Detection of vertical lines for the estimation of vanishing point in order to extract 3D information

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Context

In mobile mapping field, having a precise estimation of the camera orientation is crucial for the further exploitation of 3D data extracted from 2D image.

[2] and [3] present methods in order to extract vanishing points which are interesting features of image information, with probabilistic and/or geometric tools.

The main objective is to improve the accuracy of the camera position (the roll and pitch angles) by obtaining information on the local Up (normal to the local horizontal plane) from sequence of single view images.

Acquisition system

GPS data

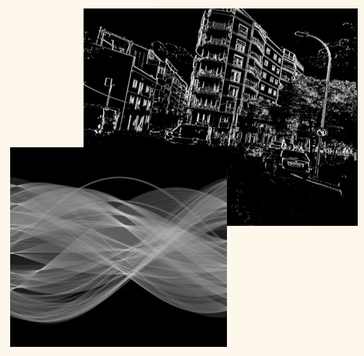
Georeferenced imagery

Method

We propose to estimate **camera orientation angles** using the geometric content from human-made objects present in the scene. In particular, straight lines are detected in grey level images in order to estimate the vertical vanishing point which is required for the computation of the roll and pitch angles.

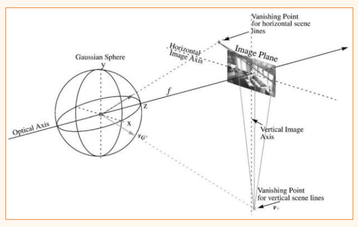
Lines detection

- Grey level image
- Edges detection : composition of Sobel derivatives
- Segments extraction : Hough transform



Vertical vanishing point estimation

- Lines projection in Gaussian space
- RANSAC algorithm [1]
  - Hypothetical vanishing point estimation
  - Best model computation
  - Elimination of false lines detection

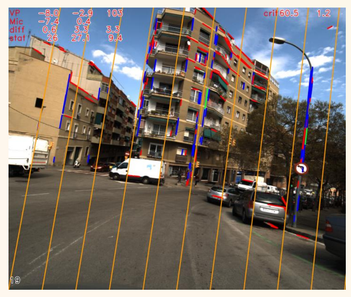


Orientation camera computation

- Roll and pitch evaluation
- Validation with other information sources

$$roll = \arccos\left(\frac{-x}{\sqrt{x^2+y^2}}\right)$$

$$pitch = \arccos\left(\frac{-y}{\sqrt{y^2+z^2}}\right)$$



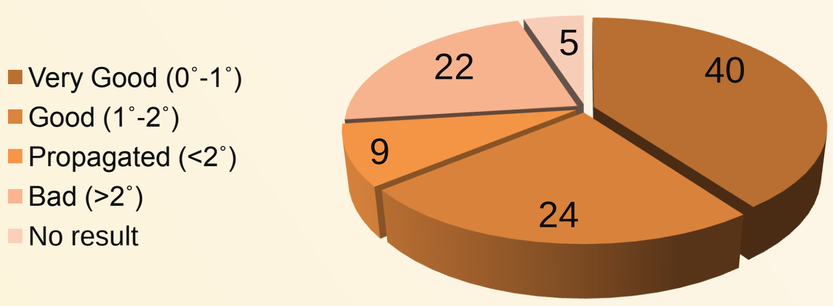
Results

This algorithm is tested on a large corpus of various images (different context, lighting…).

Results point out that we can compute accurate roll and pitch angles for more than 70% of images.

To validate the obtained results, other information sources are combined : one absolute (obtained from a magnetometer) and two relatives (estimated from image optical flow and measured with gyrometers).

Quality of results over 5000 images (5 different sequences)



Conclusions

Obtained performances show to be dependent on the scene geometry.

Our algorithm provide promising results for urban dense scene where the detected lines distribution on images shows an important standard deviation.

This context (urban scenes sequences) and previous results will be available data for future works on image segmentation (thesis subject).

References

[1] M. Fischler and R. Bolles, Random Sample Consensus: A Paradigm for Model Fitting with Applications to Image Analysis and Automated Cartography, *Communications of the ACM*, vol. 24, pp. 381−395, 1981.
[2] A. Almansa, A. Desolneux and S. Vamech, Vanishing point detection without any a priori information, *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 25, pp. 502−507, april 2003
[3] M. Kalantari, F. Jung, J.-P. Guédon and N. Paparotis, Automatic detection of vanishing points and their uncertainty based on projective geometry, *RFIA*, 2008.

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