

Track an Object in 3D Space

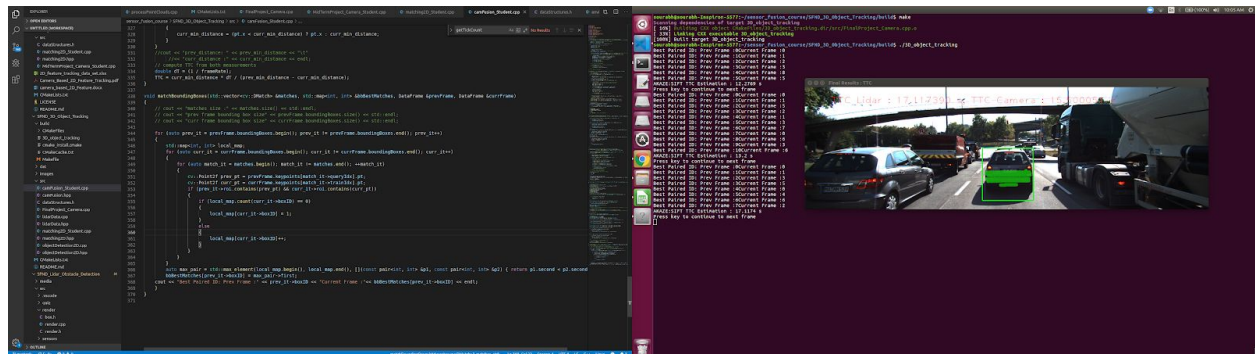
Aim: Track 3D bounding box and Compute TTC(Time to collision) Using Image keypoint detection and Clustered Lidar Points cloud.

Methodology:

1. Lidar Object Detection: Crop the Lidar point cloud, detect and classify the object using PCL (Point cloud library)
2. Camera based Object Detection: Detect Objects using YOLO deep learning Framework and detect keypoints of the object detected by YOLO, extract and match the keypoint detected between the images.
3. Create a bounding box around the key points and Lidar points obtained from the above two steps.
4. Track the bounding boxes between the images based on key points matched.
5. Compute TTC on the object in front using Point Cloud coordinates and Key points in the Images.

Performance Analysis:

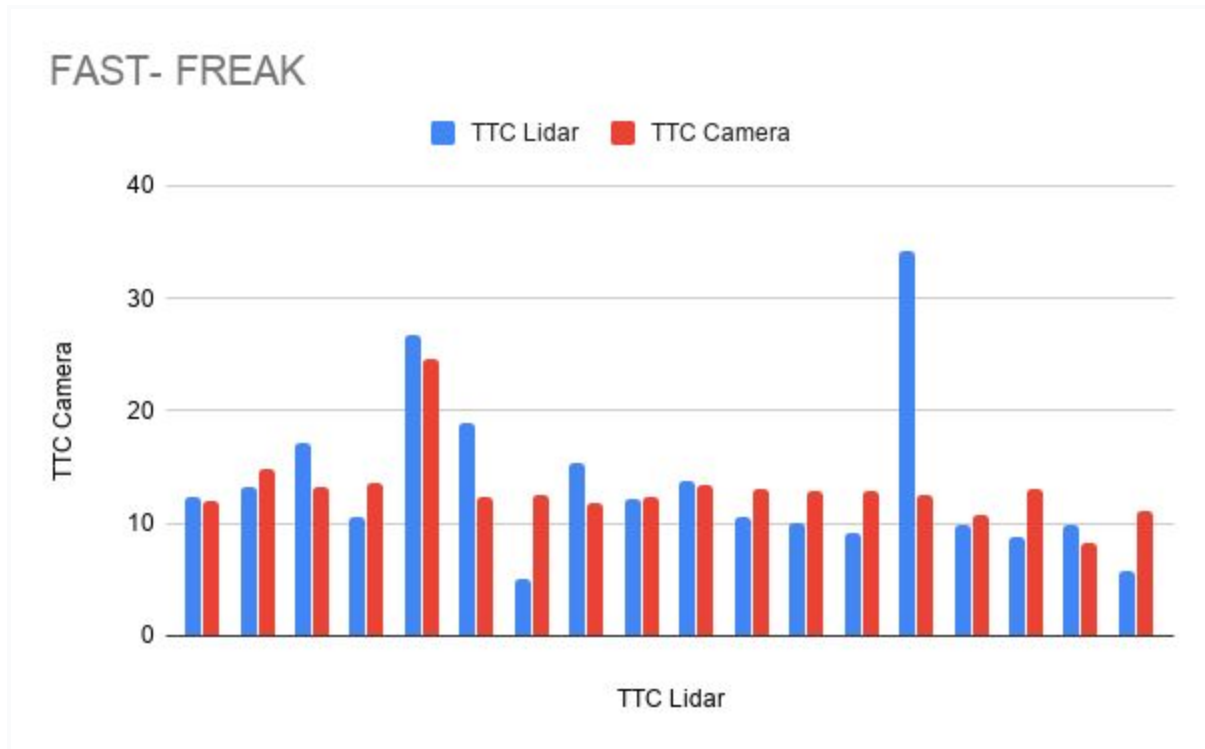
TASK 1: Match 3D Objects: Car on the front is detected and tracked in all the successive images.



TASK 2: TTC is calculated from Lidar point clouds. PCL lib is used for cluster and exact the outliers from the point cloud to avoid estimation error.

TASK 3: Matching key points of the successive images and associated each points with respect to ROI(Region of Interest).

TASK 4: TTC is calculated from the matched key points in the region of interest.



From the above two image we can see the lidar points calculation seems implausible or way of the points.

Euclidean clustering algorithms is used for clustering the point cloud to avoid outliers.

Possible reasons for the error:

1. Calibration error of the lidar sensors.
2. Error is lidar sensor values due to uneven road surface.

TASK 6 :

Please find the excel sheet in the same folder and below is the graph of all the combination of detector -descriptor with the TTC values.

Best method for TTC computing from Analysing the graph

1. FAST -FREAK
2. AKAZE-ORB
3. AKAZE- SIFT

From the below graph we can observe a lot of errors in camera based calculations.

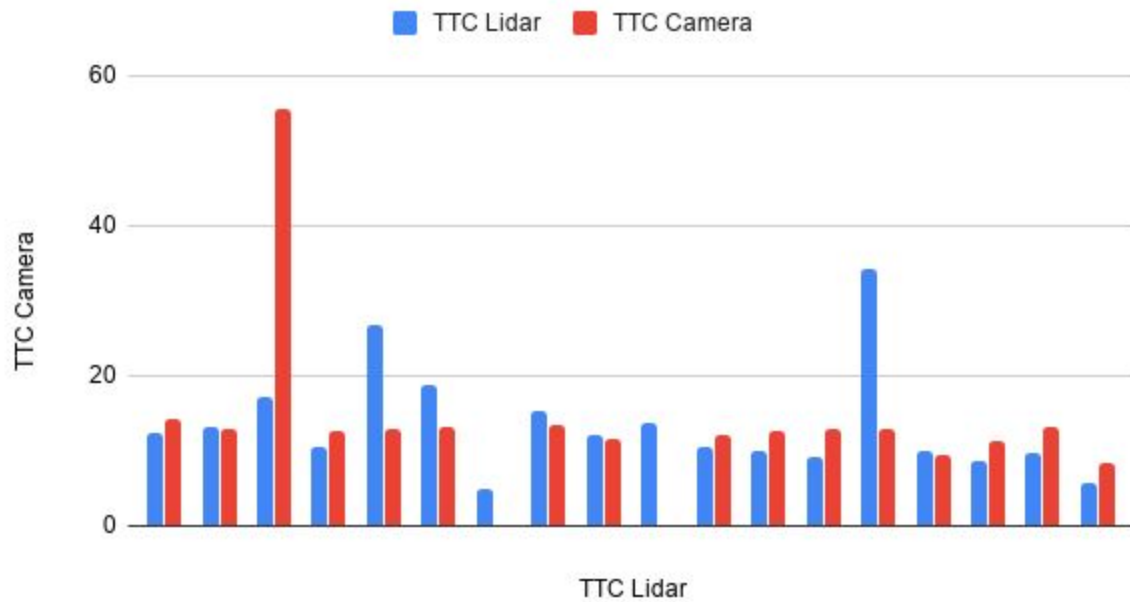
For example

1. performance for Harris Detector was bad for TTC calculation.
2. We could observe some negative values and also Invalid Infinite value which is not captured in the graph.

