

Track an Object in 3D Space

Criteria

1. FP.1 Match 3D Objects
 - a. The method matchBoundingBoxes was implemented. Matching is performed using keypoints in the bounding box, and the best match is chosen by the max number of matched keypoints from the previous frame.
2. FP.2 Compute Lidar-based TTC
 - a. I've implemented TTC estimation, based on lidar points clustered by ROI. To avoid errors in estimation, I've sorted lidar points by distance and cropped the first 5% (I'd like to implement some other filtering of outliers).
 - b. Even with filtering first 5% of points, sometimes TTC changes rapidly 14 -> 6 -> 63 -> 21 -> 11, see Table 1.
3. FP.3 Associate Keypoint Correspondences with Bounding Boxes
 - a. The keypoint filtering was implemented. I adjusted the distance threshold, as I honestly think the lower distance between descriptors the better, and filtered the last 10% of descriptors (sorted by distance).
4. FP.4 Compute Camera-based TTC
 - a. I've implemented the TTC calculation using the mean distance ratio.
5. FP.5 Performance Evaluation 1
 - a. I've analyzed the lidar-based TTC estimation and put the results in the table. I observed weird behavior on frames 5-8, when TTC changed from 14 -> 6 -> 60 -> 21.
 - b. Without filtering TTC sometimes become negative, filtering 5% helps, but sometimes spikes can be observed - Image 1.
6. FP.6 Performance Evaluation 2
 - a. I've run camera-based TTC estimation with different pairs of detector-descriptor and put the data in Table1.
 - b. Referring to Image 2. - all methods have some variance, I'd like to make an advanced model with approximation, averaging window, or tried TTC estimation with constant acceleration.
 - c. If I had to choose now - I'd probably choose AKAZE+AKAZE.

Appendix 1, Table 1.

Frame	Distance	Distance 95%	TTC Lidar	TTC Lidar	TTC Camera	TTC Camera	TTC Camera
0	7,97	7,984	No filter	Lidar 95%	AKAZE AKAZE	SHITOMA SI + SIFT	SHITOMA SI + BRIEF
1	7,91	7,925	12,97	13,43	12,34	12,98	13,65
2	7,85	7,858	12,26	11,72	13,83	11,3	13,76
3	7,79	7,815	13,91	18,17	12,79	12,7	11,37
4	7,68	7,751	7.11	12,11	14,57	11,8	11,11
5	7,64	7,697	16,25	14,25	15,82	12,61	13,08

6	7,58	7,587	12,42	6,89	14,58	14,37	15,02
7	7,55	7,575	34,34	63,12	16,85	12,2	13,86
8	7,47	7,54	9,34	21,54	13,96	12,01	12,96
9	7,43	7,477	18,13	11,86	14,07	11,19	11,06
10	7,39	7,428	18,03	15,15	12	13,83	13,75
11	7,2	7,355	3,83	10,07	11,98	10,63	10,04
12	7,27	7,286	-10,85	10,55	11,92	10,05	9,81
13	7,19	7,206	9,22	9	10,83	11,62	10,76
14	7,13	7,141	10,96	10,98	10,91	9,03	9,79
15	7,04	7,054	8,09	8,1	10,01	8,81	11,29
16	6,83	6,978	3,17	9,18	9,68	10,17	11,29
17	6,9	6,904	-9,99	9,32	9,23	9,91	8,99
18	6,81	6,834	8,3	9,76	8,93	7,81	7,71

Image 1. TTC by Lidar.

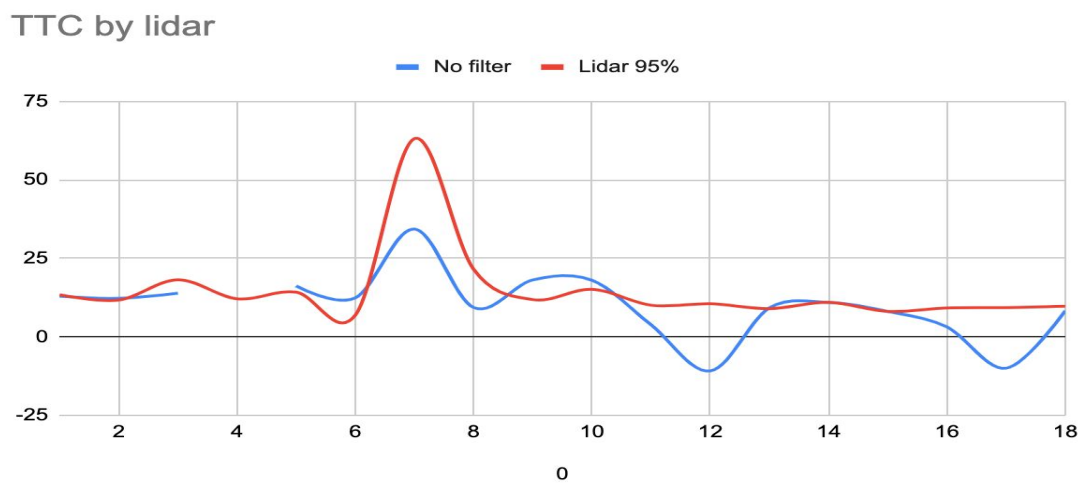


Image 2. TTC by camera

