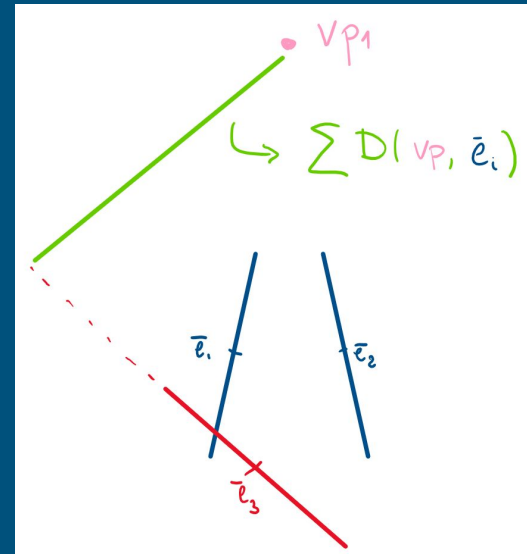
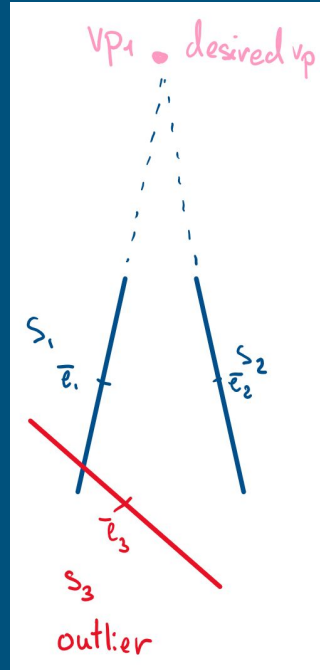
Focal distance absolute error



Principal points map

Possible improvements

- The cumulative consistency can suffer severely from outliers: replace function to find better vanishing points



Possible improvements

- Collinear edges' vanishing point is uninformative, and the same for very close lines. Solution: merge these.
- Not all the images had 3 vanishing points: improve segment detection
- Using Tanimoto didn't improve the results: improve the parameters

