

Pose Calculation and Modeling of Non Cooperative Target

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Abstract

Simultaneous localization and mapping(SLAM) is an emerging technology, which is in the ascendant at present. Non cooperative target pose calculation and modeling refers to a moving object with sensors moving in an unknown environment. For example, if you go around an object, show the outline of the object with a point cloud model, and get its own pose at the same time. That is, it should realize two functions: one is to show the outline of non cooperative targets in point cloud, which is three-dimensional; The second is to record your posture at different times, which can be expressed in quaternions or other forms.

Keywords

Posture; Direct method; Non cooperative target.

1. Introduction

At present, the level of computer hardware is advancing by leaps and bounds, and there are many open source projects [2]. With the continuous improvement of computer software and hardware technology, human demand for a better life is becoming stronger and stronger, and social productivity needs to be continuously improved. Therefore, a series of intelligent robot devices have been derived. Robots have now flown into the homes of ordinary people, which is no longer rare. Robot equipment covers all aspects of social life, such as smart home, aerospace, industrial production and many other fields. At present, all kinds of sweeping robot products emerge in endlessly. The sweeping robot, to put it simply, is a series of mechanical equipment that can automatically sweep and clean the floor. Sweeping robot is one of the many landing products in Slam (simultaneous localization and mapping) related fields. Both UAV and various robot equipment reflect that robots will have a place in future life and can lead life.

Machine vision is an important part of robot technology. In other words, a robot must have vision and "eyes" in order to perceive the surrounding environment, know its position and build a scene map, so as to have eyes like people [3]. The robot is equipped with a monocular camera to obtain the information of the external environment, such as various road signs. Then the robot will be able to locate and map at the same time. If an unknown target in the space does not have the cooperation flag installed, it is called a non cooperative target, otherwise it is a cooperative target. But they are basically non cooperative goals.

2. Development Status at Home and Abroad

2.1. Development Status Abroad

At present, the development of slam technology in China is mainly reflected in two aspects: universities and enterprises.

In Colleges and universities, there are the CAD & CG State Key Laboratory of Zhejiang University (State Key Laboratory of computer aided design and graphics of Zhejiang University) and the CVRS Lab (Computer Vision & Remote Sensing Laboratory) of Wuhan University. The director of the laboratory Committee of the State Key Laboratory of computer aided design and graphics of Zhejiang University is academician pan Yunhe, and the director of the

laboratory is Professor Zhou Kun. The website of the laboratory is <http://www.cad.zju.edu.cn/zhongwen.html>. The computer vision and Remote Sensing Laboratory of Wuhan University was established by Professor Yao Jian in 2012. The laboratory cooperates with many science and technology enterprises such as Tencent, Huawei and Alibaba. The website of the laboratory is <http://cvrs.whu.edu.cn/>.

In terms of enterprises, there are many. Hikvision performs well in slam navigation, and its AI camera also has excellent performance. Hikvision is the R & D and provider of mobile robots, machine vision products and algorithm platforms. Speed technology was established in 2014 and is a machine vision solution provider. Yuanxing spacetime was founded in 2016, focusing on the R & D and production of visual slam, and completed the research and development of monocular visual navigation module with high positioning accuracy and high stability in 2017. Silan technology, founded in 2013, is mainly engaged in laser radar, that is, modular autonomous positioning and navigation solutions. There are also many related enterprises, which will not be repeated here.

To sum up, whether at the university or enterprise level, the domestic slam field blooms at many points. Although there is a certain gap compared with foreign countries, it is in the ascendant.

2.2. Brief Introduction of Foreign Development

Abroad, there are many famous laboratories and big cattle in slam field [4]. The main goal of the autonomous system lab of the Federal Institute of technology in Zurich is to develop robots and intelligent systems that can operate automatically. These systems are very suitable for various field applications [5]. The website of Automatic System Laboratory of Zurich Federal Institute of technology is <https://asl.ethz.ch/>. Of course, we can't forget the famous Munich computer vision group. In the 14 lectures on vision slam, many data sets come from tum The laboratory is open source and contributes a lot of data sets and code. And the multiply autonomous robotic systems laboratory (MARS) at the University of Minnesota. The research interests of the laboratory are resource perception estimation and control, including vision / laser assisted inertial navigation system, large-scale three-dimensional positioning and mapping on mobile phones and wearable computers, multi robot / sensor positioning, mapping and navigation, etc. David Murray is a master of visual slam. He was employed by Oxford University and trained many well-known doctors. Readers who have read the English Literature "large scale direct monolithic slam" must not forget Jakob Engel. He is the author of lsd-slam and dso-slam. He is famous all over the world, young and promising. He is a genius in the industry.

