Department, University, and/or Company Logos (optional)

The Title Should Be Large and Easy to Read

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Problem

When presenting a geo-localization problem , we need to estimate the camera pose using an overhead image captured by a low-altitude aerial device as query and a corresponding building point cloud as 3D model.

Related Work

- Image database
  -- Multiple nearest neighbor feature matching [Zamir and Shah, 2014]
- Image captured on the ground
  -- 2.5D map [Arth et al. 2015]
- Image captured in high altitude
  -- Extended Chamfer matching [Zhang et al. 2014]

Challenges

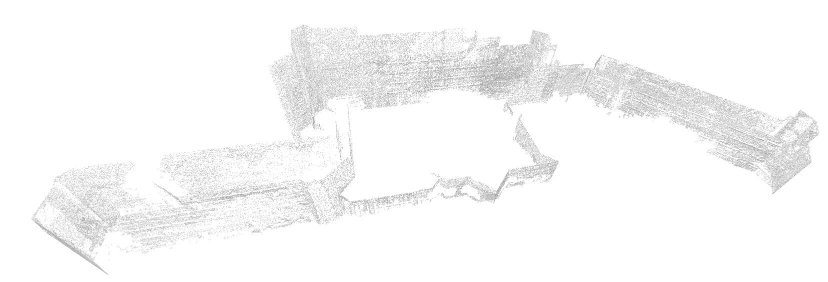
- Low-altitude aerial image is not able to take advantages of vanishing points.
- Low-altitude aerial image suffers from more critical perspective effect.

Our Approach

- Observations: vertical facades of a point cloud correspond to edges of building roofs in the overhead image.
- We propose a geo-localization algorithm to based on multi-altitude shape matching and iterative optimization.

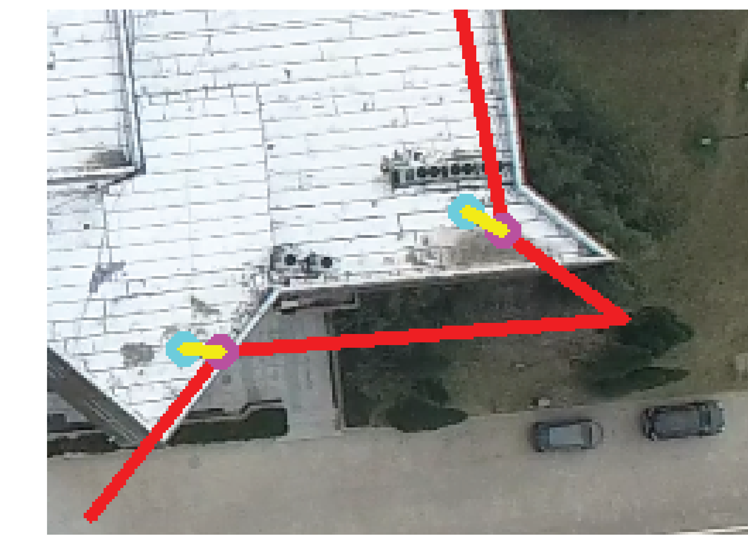
Input

An overhead image captured by an aerial device in low altitude.



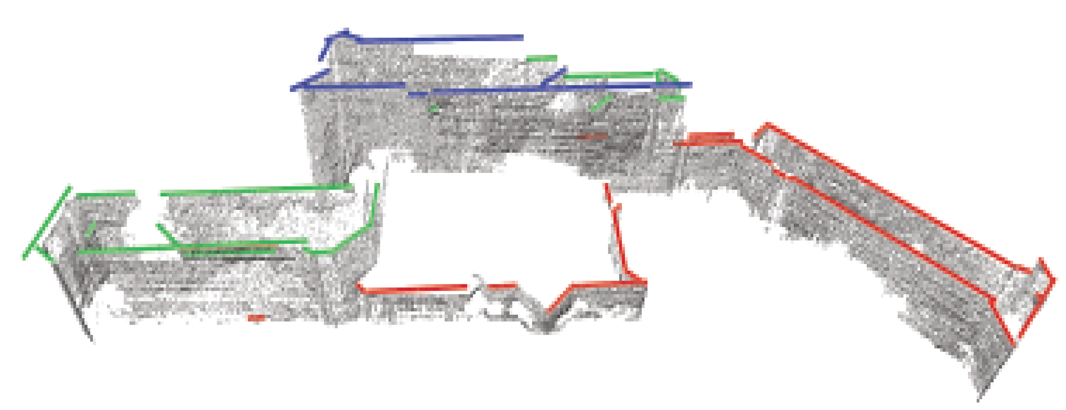
A point cloud captured by a laser device on the ground. Only the facades of the building can be scanned.

