Immersive Video Stitching of Dual Fisheye Videos

Author: Xinyu FU

Supervisor: Prof. Hanqiu Sun, Ph.D. Zhensong Zhang

香港中文大學
The Chinese University of Hong Kong

Introduction

Dual-fisheye cameras are popular nowadays for creating 360-degree immersive videos. Two separate footages produced by two fisheye lenses need to be merged into one. Existing commercial solutions for stitching dual-fisheye videos ususally produce results with misalignments and artifacts.

So, the research objective is to design and implement an effective approach to de-warp, stitch, calibrate and refine videos captured from dual-fisheye cameras, into seamless 360-degree videos.

Methods

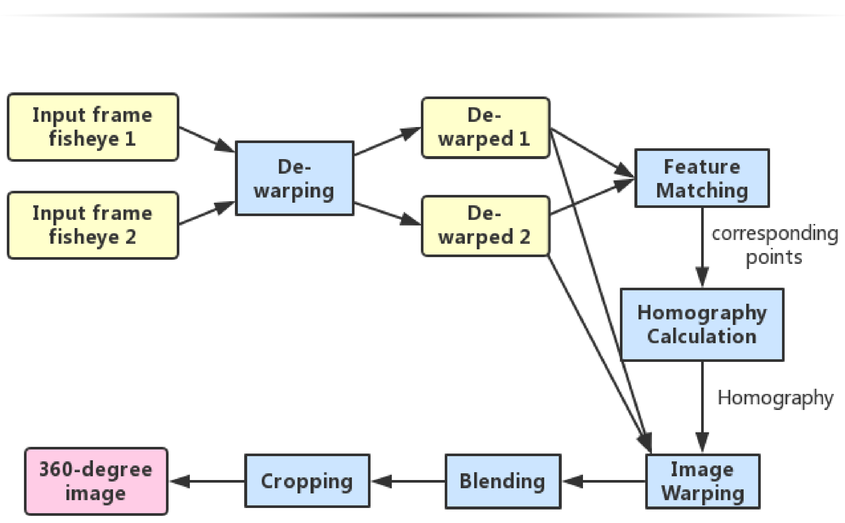

Figure 1: Method overview.

Fig. 1 is an overview of the stitching method, which is further explained by the following.

- De-warping: A geometric model for fisheye de-warping;
  - Fisheye -> Unit sphere -> Rectangular image
- Feature matching: A combination of Shi-Tomasi corner detector [1] and normalized template matching;
- Homography calculation: RANSAC [2] to reject outliers and obtain reasonable homography for stitching;
- Blending: Optimal seamline & Multi-band blending [3];
- Cropping: The largest valid rectangular image.

Results

An implementation of our method was written in Python 2 using OpenCV 3.3 library, and well tested on Ubuntu 16.04 64-bit version. We used Samsung Gear 360 (2016) to record 2560 × 1280 dual-fisheye videos, and created 360-degree videos of the same resolution.

Fig. 2 demonstrates the performance of our method, compared to Samsung's official tool Gear 360 Action Director.

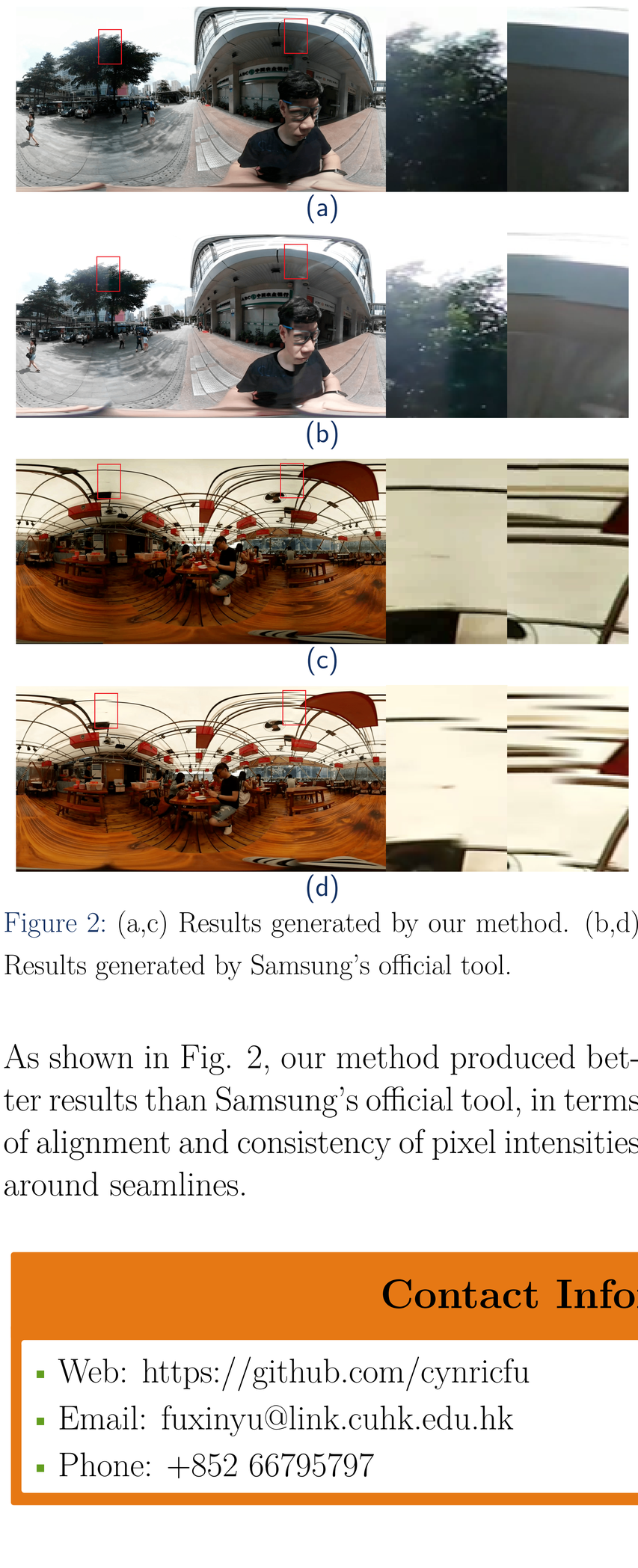

Figure 2: (a,c) Results generated by our method. (b,d) Results generated by Samsung's official tool.

As shown in Fig. 2, our method produced better results than Samsung's official tool, in terms of alignment and consistency of pixel intensities around seamlines.

Conclusion

This paper proposes a general method for dual-fisheye video stitching, consisting of de-warping, feature matching, homography calculation, blending and cropping.

The method is a balance between computation complexity and performance, and outperforms Samsung's official tool without knowing cameras' hardware parameters beforehand.

References

[1] J. Shi and C. Tomasi, "Good features to track," in *9th CVPR*. Springer, June 1994.

[2] M. A. Fischler and R. C. Bolles, "Random sample consensus: A paradigm for model fitting with applications to image analysis and automated cartography," SRI International, Tech. Rep. 213, March 1980.

[3] P. J. Burt and E. H. Adelson., "A multiresolution spline with application toimage mosaics," *ACM Tran. on Graphics*, no. 2(4), 1983.

Acknowledgements

I would like to express my special thanks of gratitude to my supervisors Prof. Hanqiu Sun and her Ph.D. student Zhensong Zhang who gave me guidance during this research project.

I would also like to thank Faculty of Engineering, CUHK for providing the research opportunity and fundings.

Contact Information

- Web: https://github.com/cynricfu
- Email: fuxinyu@link.cuhk.edu.hk
- Phone: +852 66795797