FP.1 Match 3D Objects

A 2-D array was created to record the highest number of keypoints which are located in bounding boxes of both previous and current frame. The map bbBestMatches was updated in the end.

FP.2 Compute Lidar-based TTC

The equation d1*(deltaT)/(d0-d1) was used. The solution from lesson 3 was used. Median distances instead of minimum distances were used.

FP.3 Associate Keypoint Correspondences with Bounding Boxes

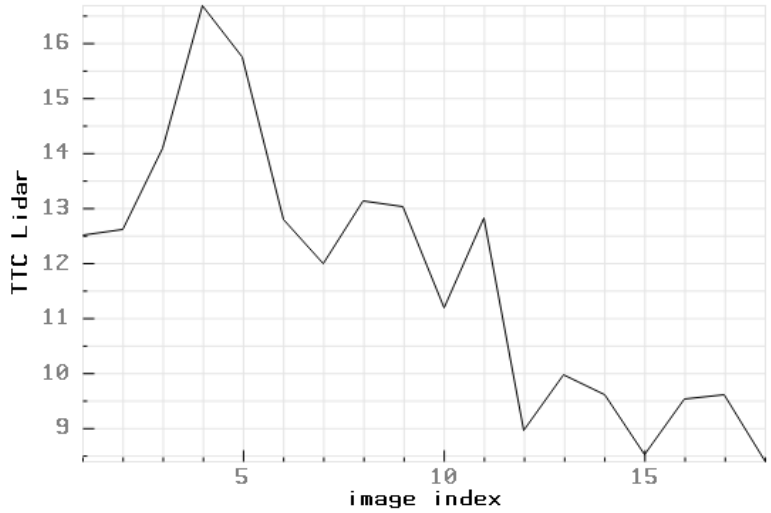
Loop all kptMatches and check if the corresponding keypoint within region of interest for the current bounding box. If within ROI, save the matches and distances. Then, used the mean of the distances for removing outliers. In the end, the remaining keypoint matches and keypoints are saved in the bounding box data struct.

FP.4: Computer Camera-based TTC

The equation -(deltaT)/(1-h1/h0) is used. I used the solution from less 3 “engineering a collision System”.

FP.5 Performance Evaluation 1

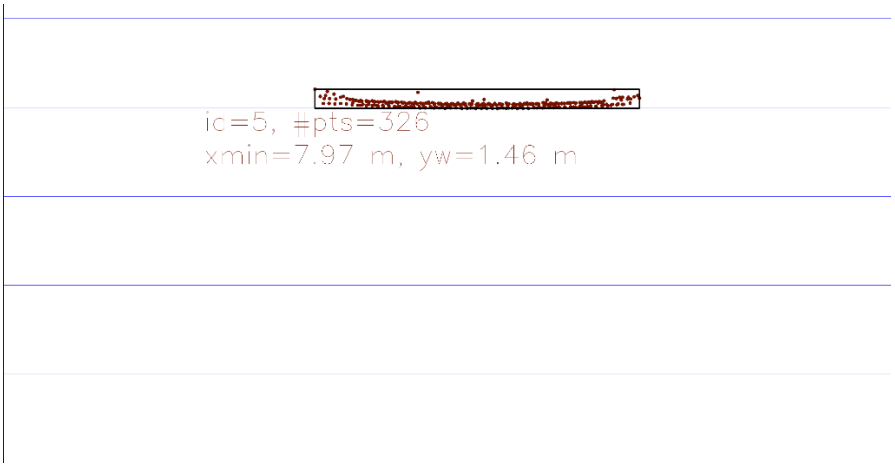
See TTC calculations based on Lidar points from the following figure.