Paried feature points

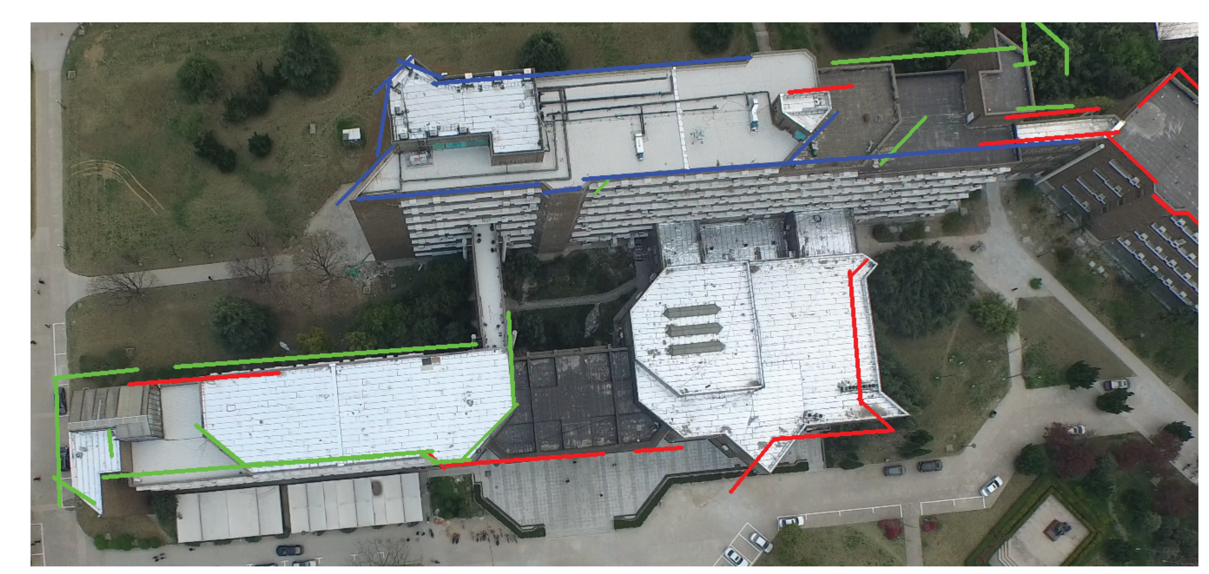


- For a 3D feature point, we project it on the overhead image (magenta points) using current project matrix and search in its neighborhodd for a corner (cyan points). These 3D feature points and corresponding corners will form pairs of feature points for next iteration of calculating global matrix.

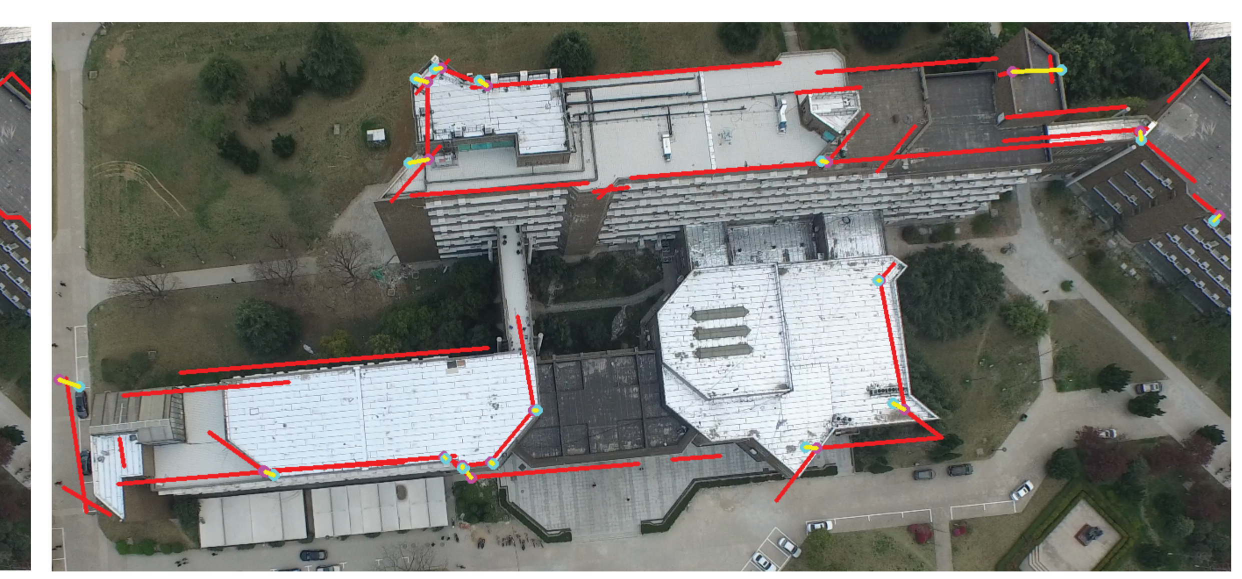
Method



- Step 1: Fit sets of lines in different altitudes as contours of building roofs and extract corners of these contours as 3D feature points.

