Wide-baseline stereo of near-baseline image pairs

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Definition of the problem

Figure 1: WBS – wide baseline stereo,NBS – near baseline stereo, WBS unknown <-> NBS known [1]

Definition of the problem

- Input: two pairs of images of the same scene
- The 1st pair is near baseline stereo pair of images (possibly with known epipolar geometry)
- The 2nd pair is near baseline stereo pair of images (possibly with known epipolar geometry)
- between the 1st and the 2nd pair there can be a wide baseline (different rotations, scale, illumination conditions)
- Output: epipolar geometry between the cameras in the 1st and 2nd pair

Definition of the problem

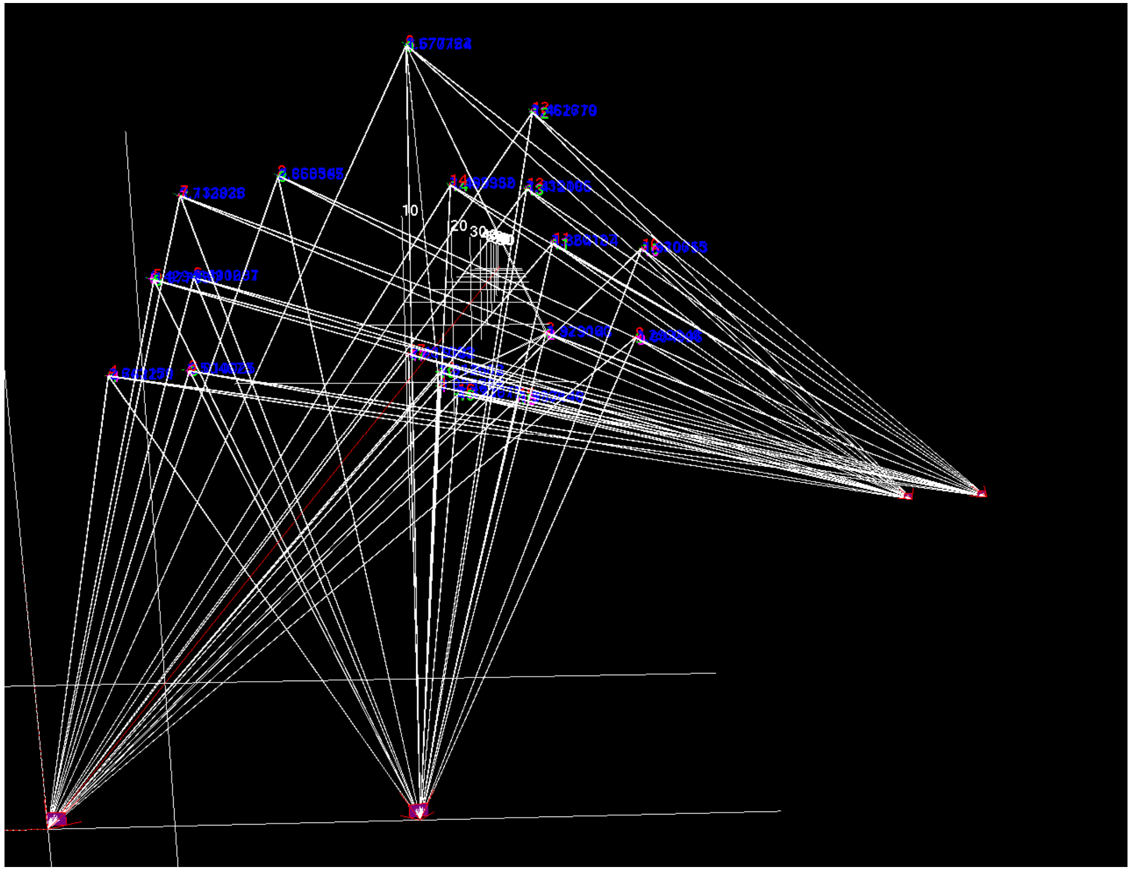

Figure 2 : Original scene and original camera positions

Core of the idea

- We mark the cameras and images as 1L,1R and 2L,2R.
- The method consist of three steps

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Core of the idea : 1. step

- We detect corresponding points in the first near-baseline image pair (1L,1R) and also in the second one (2L,2R), for example with KLT feature tracker. Instead of points the corresponding lines, regions or other features can be detected.
- In our experiments we have used only the points. Now the goal is to find the corresponding points in 1L and 2L images.