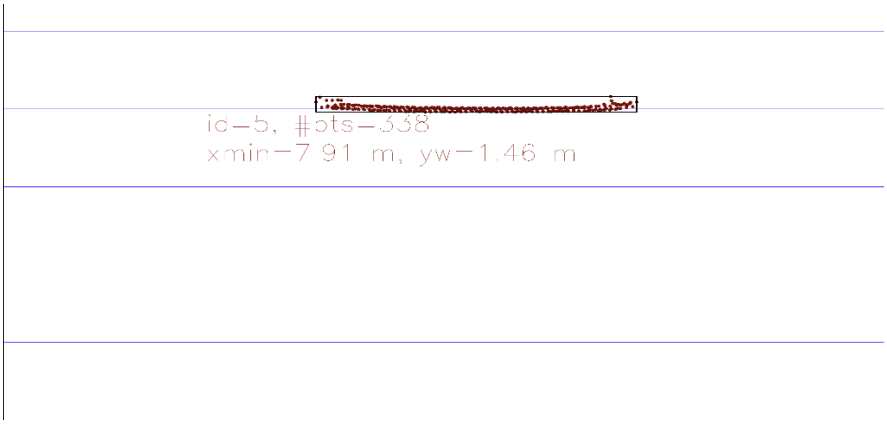
In order to check the ground truth, top views of Lidar points are plotted in below.

The distance from the rear part of the preceding vehicle gradually reduced from 8 to 7 meters between frame 0 and frame 18. If vehicle speed does not change too much, the TTC shall also gradually reduce. Lidar-based TTC is much higher in frame 4 and 5. The data noises may cause inaccuracy of TTC.