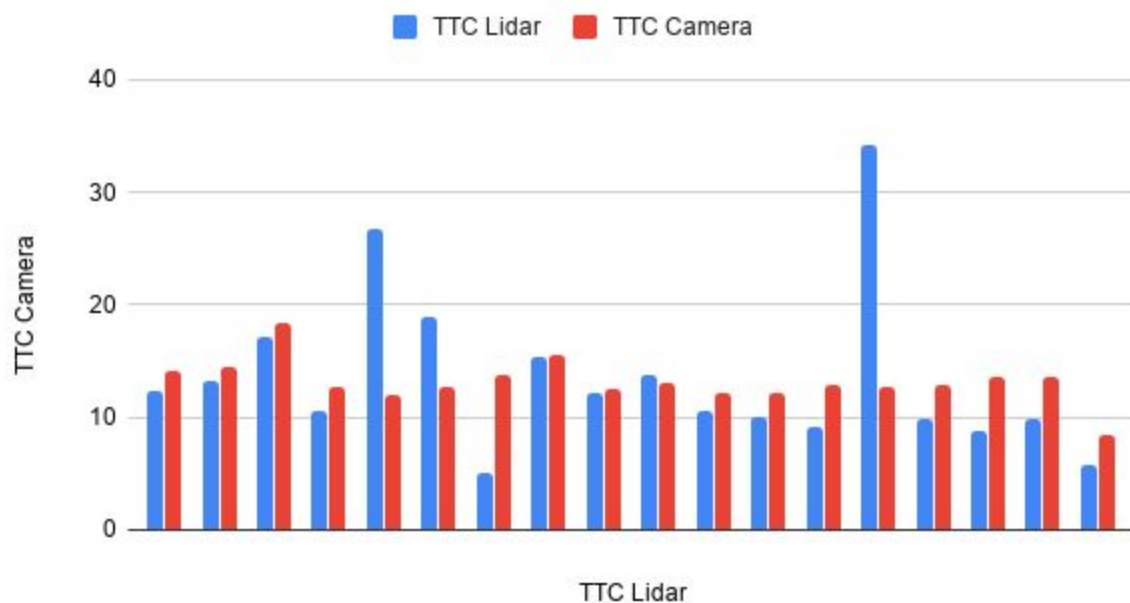
Potential reasons for this error could be:

1. Key points mismatch between the frames.
2. Change is the properties of image like orientation, scale and contrast between the frames.

