FSVO: SEMI-DIRECT MONOCULAR VISUAL ODOMETRY USING FIXED MAPS

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Abstract

Introduction

Visual Odometry (VO) System includes three main categories:

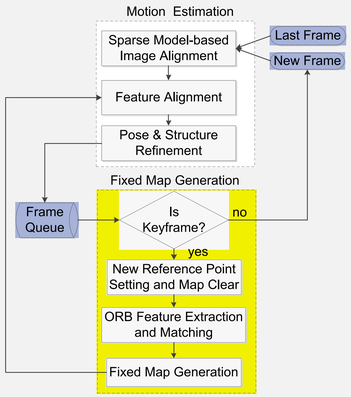
- Feature-based Approaches: ORB-SLAM
- Direct Methods: LSD-SLAM
- Semi-direct Methods: SVO

Motivation

- Propose a novel semi-direct VO framework for MAVs using fixed maps to achieve improved motion estimation result
- Reduce the storage of keyframes for the VO framework
- there is no constraint on the orientation of the fixed camera

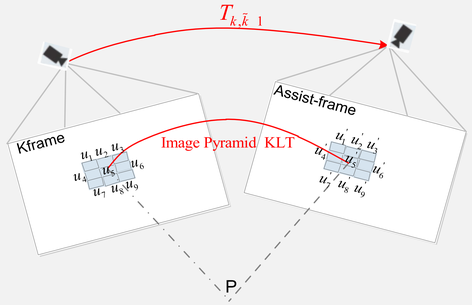
Proposed Method

The Pipeline of Proposed Method



Proposed Method

Step 1: Fixed Map Generation



We build a fixed map to replace the incremental map used in previous works using the keyframe and the assist-frame only.

- Feature Extraction
- Feature Tracking
- Feature Matching
- Fixed Map Generation Based on Robust Features

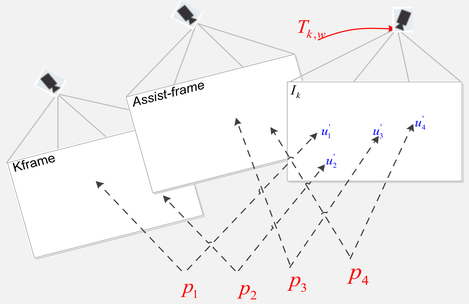
Step 2: Motion Estimation Based on Semi-direct Method

We use sparse model-based image alignment, feature alignment to recover initial camera motion.

- Image Alignment And Feature Alignment
- Minimizing The Intensity Residuals Between Adjacent Frames

Proposed Method

Step 3: Pose and Structure Optimization



In this step, the camera pose and the structure (3D points) are optimized to minimize the reprojection error(motion-only BA problem).

Step 4: Relocalization

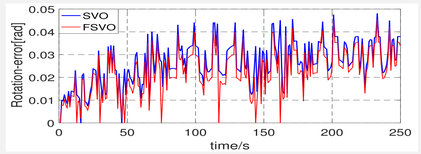
a) Feature Tracking Quality

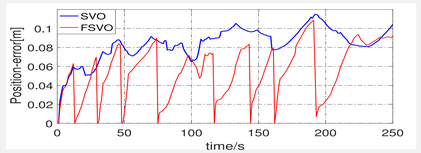
b) Overlop Between The Reference Frames And The Current Frame

If one of these two numbers mentioned above is less than a given threshold, we determine the current position of MAV using its previous position and select the next frame as a keyframe. Then, we set new reference position at each keyframe.

Experiments and Results

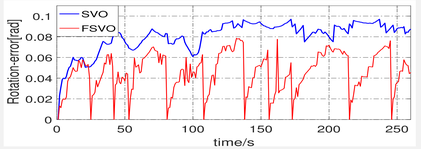
EuRoC Dataset

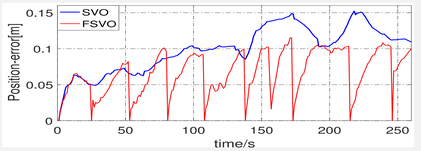




we run our algorithm on the EuRoC dataset and the average position/rotation estimation error of SVO and FSVO is 0.0783m/0.0262rad and 0.0554m/0.0223rad, respectively.

KITTI Dataset





we run our algorithm on the KITTI dataset and the average position/rotation estimation error of SVO and FSVO is 0.0996m/0.0711rad and 0.0662m/0.0464rad, respectively.

Conclusion

- We propose a semi-direct VO framework using fixed maps
- We propose a new keyframe selection criterion and a relocation approach
- Experimental results on the EuRoC and KITTI datasets show that it is more accurate and robust than the SVO algorithm

Reference

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Any Questions?

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