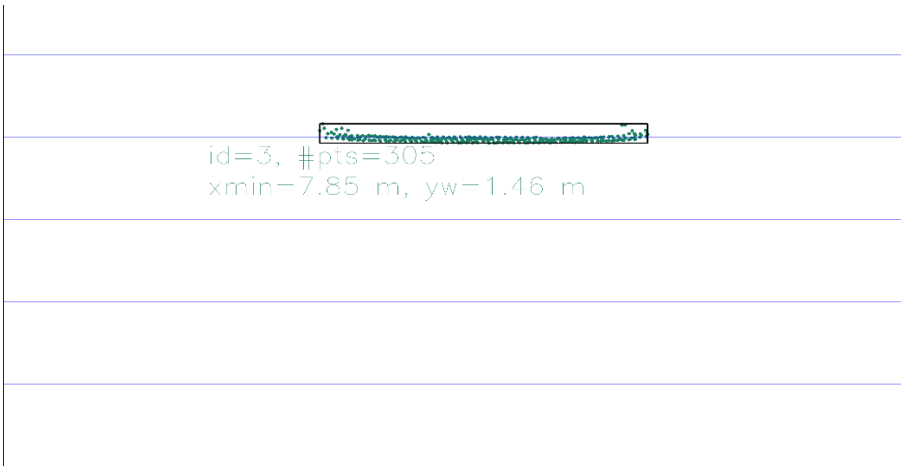
Frame 0



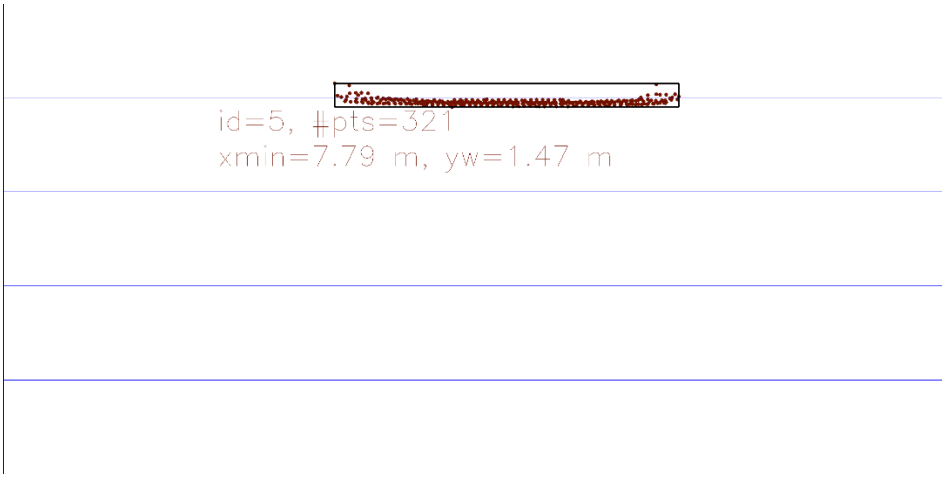
Frame 1



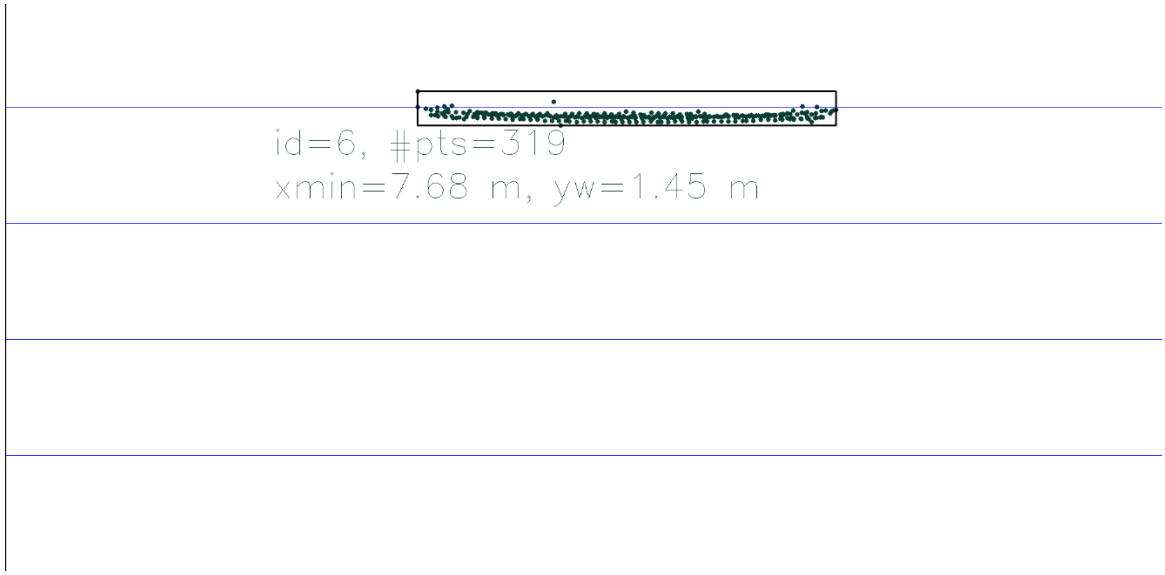
Frame 2



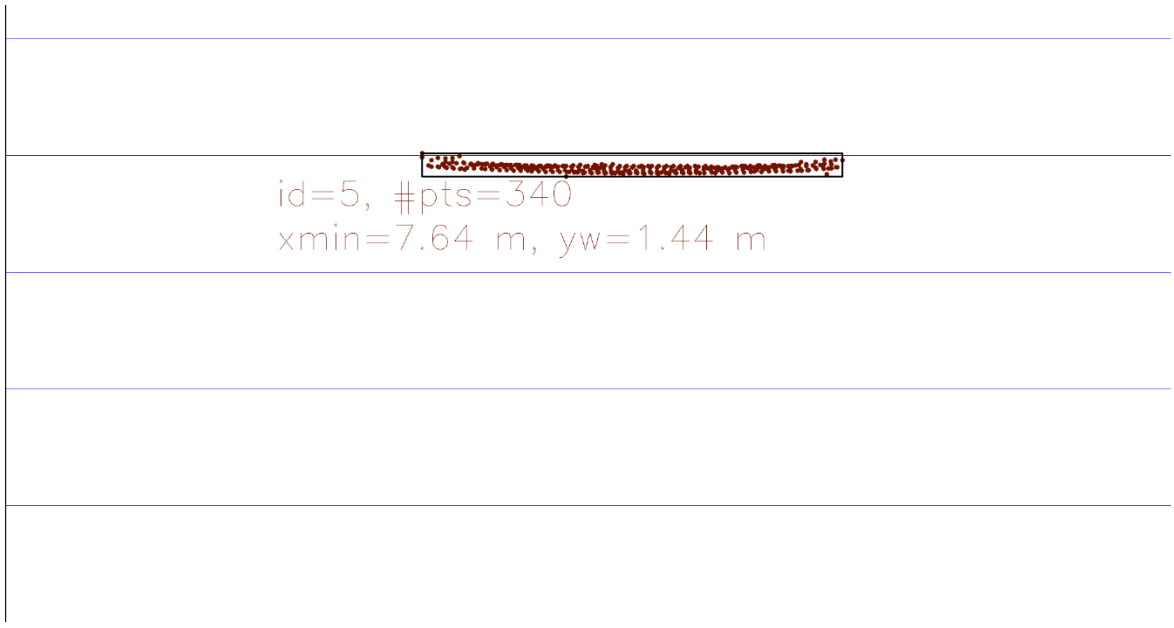