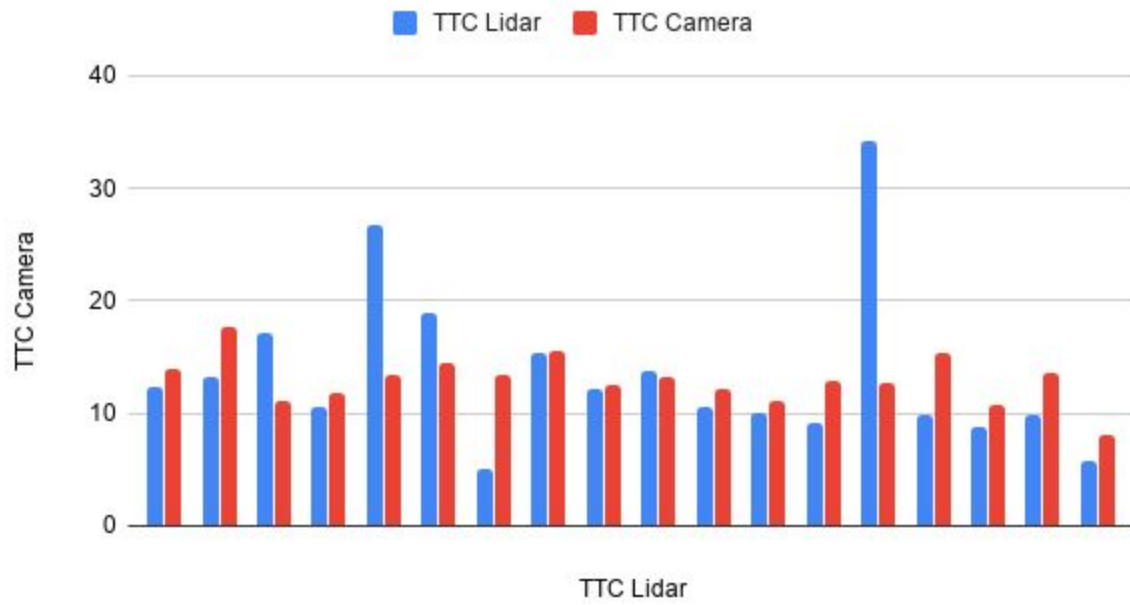
SHITOMASI - BRISK



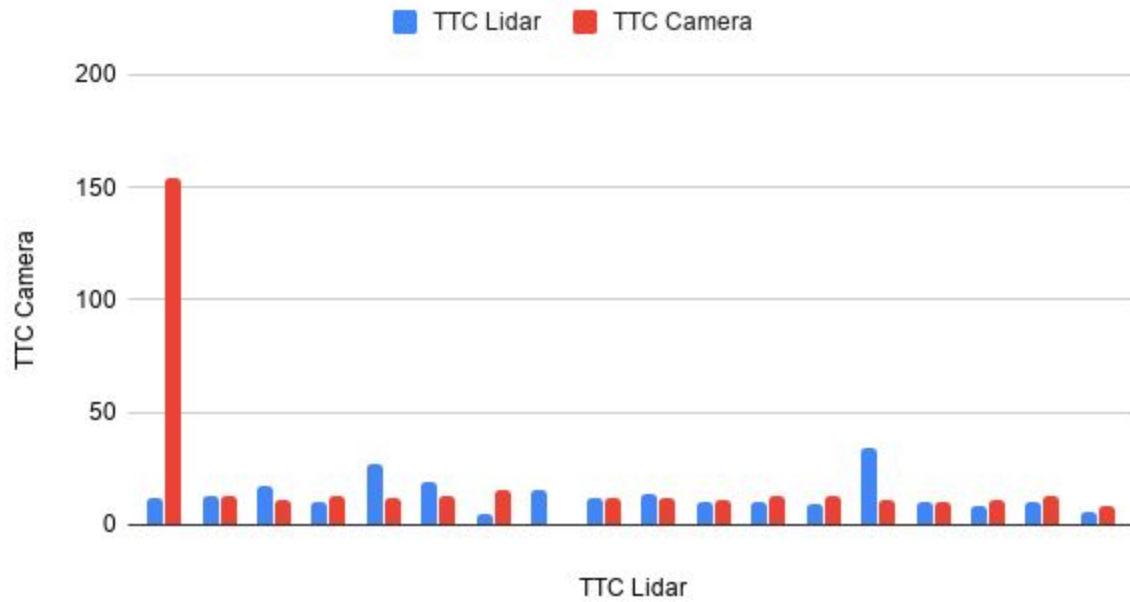
SHITOMASI- BRIEF



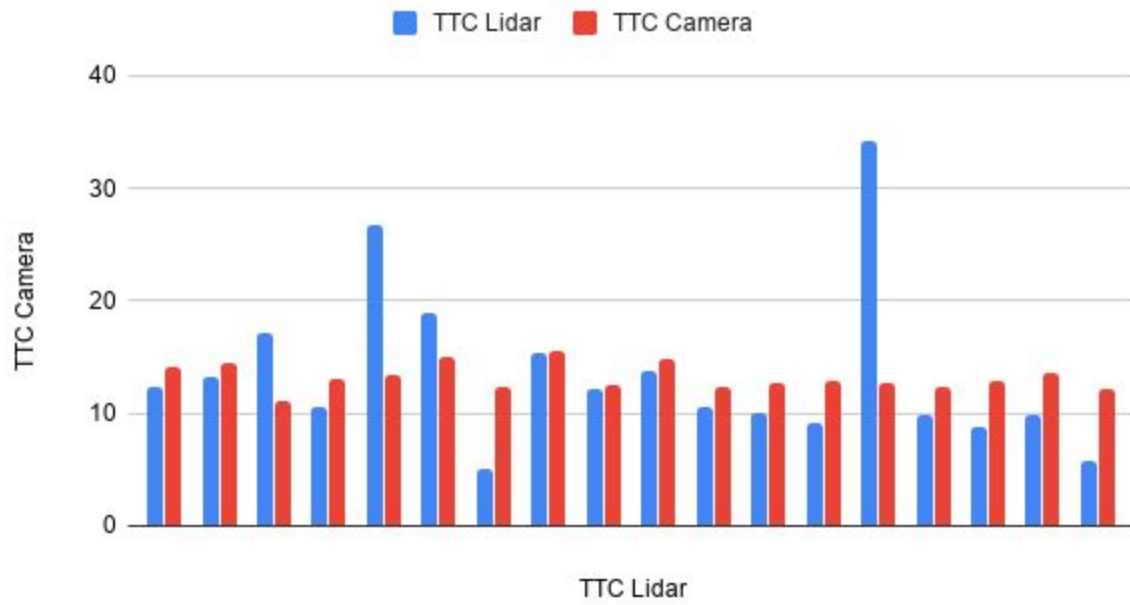
SHITOMASI- ORB



SHITOMASI- FREAK



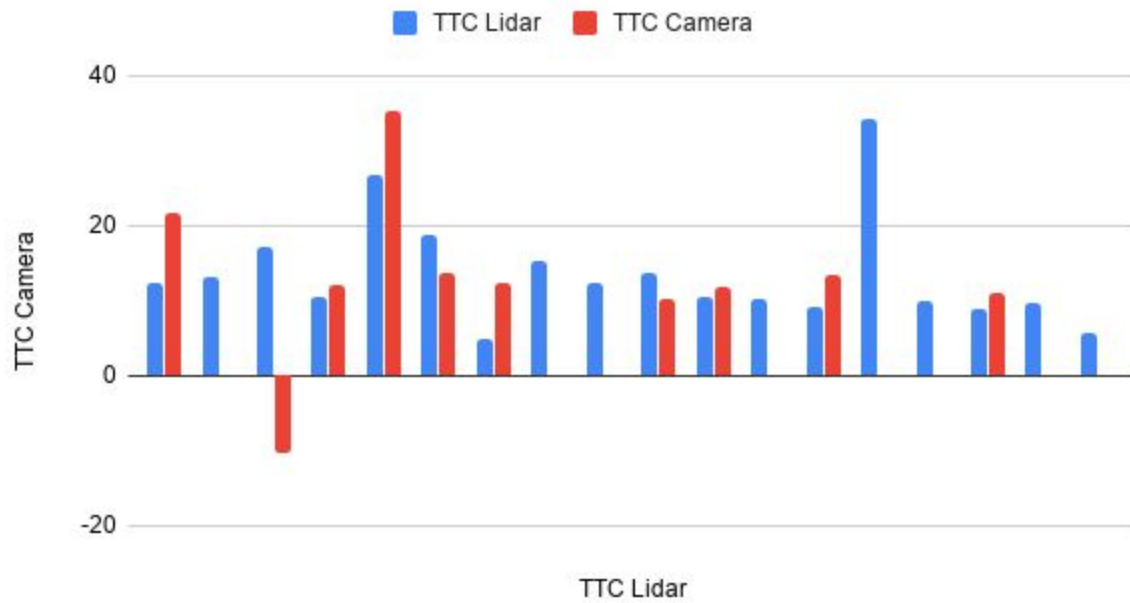
SHITOMASI- SIFT



HARRIS- BRIEF