Core of the idea : 2. step

- For detected corresponding points we compute their positions in 3D space, so we have two sets of 3D points, each one with known two camera positions and rotations. We can mark these two models as 1S and 2S.

Core of the idea : 3. step

- The matching algorithm

a) We choose three points from the 1S and also from the 2S

b) We transform 2S according to chosen triple points from 1S

c) We project 1S to the image 2L

Experiments : simulation results

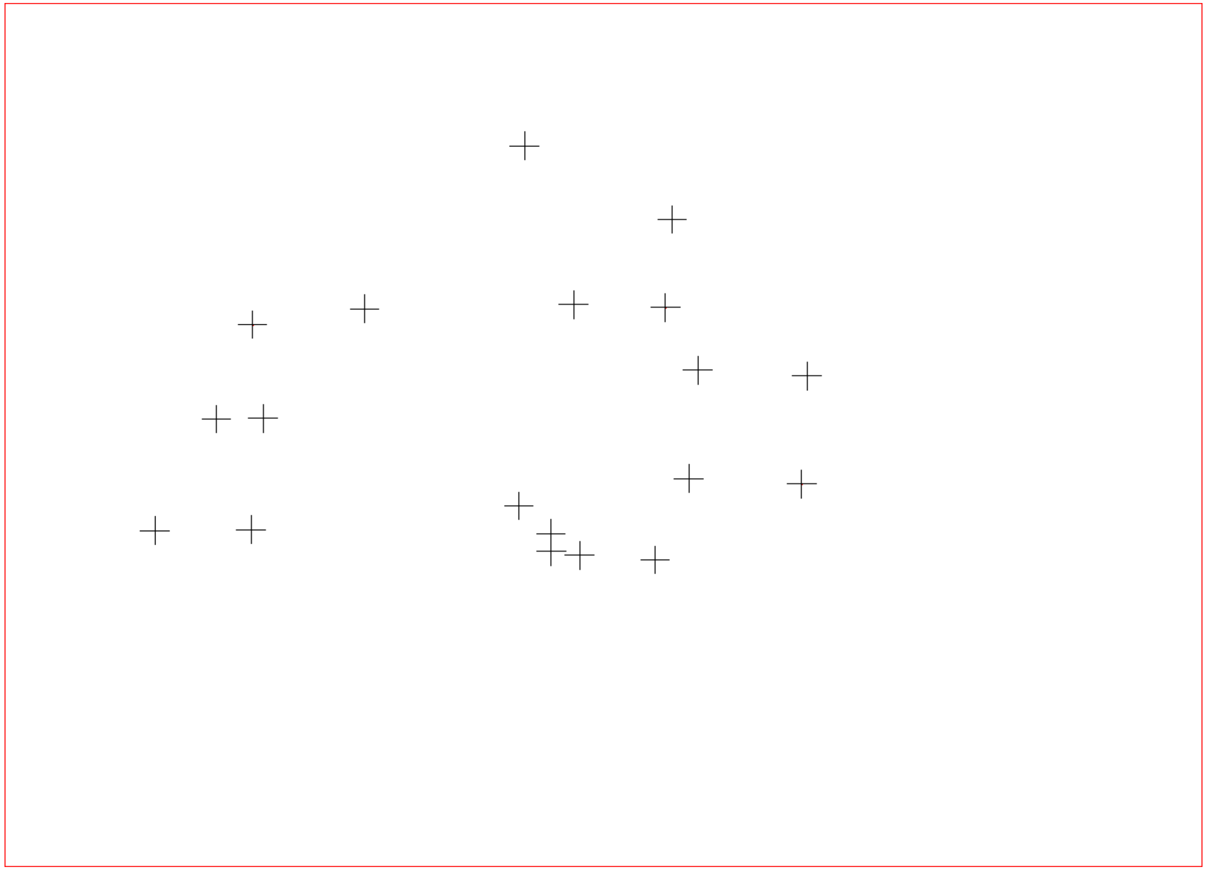

Figure 3 : Image 1L and the detected feature points

