Comments on :

"Low-drift and real-time lidar odometry and mapping"

Virgile Daugé*

University of Lorraine
virgile.dauge@inria.fr

May 15, 2017

Abstract

This paper explain how LOAM algorithm is working, and present some results. This method, coupled with IMU, try to achieve both low drift in motion estimation and low computational complexity.

I. Introduction

The problem addressed here is to achieve SLAM without accurate pose estimation (as GPS). They don't consider Loop Closure, as they consider it unnecessary for mapping floor of a building. They are dividing SLAM problem into 2 algorithms :

- Odometry estimation at high frequency (but low fidelity)
- Registration of Point Cloud (lower frequency)

They are presenting their work in a high level of details.

They said that when the lidar scanning rate is high compared to this motion, motion distortion is neglectable and ICP [2] can be used. Other methods exists for removing motion distortion [3] and [4] vor velodyne lidar. Using IMU in multimodal system can compensate intermittent GPS [5].

IMU and loop closure alows to build large indoors maps in underground mines : [6].

They used 4 different lidars for testing purposes.

*A thank you or further information

II. Methods

i. Lidar odometry

i.1 feature point extraction

They select feature point on sharp edges and planar surfaces patches. they evaluate smoothness of local surface, then sort them, considering smoother points as planar and sharpest points as edges.

i.2 Feature point correspondence

When adding more points to the pointcloud, they try to find ones in features region as lines and planar areas.

i.3 Motion estimation

They estimate a geometric relationship between a point and his feature line/planar area. And Computing the sum of all geometric transformations give the estimated motion of the lidar.

III. Results

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcor-

per, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

IV. Discussion

i. Current state

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

ii. Possibles enhancements

Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Etiam lobortis facilisis sem. Nullam nec mi et neque pharetra sollicitudin. Praesent imperdiet mi nec ante. Donec ullamcorper, felis non sodales commodo, lectus velit ultrices augue, a dignissim nibh lectus placerat pede. Vivamus nunc nunc, molestie ut, ultricies vel, semper in, velit. Ut porttitor. Praesent in sapien. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Duis fringilla tristique neque. Sed interdum libero ut metus. Pellentesque placerat. Nam rutrum augue a leo. Morbi sed elit sit amet ante lobortis sollicitudin. Praesent blandit blandit mauris. Praesent lectus tellus, aliquet aliquam, luctus a, egestas a, turpis. Mauris lacinia lorem sit amet ipsum. Nunc quis urna dictum turpis accumsan semper.

References

[1] J. Zhang and S. Singh, "Low-drift and real-time lidar odometry and mapping", *Autonomous Robots*, vol. 41, no. 2, pp. 401–416, Feb. 2017, ISSN: 0929-5593, 1573-7527. DOI: 10.1007/s10514-016-9548-2. [Online]. Available: http://link.springer.com/10.1007/s10514-016-9548-2 (visited on 05/15/2017).

[2] F. Pomerleau, F. Colas, R. Siegwart, and S. Magnenat, "Comparing ICP variants on real-world data sets: Open-source library and experimental protocol", *Autonomous Robots*, vol. 34, no. 3, pp. 133–148, Apr. 2013, ISSN: 0929-5593, 1573-7527. DOI: 10.1007/s10514-013-9327-2. [Online]. Available: http://link.springer.com/10.1007/s10514-013-9327-2 (visited on 05/15/2017).

[3] S. Hong, H. Ko, and J. Kim, "VICP: Velocity updating iterative closest point algorithm", in *2010 IEEE International Conference on Robotics and Automation*, May 2010, pp. 1893–1898. DOI: 10.1109/ROBOT.2010.5509312.

[4] F. Moosmann and C. Stiller, "Velodyne SLAM", in *2011 IEEE Intelligent Vehicles Symposium (IV)*, Jun. 2011, pp. 393–398. DOI: 10.1109/IVS.2011.5940396.

[5] S. Scherer, J. Rehder, S. Achar, H. Cover, A. Chambers, S. Nuske, and S. Singh, "River mapping from a flying robot: State estimation, river detection, and obstacle mapping", *Autonomous Robots*, vol. 33, no. 1, pp. 189–214, Aug. 2012, ISSN: 0929-5593, 1573-7527. DOI: 10.1007/s10514-012-

9293-0. [Online]. Available: http://link.springer.com/10.1007/s10514-012-9293-0 (visited on 05/15/2017).

[6] R. Zlot and M. Bosse, "Efficient large-scale 3d mobile mapping and surface reconstruction of an underground mine", in *Field and Service Robotics*, K. Yoshida and S. Tadokoro, Eds., vol. 92, DOI: 10.1007/978-3-642-40686-7_32, Berlin, Heidelberg: Springer Berlin Heidelberg, 2014, pp. 479–493, ISBN: 978-3-642-40685-0 978-3-642-40686-7. [Online]. Available: http://link.springer.com/10.1007/978-3-642-40686-7_32 (visited on 05/15/2017).