Final report

FP1 Match 3D objects

See implementation in code. Note that this function also populates the keypoints and keypoint matches in the bounding boxes, since it has to go through them anyway. (It doesn't filter out outliers.) A pair of bounding boxes (A in previous frame, B in current frame) is identified as a match if most keypoint matches from A to the current frame are to points in B, and most keypoint matches from B to points in the previous frame are to points in A; this two-way maximization is done to prevent situations like a car mirror being matched to the entire car, although in the current dataset they probably wouldn't have arisen.

FP2 Compute Lidar-based TTC

See implementation in code. The 10th percentile of the distances to the points is used for robustness; in all likelihood, a lower order statistic, e.g. "3rd closest" or "closest 2%" could have been used, since there were rarely more than 1 or 2 outlier points, and typically over a hundred points identified in the vehicle in front.

FP3 Associate keypoint correspondences with bounding boxes

See implementation in code. Note, the keypoints and matches are populated into their bounding boxes in FP1, so this function only filters out the outliers. A match is declared to be an outlier if the Euclidean distance between the image coordinates of the point pair is more than 50% larger than the median for the bounding box. A more statistically robust approach would use the standard deviation of the distribution of the distances, rather than a flat 50%; it might also consider the vector direction of change, rather than just the distance.

FP4 Compute camera-based TTC

See implementation in code. The median of the pairwise distances between keypoints in each image is used to estimate the change in the relative size of the object between the two images, which is then plugged into the constant velocity model. The median is used instead of the mean because it is the more statistically robust estimate; however, computing it requires sorting all the distances, which is quite slow.

FP5 Performance evaluation 1

See FP5.doc and FP5.xls.

FP6 Performance evaluation 2

See FP6.doc and ttcCamera.xls.