Mid-Term Report

1. Data Buffer Optimization

To realize the data buffer, my solution is: at the first time the images are inserted into the buffer space, just simply insert the images; when buffer space is full, the first image in the buffer space should be released with “erase”, and a new image should be inserted to the last position of the buffer space with “push_back”.

2. Keypoint Detection

Function „detKeypointsShiTomasi” is for detector Shi-Tomasi
Function “detKeypointsHarris” is for detectors Harris
Detectors BRISK. FAST, ORB, AKAZE and SIFT are integrated in the function “detKeypointsModern”, which can be chose by entering their corresponding “detectorType”.

3. Keypoint Removal

In the main program “MidTermProject_Camera_Student.cpp” (Line 109 – Line 122), keypoints from above are sifted which only the points “keypoints[i].pt” in the vehicle bounding box are selected.

4. Keypoint Descriptors

In function „descKeypoints“, all descriptors can be found and can be implemented.

5. Descriptor Matching

In “matching2D_Student.cpp” under the function “matchDescriptors”, all matching types (BF and FLANN) and selsctor types (NN and KNN) are included. It should be noticed that the descriptor format of BF and FLANN should fit the format of different descriptors.

6. Descriptor Distance Ratio

In “matching2D_Student.cpp”, from line 47 to 67 the kNN distance ratio is set so as to choose the best match pair.

7-9. Performance Evaluation

All results using different detectors and descriptions are listed below. Each number is the calculation of the average value of 10 images / 9 matches. AKAZE detector functions only when descriptor is AKAZE as well and SIFT detector with ORB description leads to out of memory.

Pair (dete/desc)	Keypoints befor sifting	Matching points	detection time	description time
SHITOMASI/BRIEF	1205,3	104,889	15,1092	1,07367

SHITOMASI/ORB	1205,49	100,889	15,13	0,877834
SHITOMASI/FREAK	1205,3	85,3333	11,8317	36,9509
SHITOMASI/SIFT	1205,3	103	11,2861	14,6215
HARRIS/BRIEF	162,2	19,2222	14,8188	0.292062
HARRIS/ORB	162,2	18	13.8563	0,866804
HARRIS/FREAK	162,2	16	13.3987	37,0119
HARRIS/SIFT	162,2	18,1111	14,3657	13,9474
FAST/BRIEF	1605	122,111	0,998591	0,828245
FAST/ORB	1605,19	119	0,989643	1,02433
FAST/FREAK	1605	97,5556	1,06077	38,2483
FAST/SIFT	1605	116,222	1,02011	18,7143
BRISK/BRIEF	2435,9	189,333	341,842	1,07575
BRISK/ORB	2436,09	168,222	342,885	4,06081
BRISK/FREAK	2435,9	169,333	339,797	38,5288
BRISK/SIFT	2435,9	182,889	338,409	39,3145
ORB/BRIEF	450,19	60,5556	6,78207	0,561863
ORB/ORB	450,19	84,7778	6.77465	4,48747
ORB/FREAK	450	46,6667	6,76251	37,8722
ORB/SIFT	450,19	84,7778	6,91717	50.1091
SIFT/BRIEF	1242,4	78	123,975	0,846896
SIFT/FREAK	1242,4	65,8889	120,269	38,4475
SIFT/SIFT	1242,4	88,8889	113,497	87,5496
AKAZE/AKAZE	1207,8	139,889	69,717	60,82421

The best three detectors which detect most key points (before target sifting) are:
1. BRISK
2. FAST
3. SIFT

The best three combinations which get most match points within the car box are:
1. BRISK-BRIEF
2. BRISK-SIFT
3. BRISK-FREAK

The best three detectors which owns the minimum detection time are:
1. FAST
2. ORB
3. SHIMATOSI

The best three combinations which owns the minimum detection time are:
1. HARRIS-BRIEF
2. ORB-BRIEF
3. FAST-BRIEF

Overall, the recommended combinations should balance the effectiveness of time consuming and key points finding and matching. The TOP3 detector-descriptor combinations are:

1. FAST-BRIEF
2. FAST-ORB
3. FAST-SIFT