# A Fast Optimal Algorithm for $L_2$ Triangulation


| | |
|---|---|
| Book Series | Lecture Notes in Computer Science |
| Publisher | Springer Berlin / Heidelberg |
| ISSN | 0302-9743 (Print) 1611-3349 (Online) |
| Volume | Volume 4844/2007 |
| Book | Computer Vision – ACCV 2007 |
| DOI | 10.1007/978-3-540-76390-1 |
| Copyright | 2007 |
| ISBN | 978-3-540-76389-5 |
| DOI | 10.1007/978-3-540-76390-1_28 |
| Pages | 279-288 |
| Subject Collection | Computer Science |
| SpringerLink Date | Wednesday, November 14, 2007 |




**Fangfang Lu[1] and Richard Hartley[1]**

(1) Australian National University,

Abstract

This paper presents a practical method for obtaining the global minimum to the least-squares ($L_2$) triangulation problem. Although optimal algorithms for the triangulation problem under $L_\infty$-norm have been given, finding an optimal solution to the $L_2$ triangulation problem is difficult. This is because the cost function under $L_2$-norm is not convex. Since there are no ideal techniques for initialization, traditional iterative methods that are sensitive to initialization may be trapped in local minima. A branch-and-bound algorithm was introduced in [1] for finding the optimal solution and it theoretically guarantees the global optimality within a chosen tolerance. However, this algorithm is complicated and too slow for large-scale use. In this paper, we propose a simpler branch-and-bound algorithm to approach the global estimate. Linear programming algorithms plus iterative techniques are all we need in implementing our method. Experiments on a large data set of 277,887 points show that it only takes on average 0.02s for each triangulation problem.



## References

1. Agarval, S., Chandraker, M., Kahl, F., Belongie, S., Kriegman, D.: Practical global optimization for multiview geometry. In: Proc. European Conference on Computer Vision (2005)

2. Hartley, R., Schaffalitzky, F.: $L_\infty$ minimization in geometric reconstruction problems. In: Proc. IEEE Conference on Computer Vision and Pattern Recognition, Washington DC, pp. I–504–509 (2004)

3. Triggs, W., McLauchlan, P.F., Hartley, R.I., Fitzgibbon, A.: Bundle adjustment for structure from motion. In: Triggs, B., Zisserman, A., Szeliski, R. (eds.) Vision Algorithms: Theory and Practice. LNCS, vol. 1883, pp. 298–372. Springer, Heidelberg (2000)
SpringerLink

4. Kahl, F.: Multiple view geometry and the $L_\infty$-norm. In: Proc. International Conference on Computer Vision, pp. 1002–1009 (2005)

5. Hartley, R.I., Zisserman, A.: Multiple View Geometry in Computer Vision, 2nd edn. Cambridge University Press, Cambridge (2003)

6. Hartley, R.I., Sturm, P.: Triangulation. Computer Vision and Image Understanding 68(2), 146–157 (1997)
crossref

7. Stewenius, H., Schaffalitzky, F., Nister, D.: How hard is 3-view triangulation really. In: Proc. International Conference on Computer Vision, pp. 686–693 (2005)

8. Nocedal, J., Wright, S.J.: Numerical Optimization, 2nd edn. Oxford University Press, Oxford (2006)
MATH

9. Boyd, S., Vanderberghe, L.: Convex Optimization. Cambridge University Press, Cambridge (2004)
MATH

10. Snavely, N., Seitz, S., Szeliski, R.: Photo tourism: Exploring photo collections in 3d. ACM Trans on Graphics 25(3), 835–846 (2006)
crossref