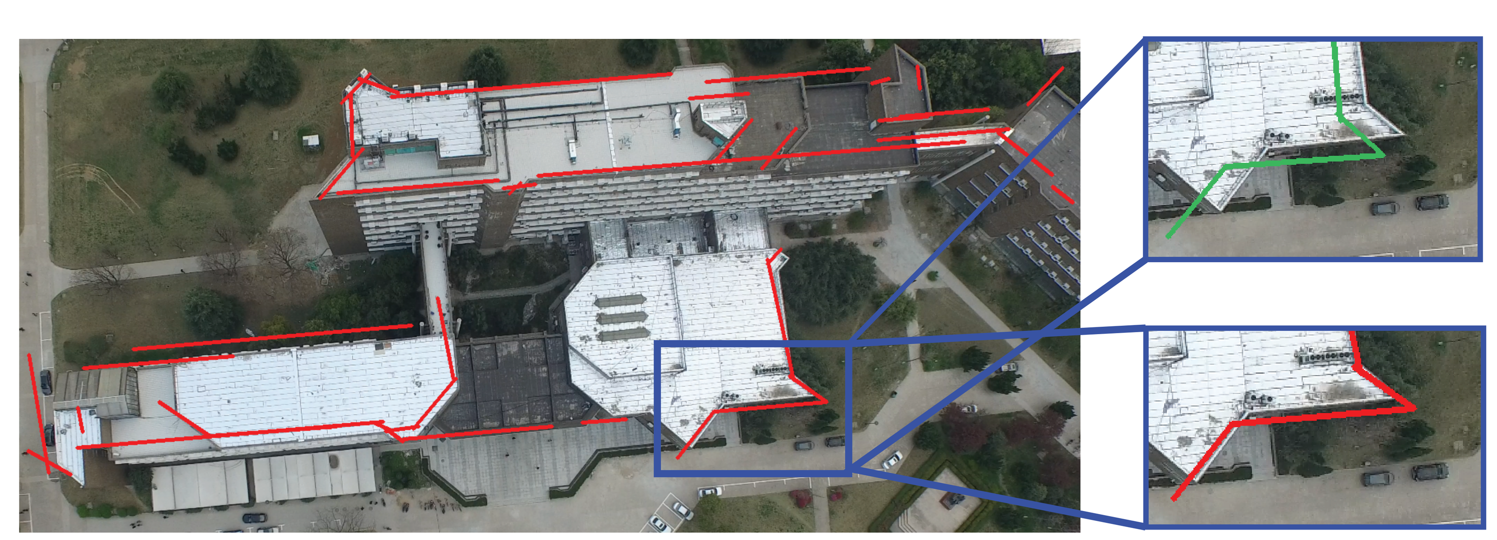


- Step 2: Match contours with the overhead image respectively and achieve one local project matrix for each contour. We use these results as initialization for the next step.



- Step 3: Optimize a global project matrix by alternatively find paried feature points and minimizing the average distance between projected contours and the edges of the overhead image.
- Step 4: The camera pose is estimated by the global project matrix.

Results



Befor global optimization

After global optimization

- We project 3D contours of buillidng roofs on the overhead image to show the result of our experiment. Details in right indicate that the global optimization increases the performance a lot.

References<to be modified>

[1] A. R. Zamir and M. Shah, "Image Geo-Localization Based on Multiple-Nearest Neighbor Feature Matching UsingGeneralized Graphs," in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 36, no. 8, pp. 1546-1558, Aug. 2014.

[2] X. Zhang, G. Agam and X. Chen, "Alignment of 3D Building Models with Satellite Images Using Extended Chamfer Matching," 2014 IEEE Conference on Computer Vision and Pattern Recognition Workshops, Columbus, OH, 2014, pp. 746-753.

[3] C. Arth, C. Pirchheim, J. Ventura, D. Schmalstieg and V. Lepetit, "Instant Outdoor Localization and SLAM Initialization from 2.5D Maps," in IEEE Transactions on Visualization and Computer Graphics, vol. 21, no. 11, pp. 1309-1318, Nov. 15 2015.