

Real-time vehicle distance estimation using single view geometry

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Abstract:

Distance estimation is required for advanced driver assistance systems (ADAS) as well as self-driving cars. It is crucial for obstacle avoidance, tailgating detection and accident prevention. Currently, radars and lidars are primarily used for this purpose which are either expensive or offer poor resolution. Deep learning based depth or distance estimation techniques require huge amount of data and ensuring domain invariance is a challenge. Therefore, in this paper, we propose a single view geometric approach which is lightweight and uses geometric features of the road lane markings for distance estimation that integrates well with the lane and vehicle detection modules of an existing ADAS. Our system introduces novelty on two fronts: (1) it uses cross-ratios of lane boundaries to estimate horizon (2) it determines an Inverse Perspective Mapping (IPM) and camera height from a known lane width and the detected horizon. Distances of the vehicles on the road are then calculated by back projecting image point to a ray intersecting the reconstructed road plane. For evaluation, we used lidar data as ground truth and compare the performance of our algorithm with radar as well as the state-of-the-art deep learning based monocular depth prediction algorithms. The results on three public datasets (Kitti, nuScenes and Lyft level 5) showed that the proposed system maintains a consistent RMSE between 6.10 to 7.31. It outperforms other algorithms on two of the datasets while on KITTI it falls behind one (supervised) deep learning method. Furthermore, it is computationally inexpensive and is data-domain invariant.

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1. Introduction

Human error is one of the major causes of driving accidents. At the heart of safe driving practices lies the driver's judgment to estimate their vehicle's braking distance w.r.t other road users. For this reason, Advanced Driver Assistance Systems (ADAS) have evolved substantially over the last few years and features such as pedestrian and tailgating detection have been introduced. [Sign in to Continue Reading](#) perilous maneuvers. Real-time logging of this information is crucial in this regard and can help fleet managers in scoring a driver's behavior. It also makes an integral part of autonomous driving in path planning, obstacle and collision avoidance and hence in overall safety assessment of the self-driving cars.

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