

Mid Term Project Report Camera Based 2D Feature Tracking

MP.1 Data Buffer Optimization

Modified the ring buffer to suit the requirements i.e. if the size of ring buffer is greater than desired size (2 elements), erase the item present at the first index.

Mp.2 Keypoint Detection

Implemented keypoint detectors such as HARRIS, FAST, BRISK, ORB, AKAZE, SIFT by making them selectable through a string.

Mp.3 Keypoint Removal

Modified the code such that only keypoints of the preceding vehicle are kept.

Mp.4 Keypoint Descriptors

Implemented Keypoint descriptors such as BRIEF, ORB, FREAK, AKAZE and SIFT by making them selectable through a string

Mp.5 Descriptor Matching

Implemented FLANN matching as well as k-nearest neighbor selection which are selectable using a string in the main function.

Mp.6 Descriptor Distance Ratio

K-Nearest-Neighbor matching to implement the descriptor distance ratio test, with k=2.

Performance of different combinations of detectors & descriptors

KeyPoints Detector	KeyPoints Descriptor	No of KeyPoints	Total Matches	Total Time (ms)	Ratio (matches/time)
SHITOMASI	BRISK	13423	1797	0.25946	6.92594
SHITOMASI	BRIEF	13423	2485	0.199137	12.4789
SHITOMASI	ORB	13423	2230	0.181142	12.3108
SHITOMASI	FREAK	13423	1532	0.576214	2.65873
SHITOMASI	SIFT	13423	3288	0.353445	9.30273
HARRIS	BRISK	1737	236	0.223228	1.05721
HARRIS	BRIEF	1737	311	0.200875	1.54822
HARRIS	ORB	1737	290	0.19689	1.4729
HARRIS	FREAK	1737	203	0.563443	0.360285
HARRIS	SIFT	1737	384	0.315939	1.21543
FAST	BRISK	17874	2500	0.111378	22.4461
FAST	BRIEF	17874	3562	0.0478483	74.4436
FAST	ORB	17874	3191	0.0338353	94.3098
FAST	FREAK	17874	2073	0.476993	4.34597
FAST	SIFT	17874	5788	0.539879	10.7209
BRISK	BRISK	27116	3822	3.91252	0.976865
BRISK	BRIEF	27116	5398	3.84612	1.40349
BRISK	ORB	27116	2938	3.85554	0.76202
BRISK	FREAK	27116	3257	4.23818	0.76849
BRISK	SIFT	27116	7241	5.19335	1.39428
ORB	BRISK	5000	1150	0.116511	9.87034
ORB	BRIEF	5000	1092	0.091457	11.94
ORB	ORB	5000	928	0.135588	6.84425
ORB	FREAK	5000	504	0.491669	1.02508
ORB	SIFT	5000	1594	0.943618	1.68924
SIFT	BRISK	13862	2155	1.21737	1.77021
SIFT	BRIEF	13862	2498	1.06264	2.35074
SIFT	ORB	OM	OM	OM	OM

SIFT	FREAK	13862	1773	1.78529	0.993118
SIFT	SIFT	13862	2617	2.38304	1.09818
AKAZE	BRISK	13429	2767	0.980047	2.82333
AKAZE	BRIEF	13429	3224	0.919081	3.50785
AKAZE	ORB	13429	2191	0.894756	2.44871
AKAZE	AKAZE	13429	3013	1.70736	1.76472
AKAZE	FREAK	13429	2317	1.26056	1.83808
AKAZE	SIFT	13429	3680	1.18531	3.10467

Performance Evaluation

The performances of all types of detectors and descriptors are tabulated above. Performance evaluation includes the following

- Total keypoints on preceding vehicle for all 10 images.
- Total matching keypoints with all possible combinations of descriptors & detectors using FLANN based technique.
- Total processing time and the keypoints ratio are also tabulated.
- Top 3 performances are highlighted in orange

Note: The function in the code is modified so that the main function loops through the combinations of keypoint detectors and descriptors initialized as a vector of strings.