Frame 3



Frame 4



Frame 5

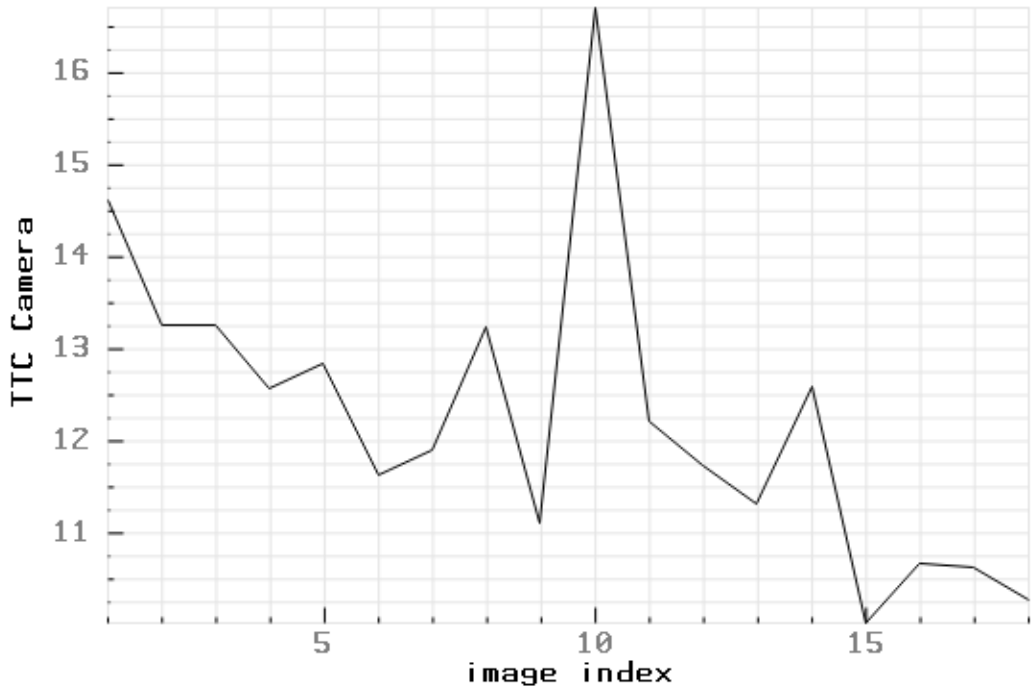


FP.6 Performance Evaluation 2

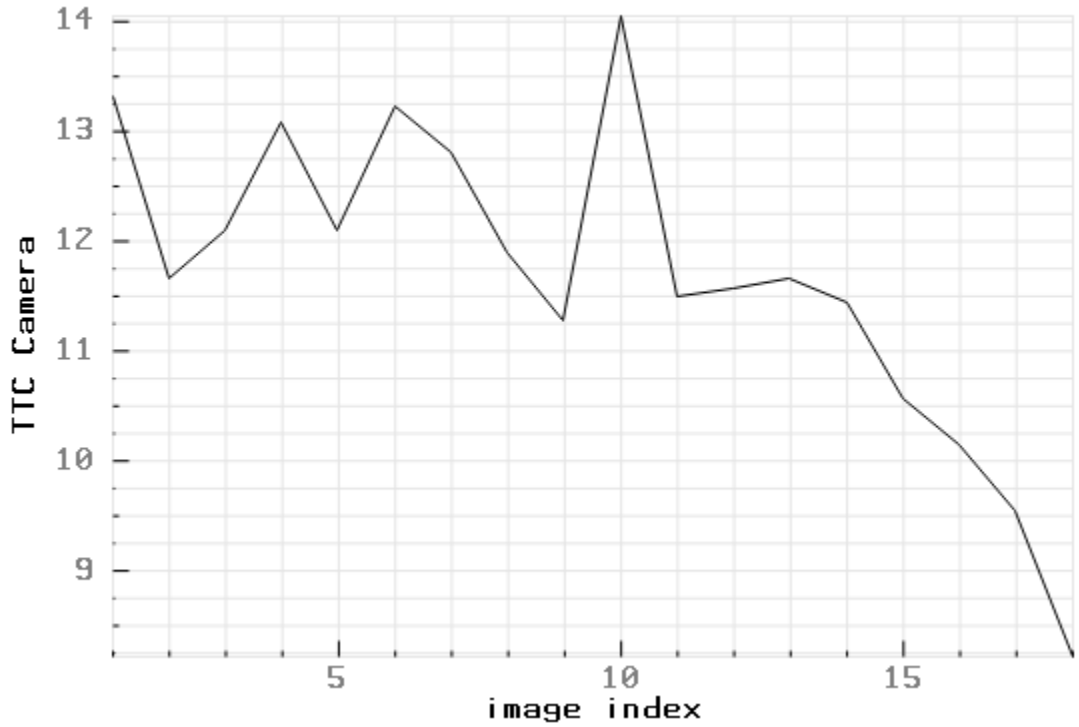
Detectors Shitomasi, FAST work pretty well.However, the detector Harris are really not stable. Negative TTC exists from Harris detector.

See details in below and more *.png files under the folder “Build”.