3. Research Methods and Routes

For non cooperative target pose measurement, we use lsd-slam [6]. The full English name of lsd-slam is large-scale direct slam, which translates to large-scale direct positioning and drawing at the same time.

We propose a monocular SLAM algorithm based on direct method. Compared with the existing direct method [7], this method can build a large-scale and globally consistent environment map. Our method can not only obtain highly accurate attitude estimation based on direct image registration, but also reconstruct the 3D environment map into key frame attitude map and corresponding semi dense depth map in real time. These are obtained by filtering the baseline stereo registration results between a large number of pixel pairs. The algorithm proposes a formula to calculate the scale drift, which can be applied even when the scene scale of the image sequence changes greatly.

Lsd-slam has two main innovations:

- (1) A novel direct tracking method based on (Lie algebra corresponding to similar transformation space) sim (3), which can clearly detect scale drift,
- (2) A probabilistic method is used to deal with the influence of noise on depth image information in the process of image tracking.

Lsd-slam contains three threads as follows:

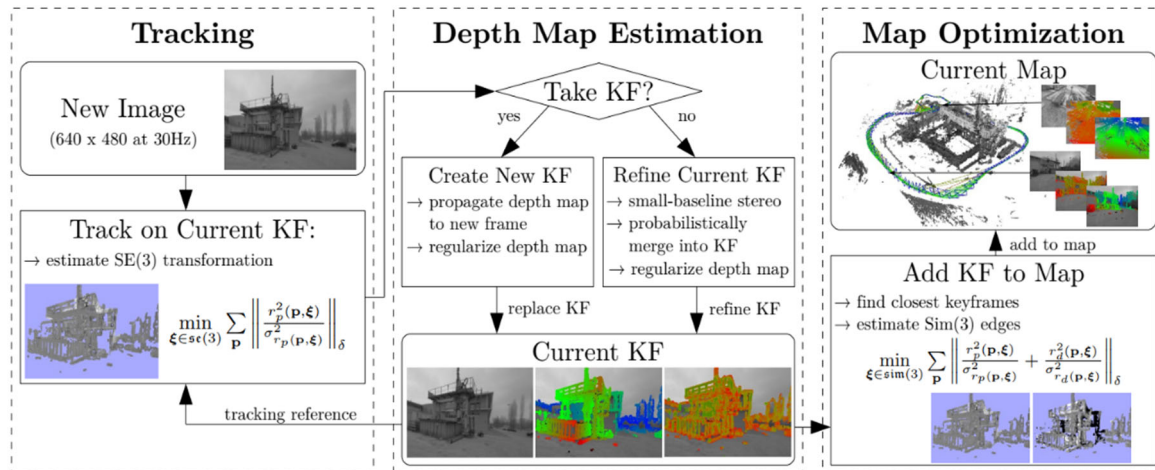


Figure 1. [1]

4. Summary

Non cooperative target pose calculation and modeling refers to a moving object with sensors moving in an unknown environment [8]. For example, if you go around an object, show the outline of the object with a point cloud model, and get its own pose at the same time. We use LSD_SLAM. LSD_Slam is a semi dense direct vision odometer based on high gray gradient. The project consists of three threads: tracking, depth map estimation and map optimization. Tracking: the current frame and reference key frame are used to minimize the photometric error, and the corresponding knowledge of Gauss Newton method and Lie algebra are used to solve the camera pose. For depth map estimation, the first step: select the key frame; Step 2: create depth map; Step 3: depth map optimization; Step 4: depth observation fusion. For graph optimization, this is the last thread. Because scale drift will occur over a long distance, this part is mainly divided into Closed-loop Detection and global optimization. The closed-loop detection method is to do two-way tracking between frames, delete the candidate frames and add them to the pose graph for graph optimization.

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