HARRIS - FREAK



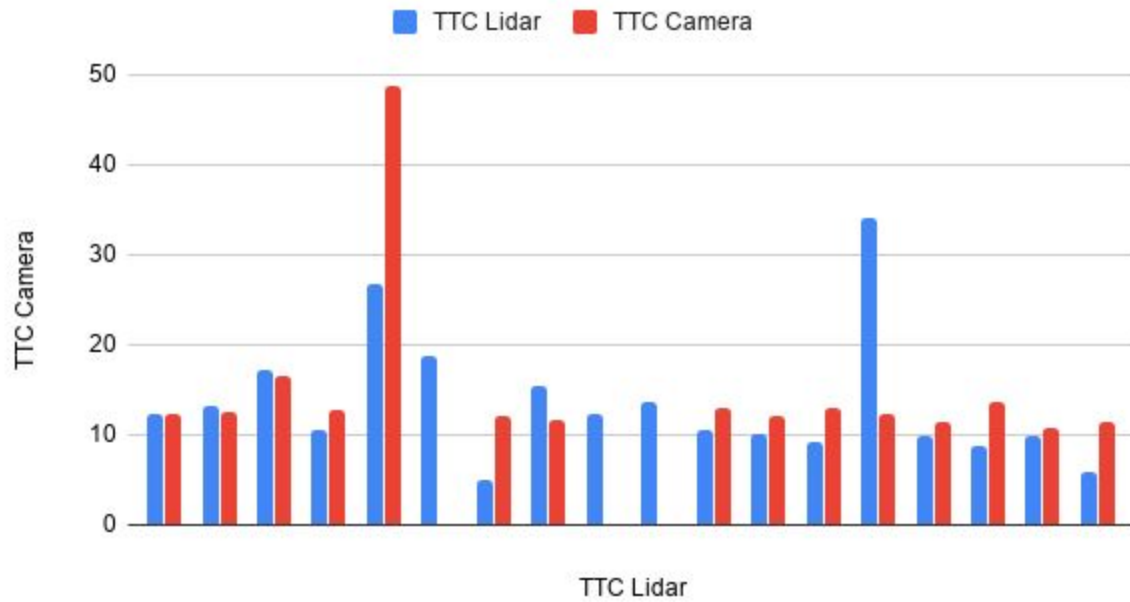
HARRIS - ORB



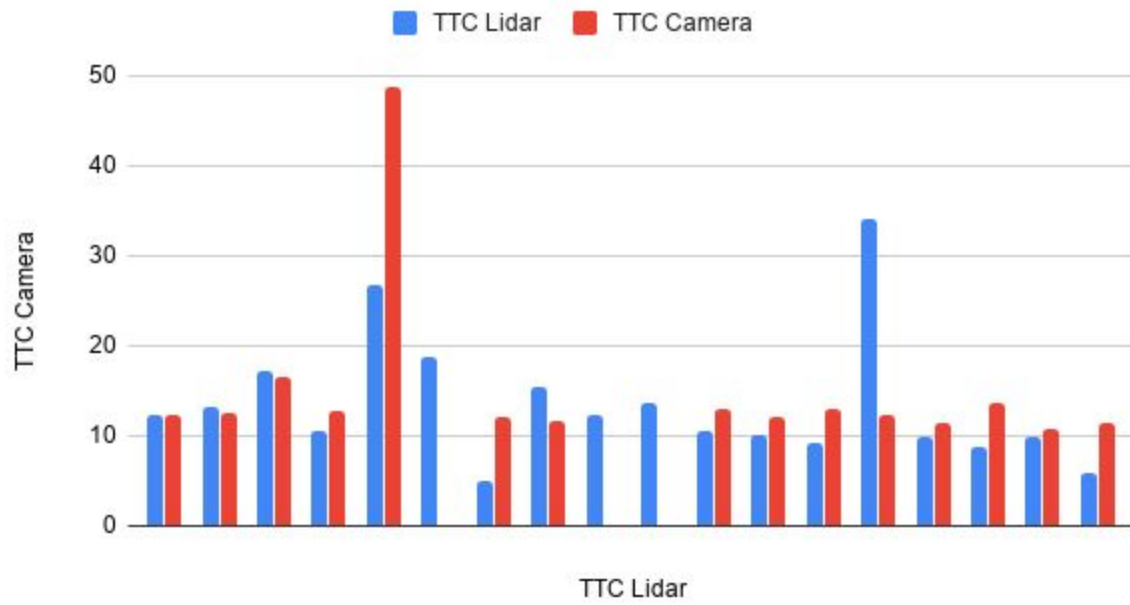
HARRIS- BRIEF



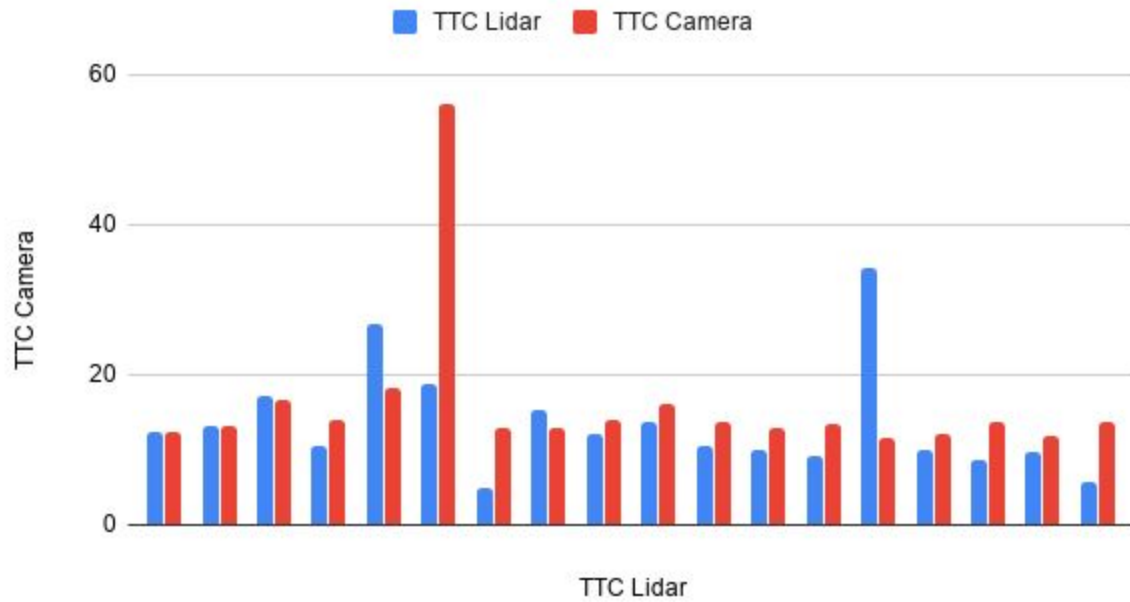
FAST - BRISK



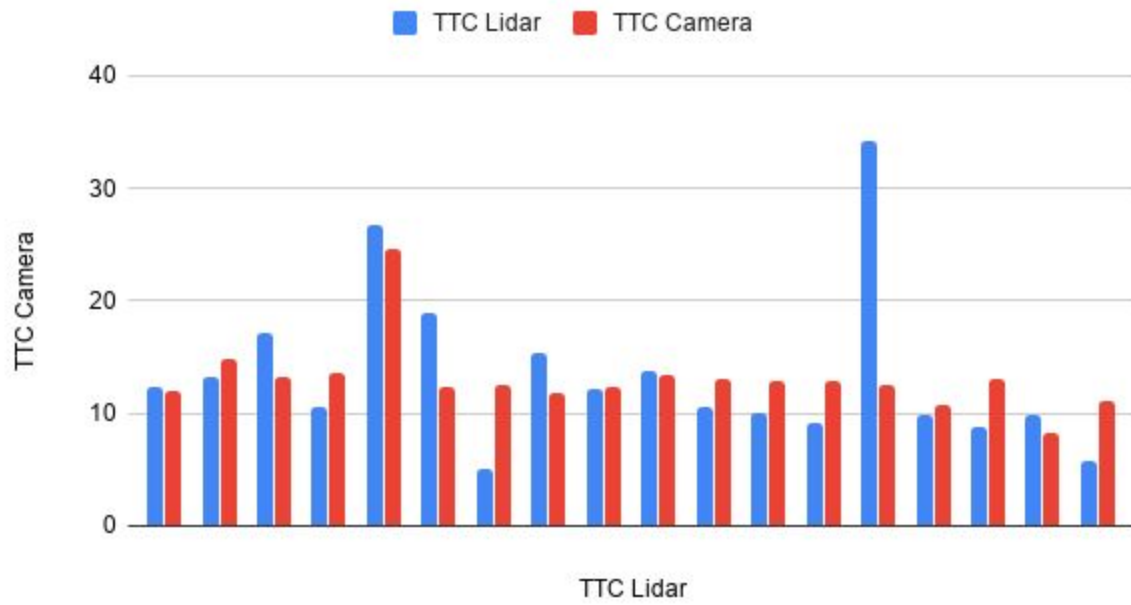
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FAST-ORB