Experiments : simulation results

Figure 4 : Image 2L and the detected feature points

Experiments : simulation results

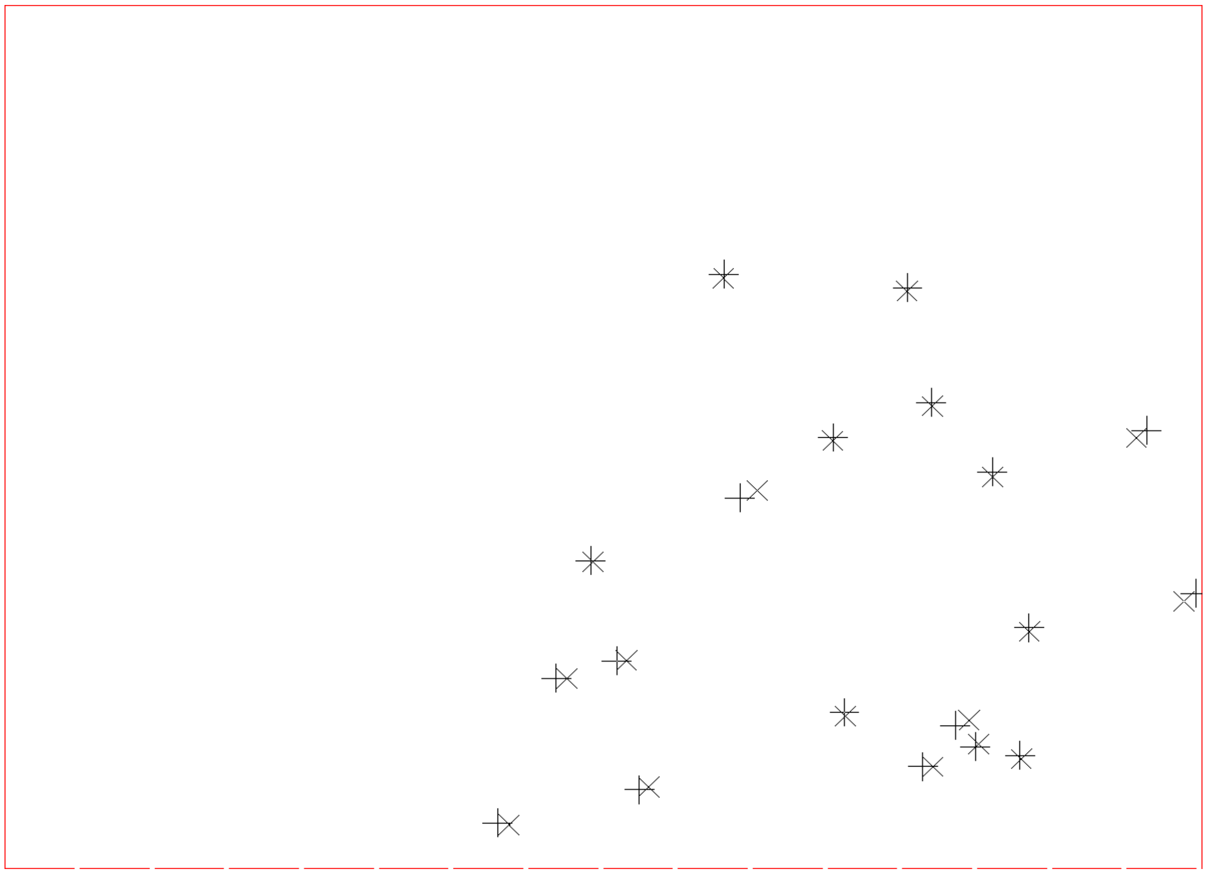

Figure 5 : Image 2L after the step 3.c

Experiments : simulation results

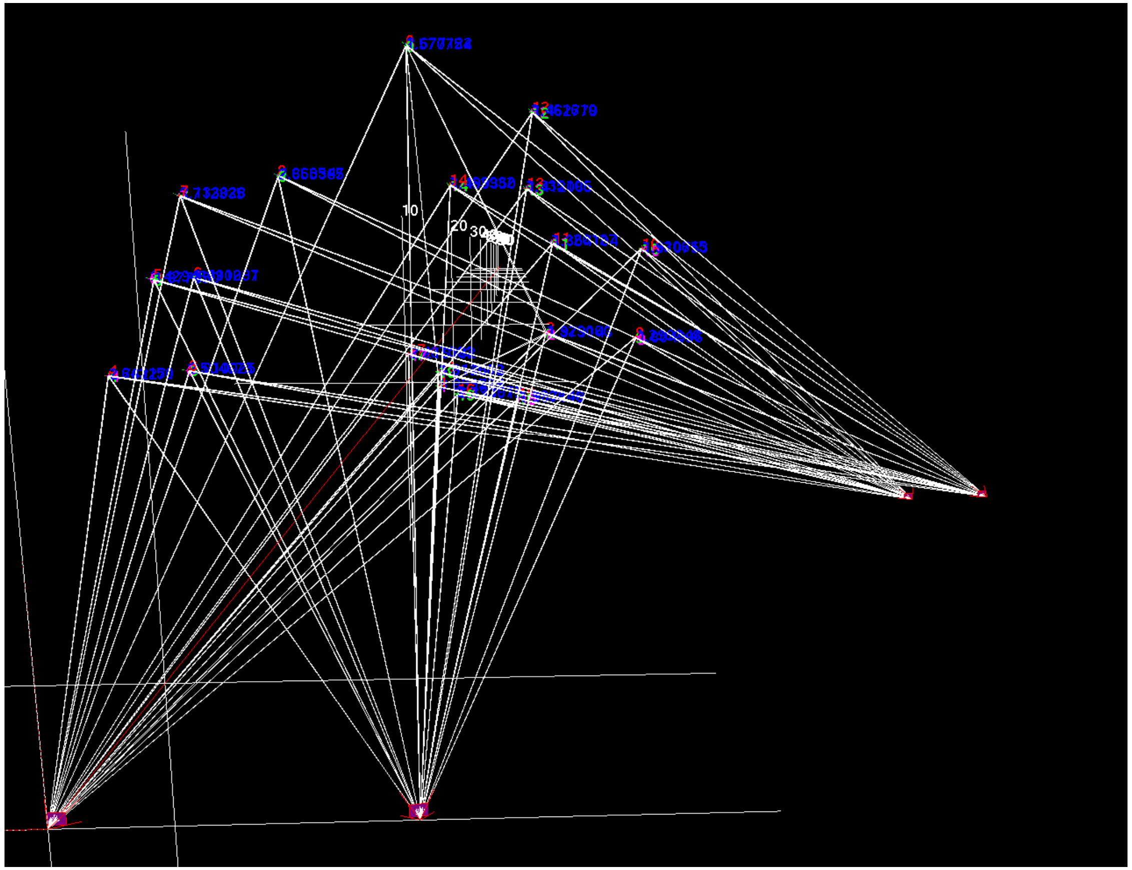

Figure 6 : Original scene and original camera positions

Experiments : simulation results

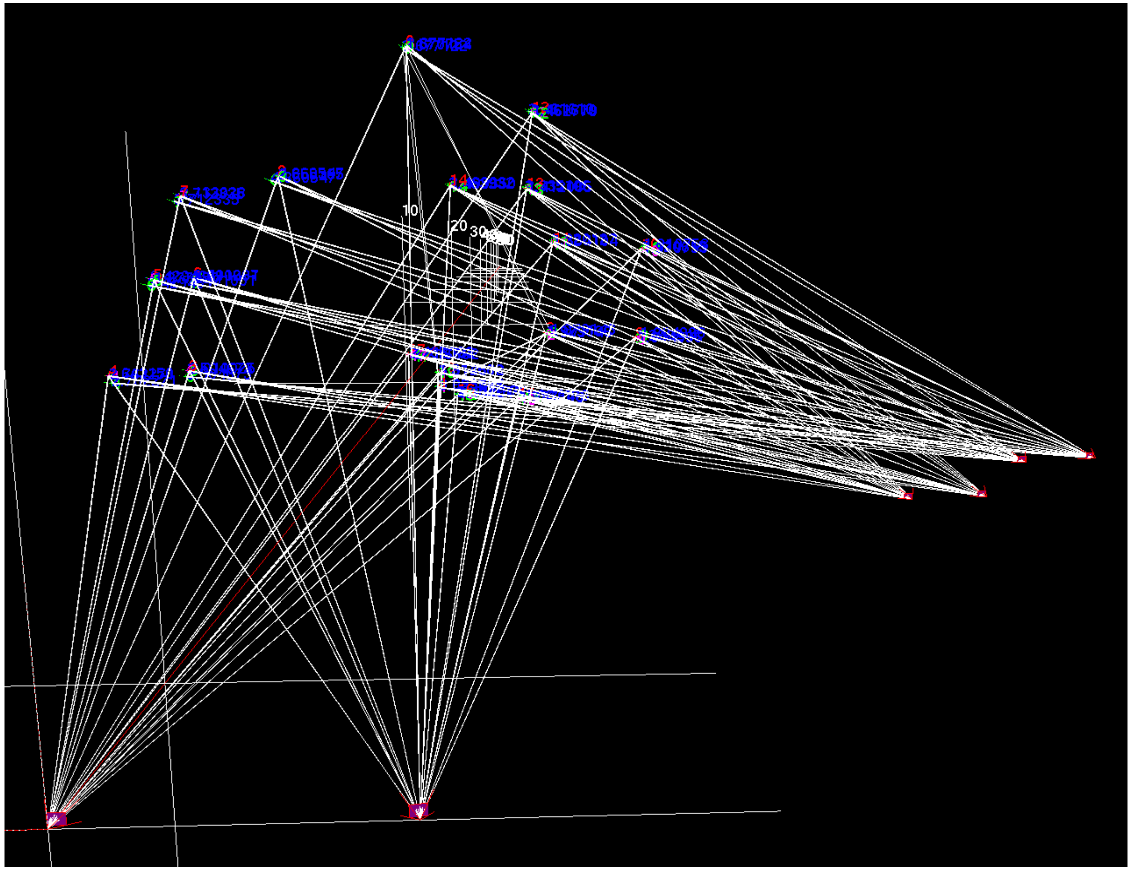

Figure 6 : Original scene, original and reconstructed camera positions

Experiments : simulation results