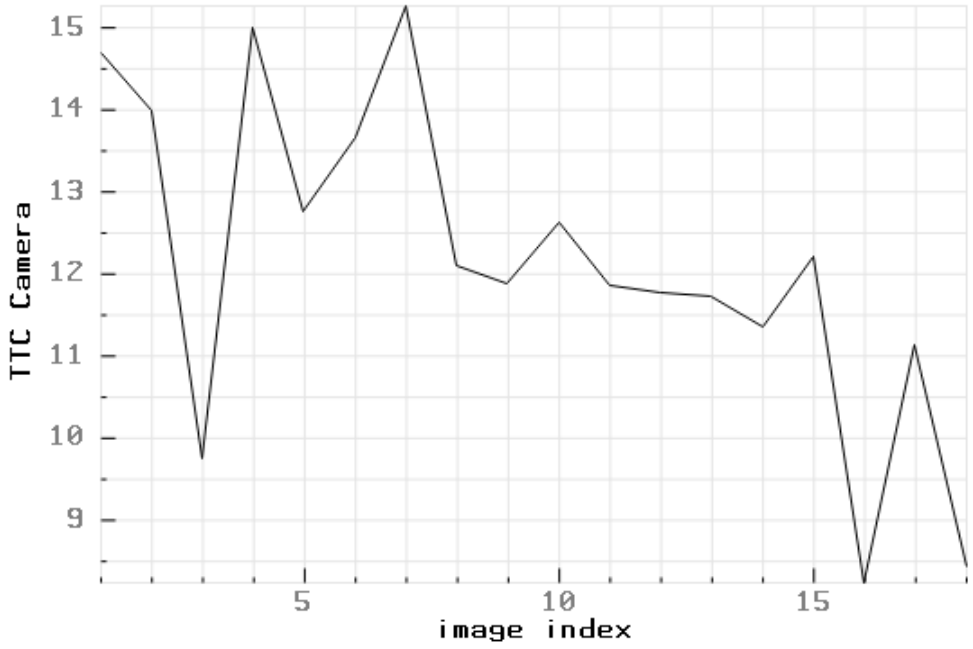
Detector: Shitomasi Descriptor:BRISK



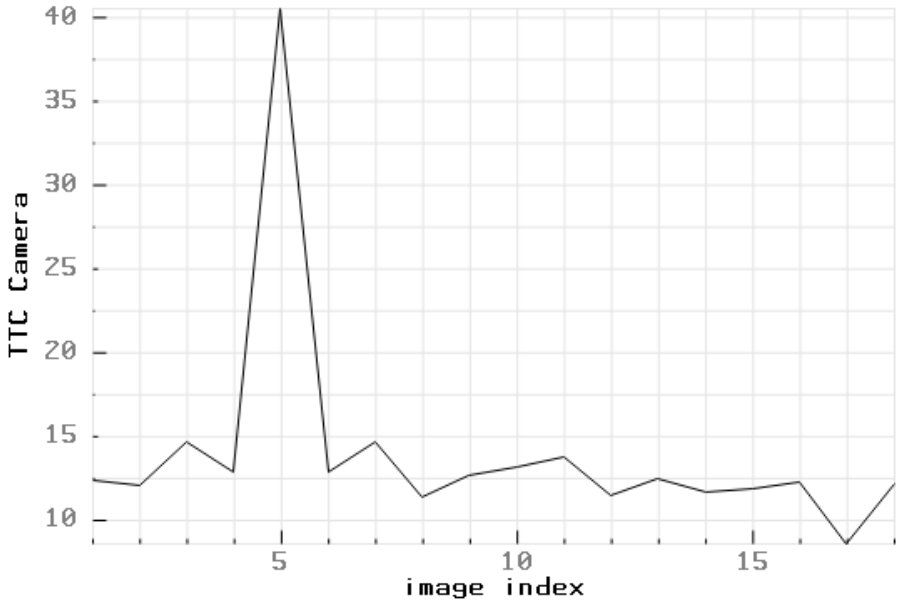
Detector: Shitomasi Descriptor:ORB



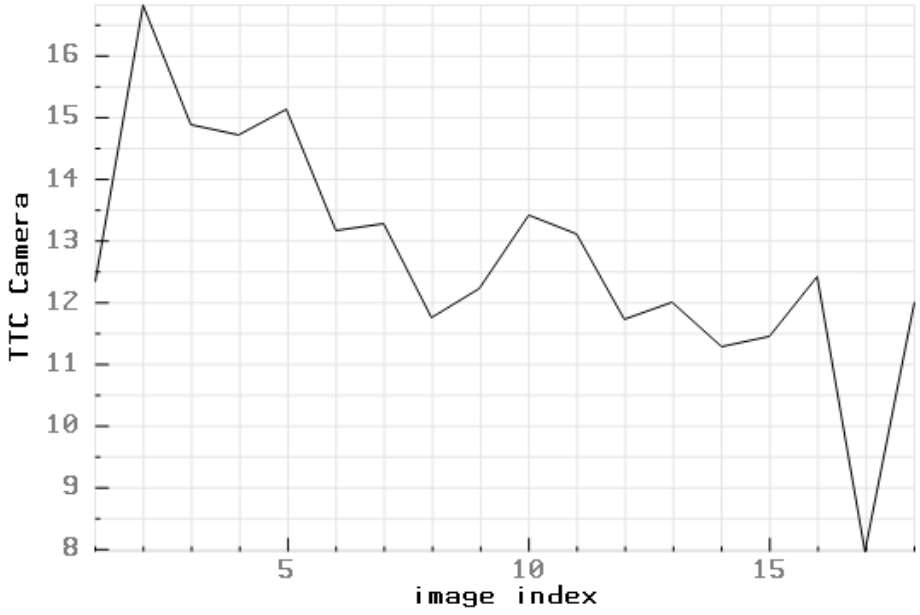
Detector: Shitomasi Descriptor:BRIEF



Detector: FAST Descriptor:BRISK



Detector: FAST Descriptor:FREAK



Detector: HARRIS Descriptor:BRISK