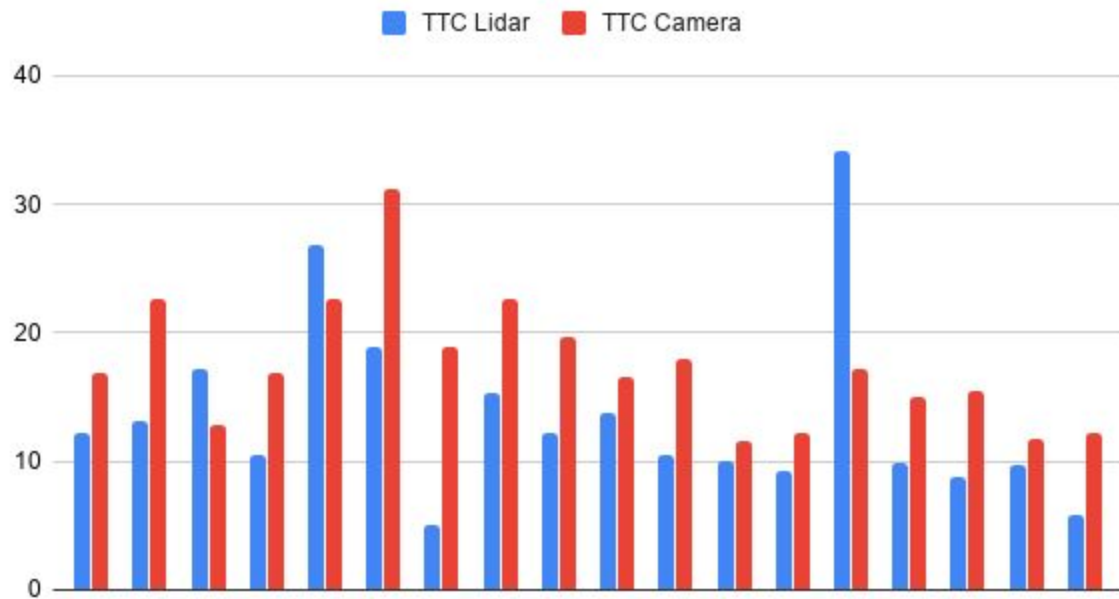
FAST- FREAK



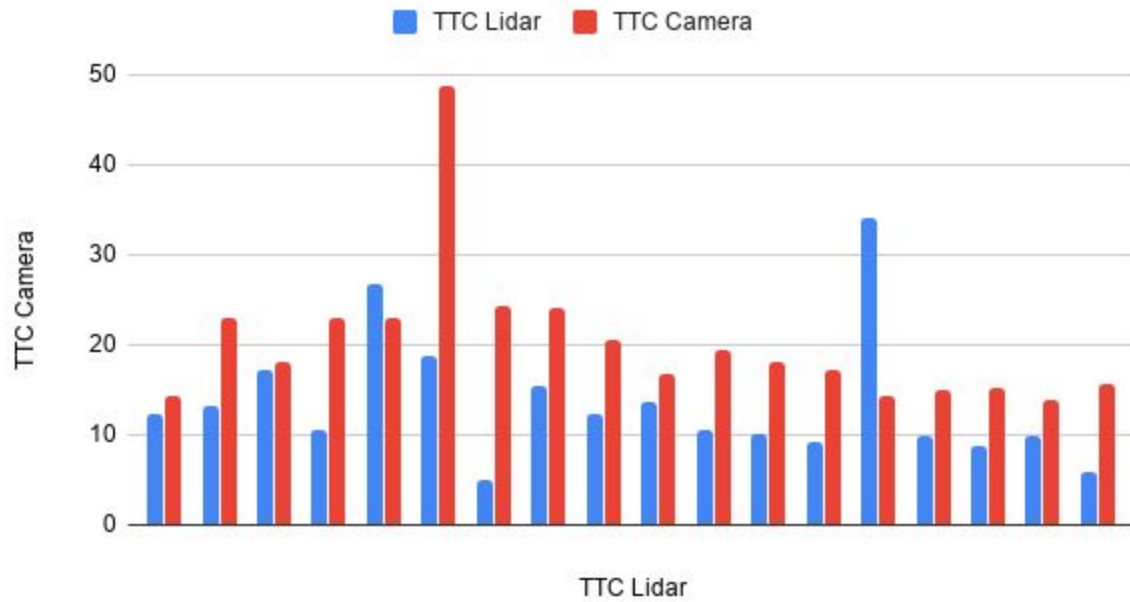
FAST-SHIFT



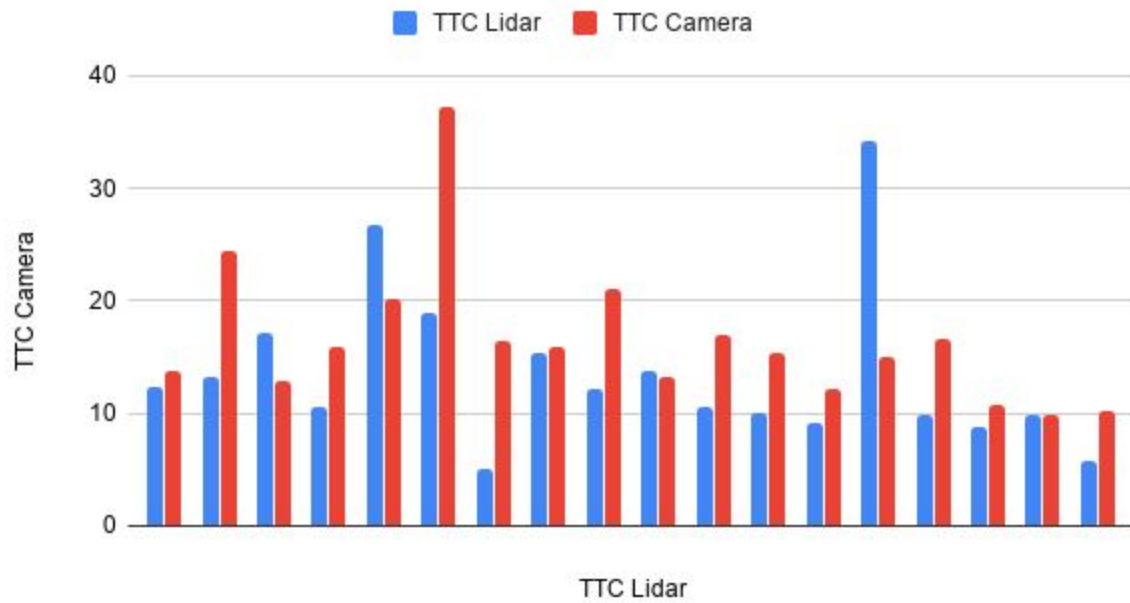
BRISK-BRISK



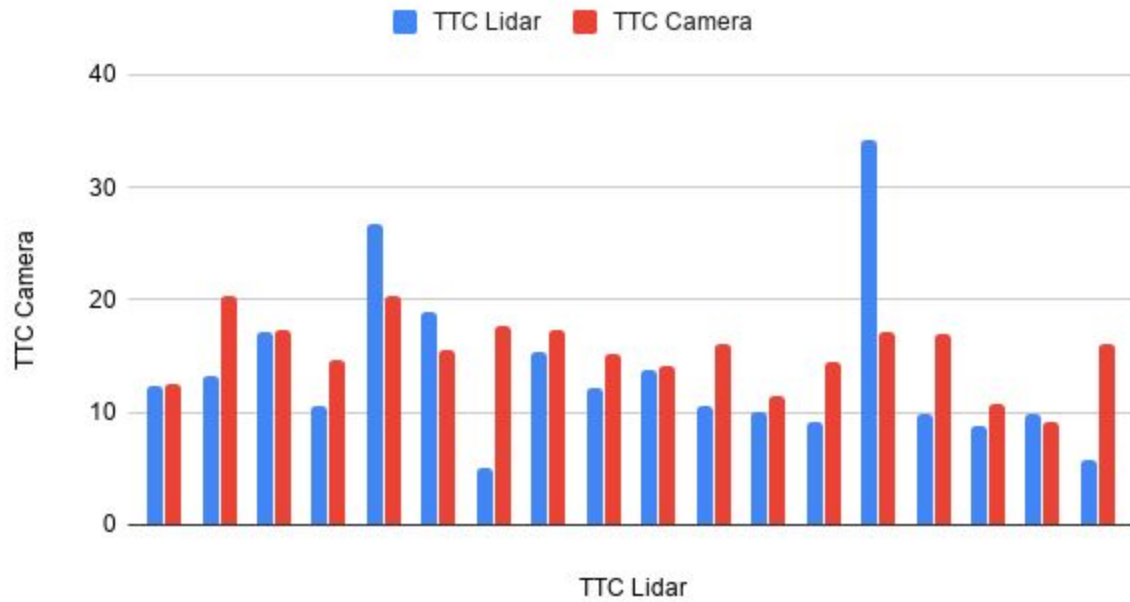
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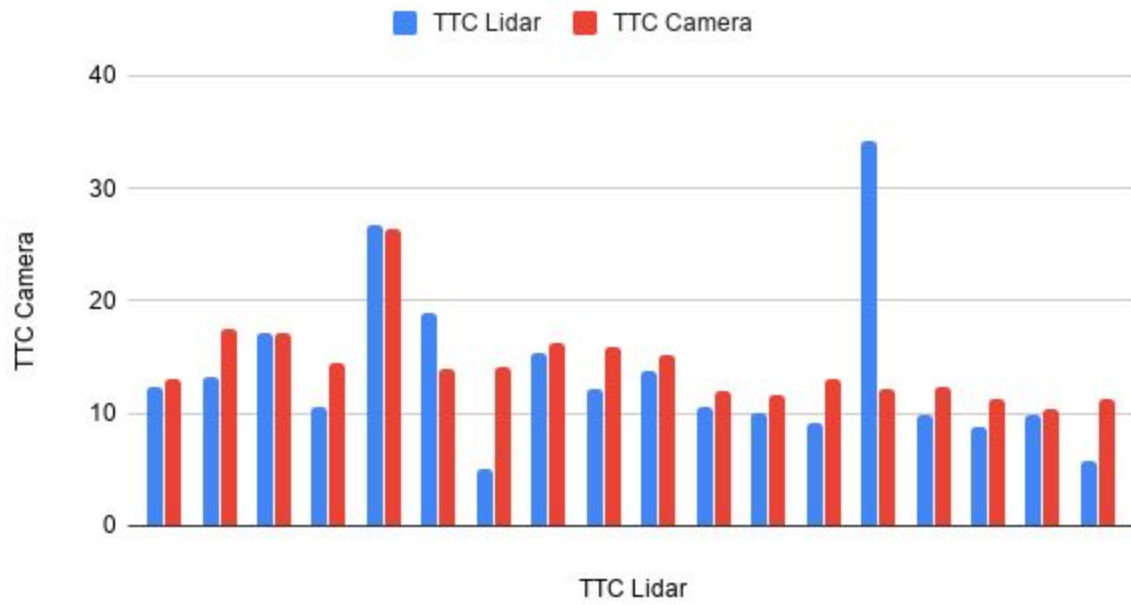
BRISK-ORB