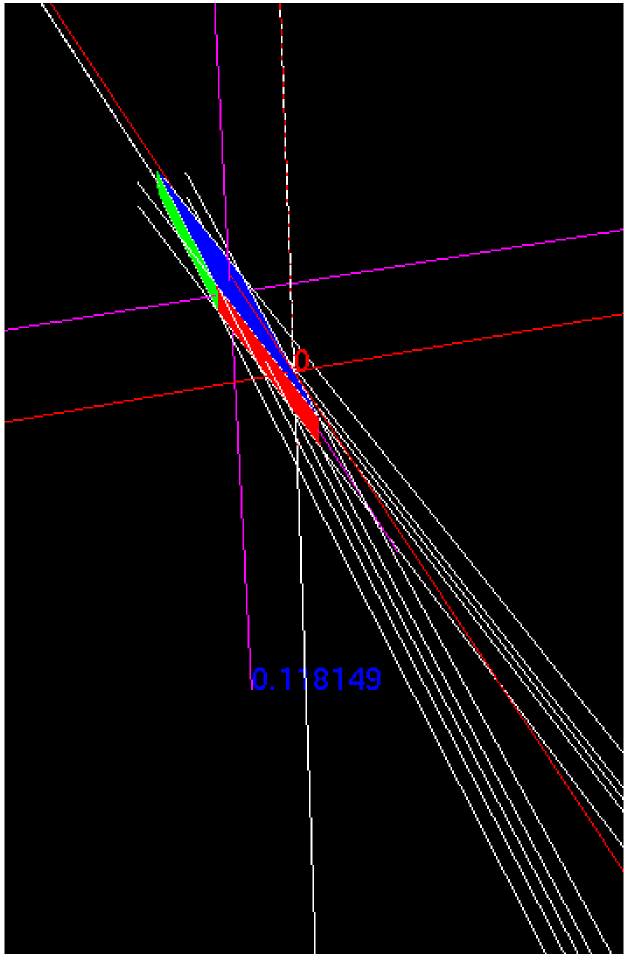

Figure 7 : Point space: the cause of the error between original and reconstructed camera positions

Distance from cameras	Deviation
10 m	0.118143 m
30 m	1.051046 m
50 m	2.955349 m
100 m	11.853376 m

The deviation depends on

a) camera positions and rotations

b) intristic camera parameters (resolution)

c) distance of real 3D point from cameras

Conclusions

- We have presented the idea which should work also when we try to reconstruct any planar object.
- For example for computing cameras positions and rotation from one WBS image pair we need 7 correspondence points which represent 7 coplanar points in 3D and lie at least in 3 non parallel planes.
- But if one reconstructs some facade which can be treated as a plane, these non-coplanar points cannot be detected.
- Our idea includes the possibility of the matching of any type of features (points, lines, regions).

Thank you for your attention.

References

[1] M. Jančošek, Feature Detection and Tentative Correspondence Estimation in Wide Baseline Stereo. master thesis, FMFI UK Bratislava 2005, 7.6.2005