# Efficiently Building 3D Line Model with Points

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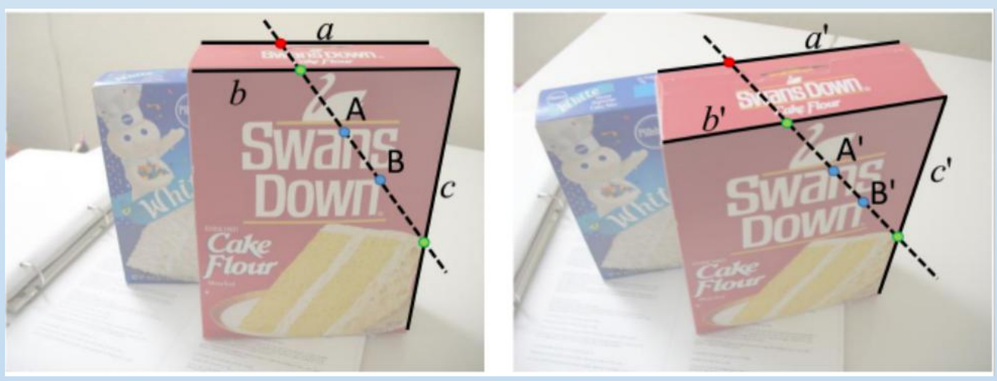
## Abstract

3D modeling is a popular topic in the field of computer vision. Most of the existing methods based on the interest point matches or the line matches. In this paper,we proposed a simple and effective approach of 3D modeling, which takes the intersections of the real lines and the virtual lines passing through interest points to construct the 3D models, and use a simple invariant to filter out wrong matches. Thus we can use the mature technology of point based methods while the 3D point cloud maintain the structural information of lines.

## Methods

A. Represent lines by points

- Line matching[2] and interest points matching[1].
- Generate some virtual intersection points on the matched lines.




Key observation:

- Wrong point or line matching results.
- The virtual lines may not be coplanar with the real line

B. Getting real intersection points

- A coplanar line point affine invariant




- Filfter out fake intersectns resulting

The similarity of the two invariants:

$$S = e^{-\|V_1 - V_2\|}$$

$$s_V = \min(e^{-\|V_1 - V_2\|}, e^{-\left\|\frac{1}{V_1} - \frac{1}{V_2}\right\|})$$

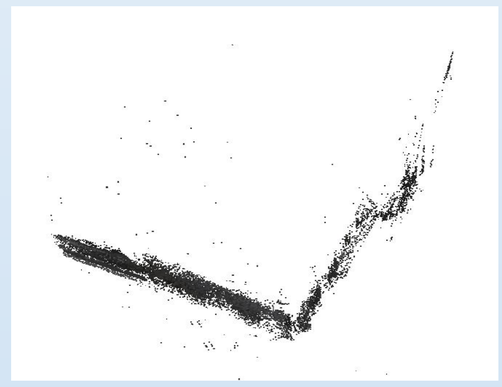
If $S_V$ <0.95, the intersections should be abandoned

## Experiments

Testing images:

3D reconstruction results:

Front view



Top view

SIFT model

## Conclusions

In this paper, we provide a simple and effective new approach to build 3D models. We take the intersections of virtual lines and real lines instead the original points or lines. Which can be applied to existing state-of-the-art points based methods while maintain the structural information of line-based models. We take only very few matched points and use a simple invariant to filter out wrong intersection correspondences thus very fast and effective. Experiments show that our approach can get 3D point cloud with more meaningful structural information than traditional point-based method.

## References

[1] David G Lowe, “Distinctive image features from scale invariant keypoints,” International journal of computer vision, vol. 60, no. 2, pp. 91–110, 2004.

[2] Qi Jia, Xinkai Gao, Xin Fan, Zhongxuan Luo, Haojie Li, and Ziyao Chen, “Novel coplanar line-points invariants for robust line matching across views,” in Computer Vision - ECCV 2016 - 14th European Conference, Amsterdam, The Netherlands, October 11-14, 2016, Proceedings, Part VIII, 2016, pp. 599–611.

[3] Bin Fan, Fuchao Wu, and Zhanyi Hu, “Robust line matching through line–point invariants,” Pattern Recognition, vol. 45, no. 2, pp. 794–805, 2012.

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