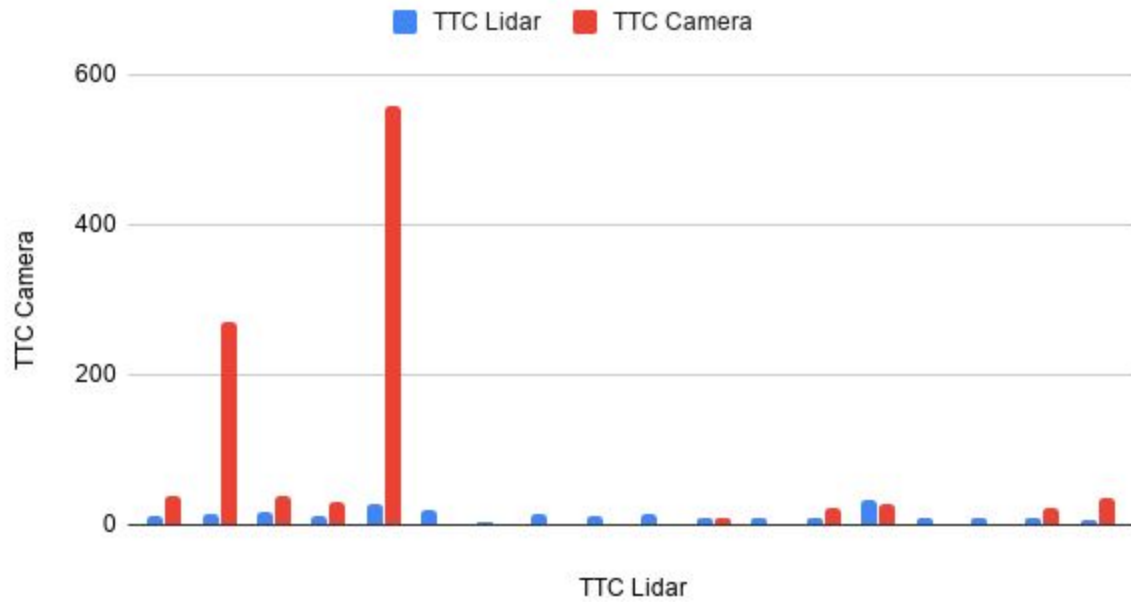
BRISK-FREAK



BRISK-SHIFT



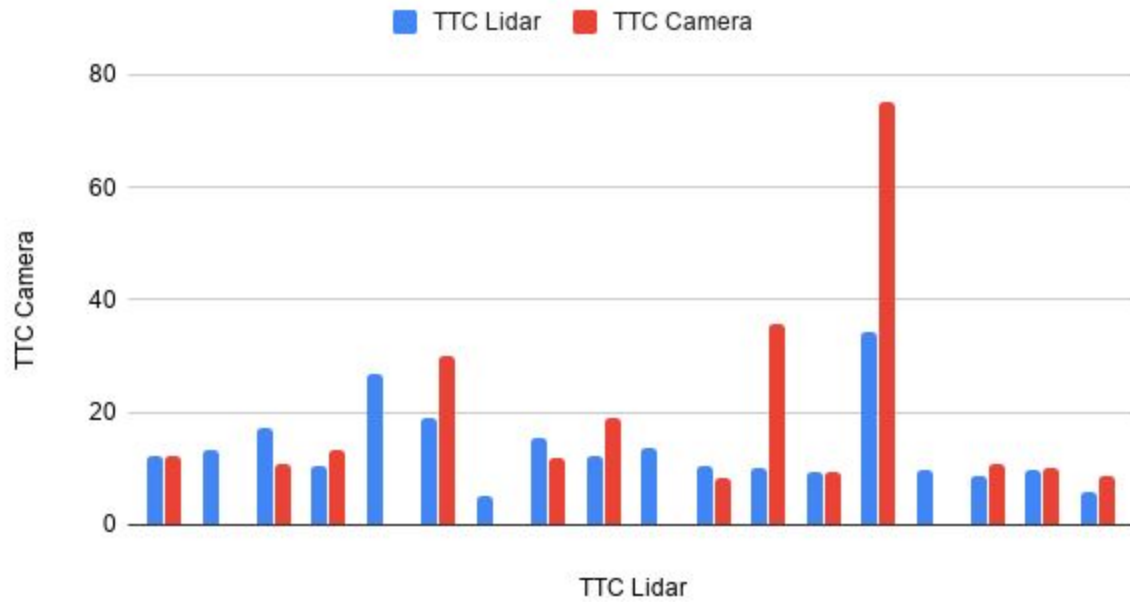
ORB-BRISK



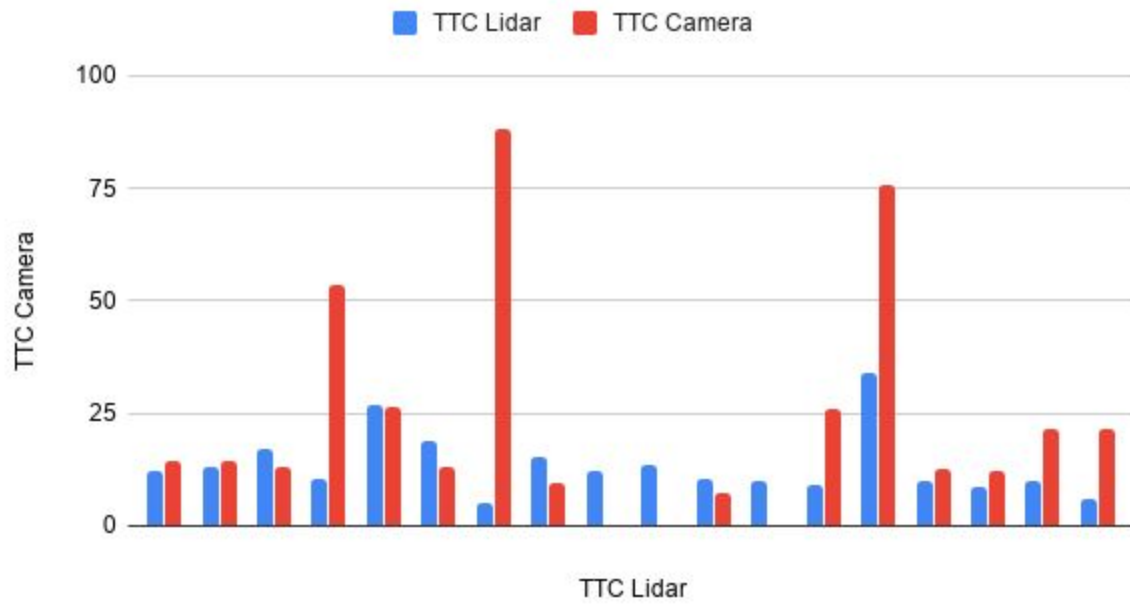
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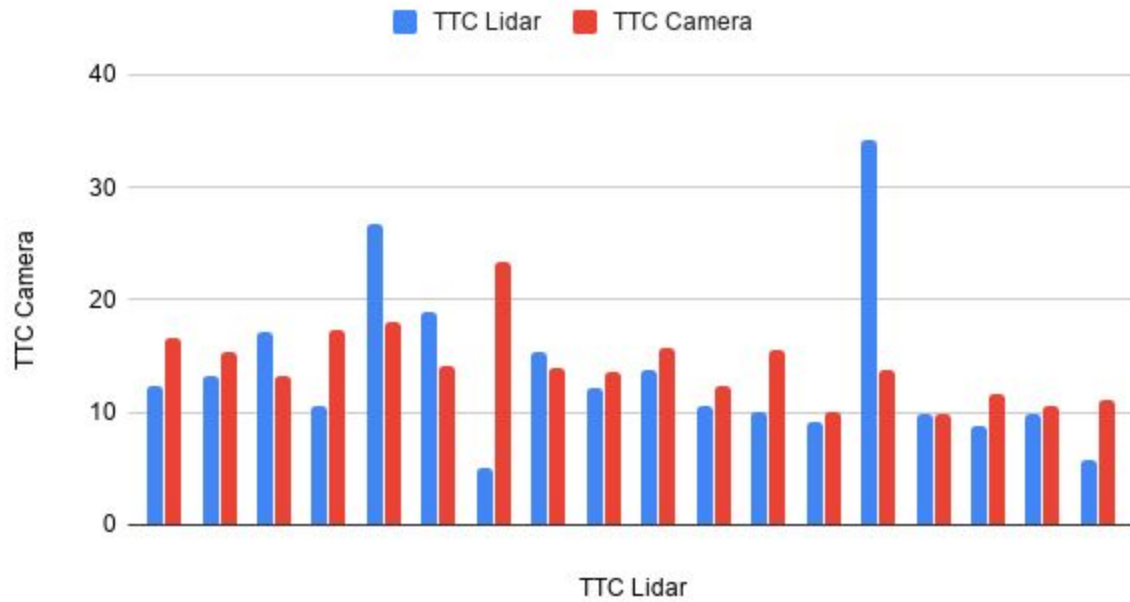
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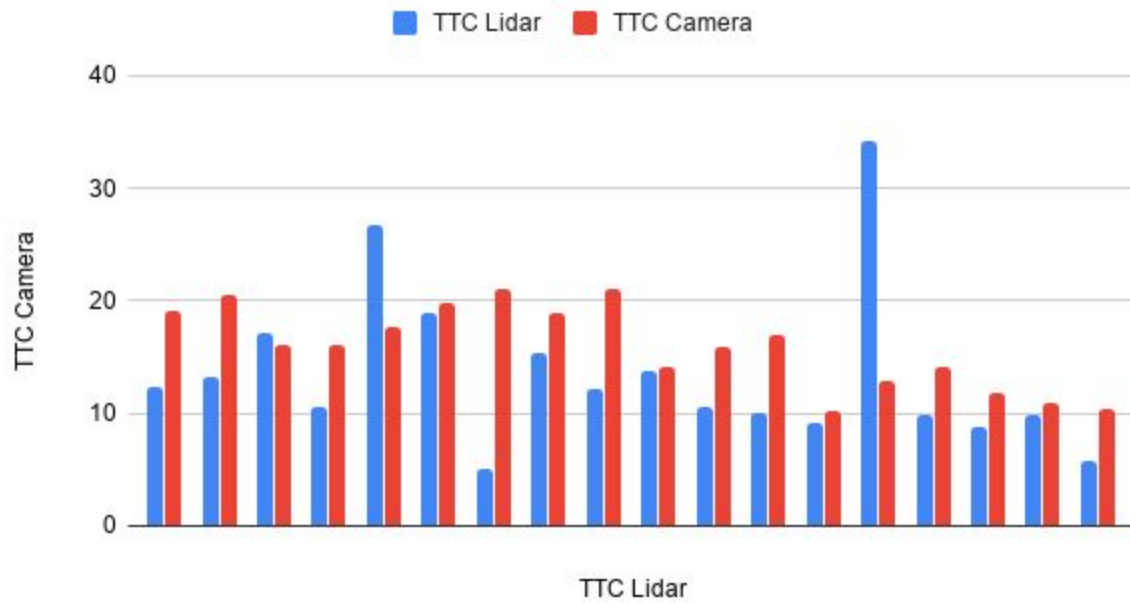
ORB-SIFT



