benchmark testing plan

s182354 Xiaohan Lyu

April 2019

Sec.1   Performance evaluation

1.1   Feature setection

1-a   Harris and Shi-Tomasi

The main idea to extract corners from an image is to use moving windows to compute the vary value of gray scale. If the value has a strong variety, there has corner in this window.

Harris has such feature that rotation invariance but it doesn't have scale invariance.

Shi-Tomasi Detector can be seen as an improvement of Harris detector. Instead of compute the difference between M matrix's determinant and M matrix's trace in the Harris.

Shi-Tomasi proposed that if the smaller of the two eigenvalues is greater than the minimum threshold, a strong corner point is obtained.

1-b   FAST and ORB

FAST corner detector uses a circle of 16 pixels (a Bresenham circle of radius 3) to classify whether a candidate point p is actually a corner.

FAST offers higher performance than other feature detectors, but it is not very robust in the presence of noise. Also, FAST is just a key-points detection algorithm and it does not give feature description of key-points.

ORB solved some disadvantage of FAST. ORB is a feature detector and descriptor based on BRIEF and FAST. An improvement of ORB is that it can resist the noise. ORB offers performance much better both than SIFT and SURF.

1-c   SIFT and SURF

SIFT is a feature detector and descriptor.The advantage of SIFT is that can provide high quality features than other methods. But high performance needs high computational effort.

SURF is inspired by SIFT, which the computational effort is lower than SIFT and without loss of accuracy.

1.2 Feature matching

2-a Brute-Force

Brute-Force is a quite effective way to match feature. The advantage is that it 's more quickly than LK tracking. But BF matching still have disadvantages, Which the complexity will grows proportionally depends on number of features and feature detection process will be repeated in every image.

2-b Lucas-Kanade algorithm

Due to Lucas-Kanade algorithm based on a lot of assumption, it has a lot of restriction. "pyramidal LK" algorithm is an improvement for small movements assumption.
Although LK algorithm needs more computation than BF. But it is unnecessary to repeat feature detection process like BF because LK algorithm does not use descriptor.

1.3 Motion estimation

There are three method to estimate between two cameras: frame to frame correspondences, map to frame correspondences and map to map correspondences. For different methods there are different solutions.

Sec.2   Test Plan

Test plan can be set for four steps.
1. Feature detection. According to the performance evaluation, ORB is the most effective way to extract feature.
2.feature matching and tracking. Based on the description of performance evaluation, LK tracking can be selected.
3.motion estimation. Implement motion estimation based on frame to frame case.
4.Judge whether if motion estimation is successful. Generally there are two methods: filtering method and Bundle Adjustment. BA is the most efficient method now, so it can be selected for this project.