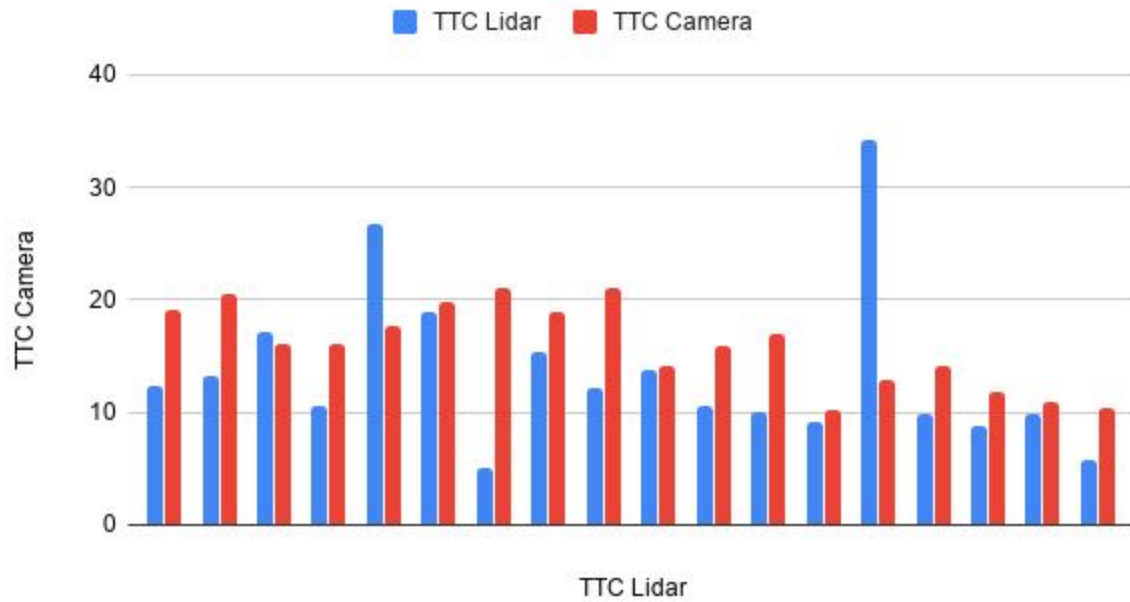
AKAZE-BRISK



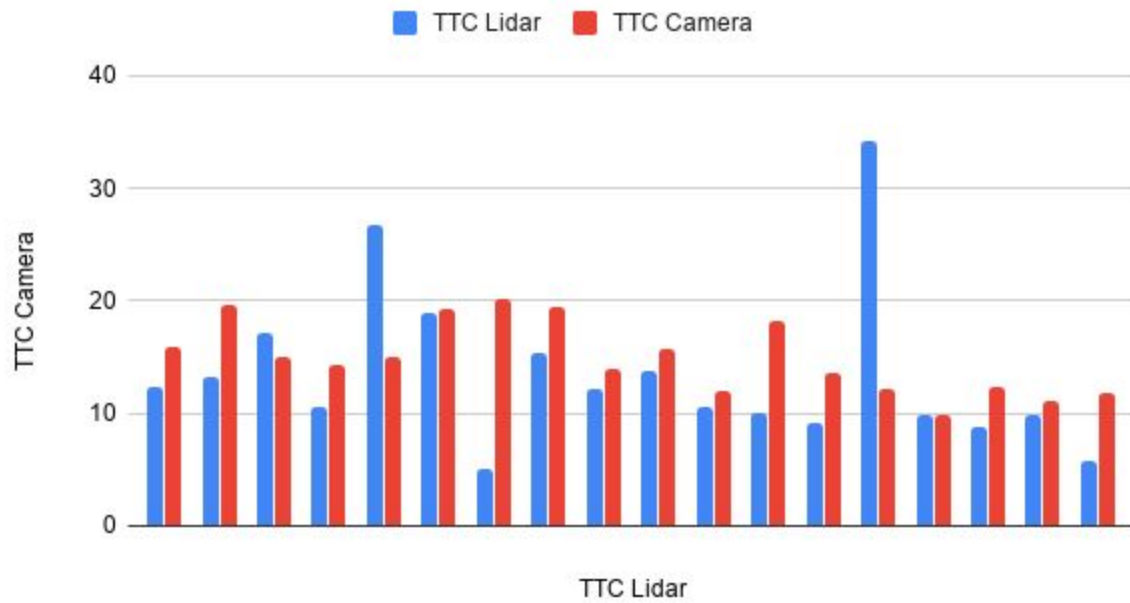
AKAZE-ORB



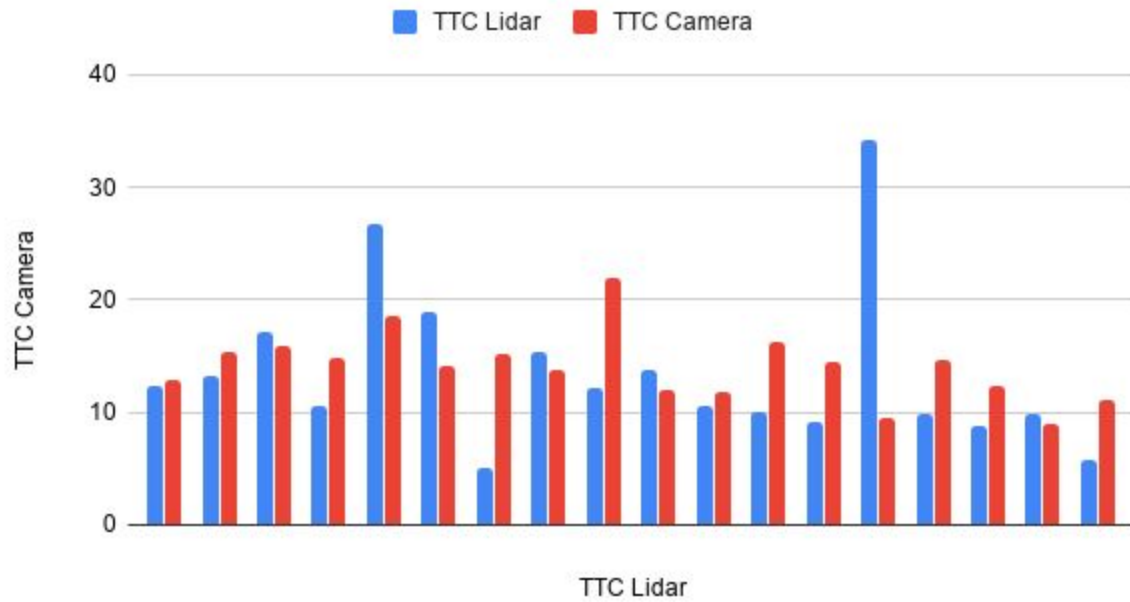
AKAZE-BRIEF



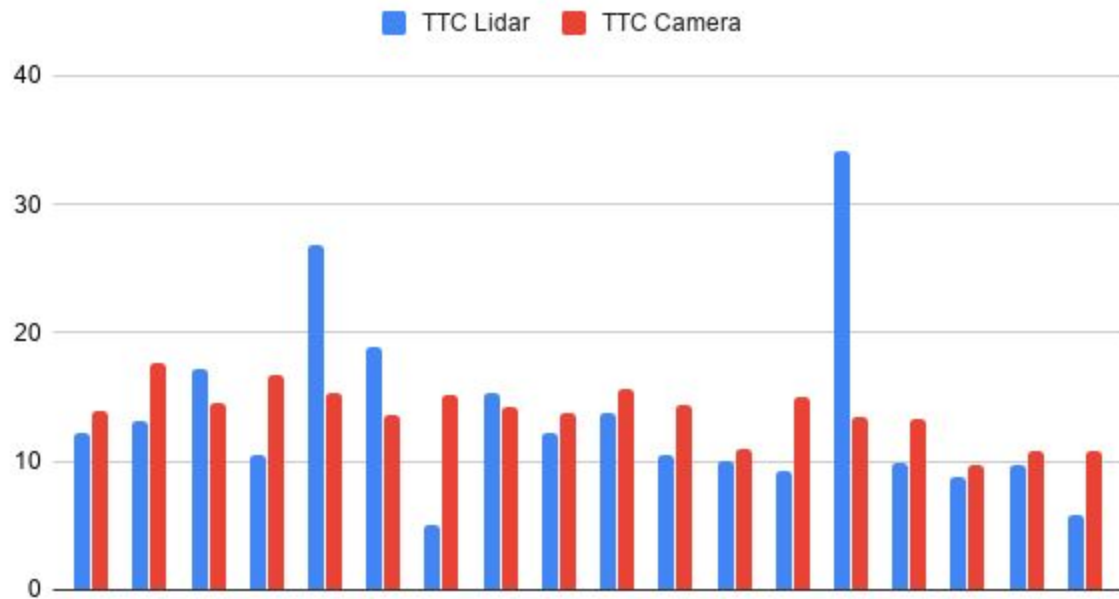
AKAZE-ORB



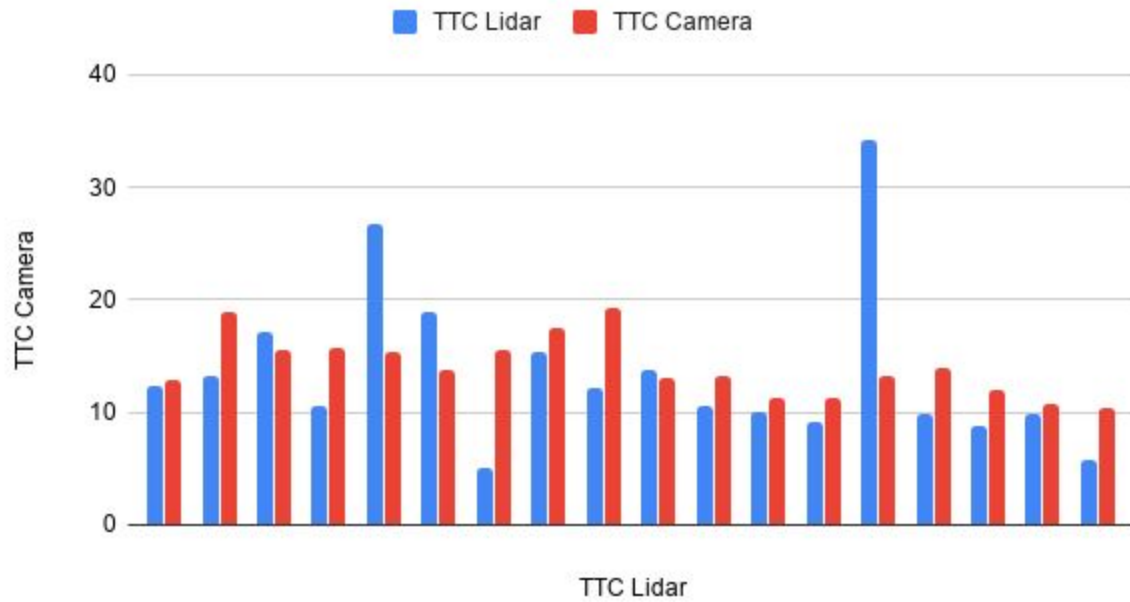
AKAZE-FREAK



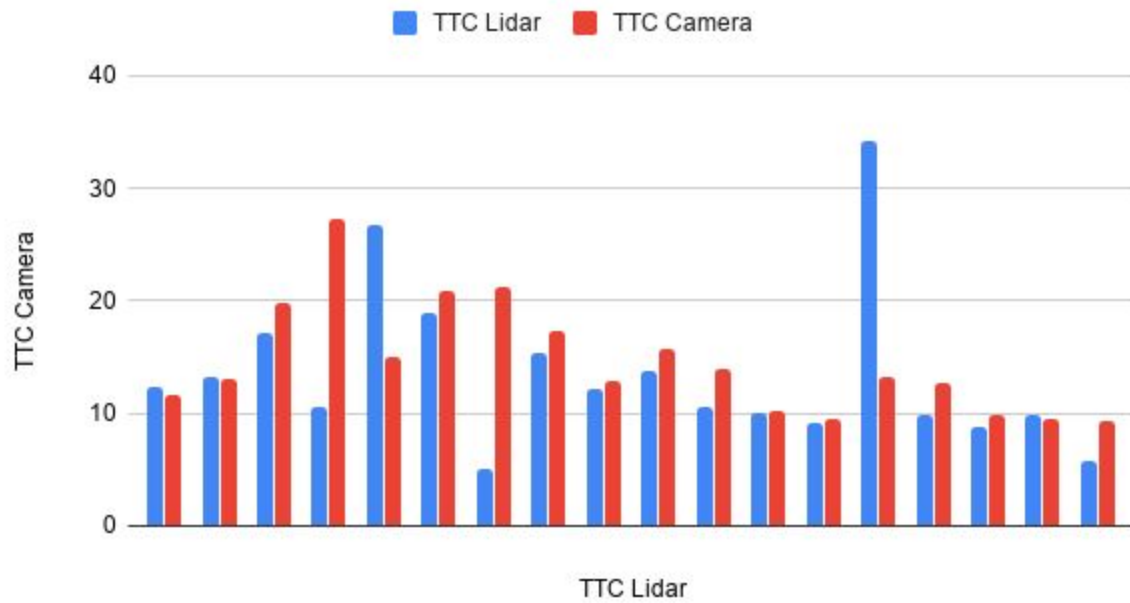
AKAZE-AKAZE



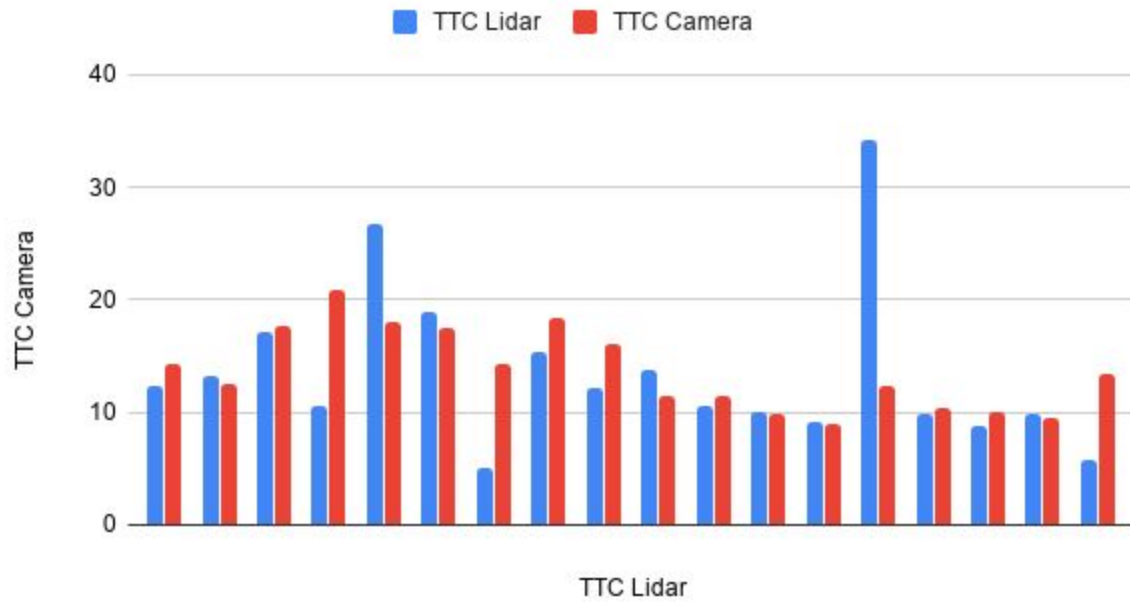
AKAZE-SIFT



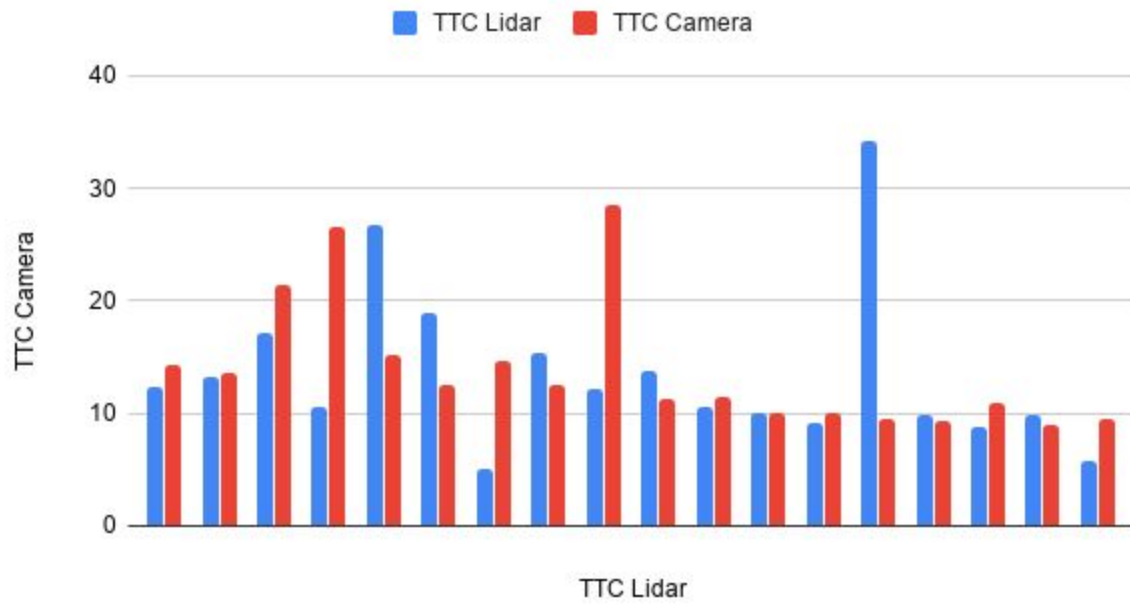
SIFT-BRISK



SIFT-BRIEF



SIFT-FREAK



SIFT-SIFT

