

Lane detection using lane boundary marker network with road geometry constraints

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[Cite This](#)Hussam Ullah Khan ; Afsheen Rafaqat Ali ; Ali Hassan ; Ahmed Ali ; Wajahat Kazmi ; Aamer Zaheer **All Authors**

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Abstract:

Lane detection is of critical importance to both the self-driving cars as well as advanced driver assistance systems. While current methods use a range of features from low-level to deep features extracted from convolutional neural networks, they all suffer from the problem of occlusion and struggle to detect lanes with low or no evidence on the road. In this paper, we use a lane boundary marker network to detect keypoints along the lane boundaries. An inverse perspective mapping is estimated using road geometry which is then applied to the detected markers and lines/curves are fitted jointly on the rectified points. Finally, missing lane boundaries are predicted using lane geometry constraints i.e., equidistant and parallelism. Reciprocal weighted averaging ensures lane boundaries with strong evidence dominate their predicted alternatives. The results show a significant improvement of +7.8%, +6.8% and +1.2% of F1 scores over the state-of-the-art on CU-Lane, Caltech and TuSimple datasets, respectively. This proves our algorithm's robustness against both occluded and missing lanes cases. Furthermore, we also show that our algorithm can be combined with other lane detectors to improve their lane retrieval potential.

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1. Introduction

Fully autonomous vehicles in the form of self-driving cars are gradually appearing on the scene and we have Google Waymo [17], Tesla's Auto-pilot [19], Comma.AI's OpenPilot kit [16] and Intel's MobileEye solutions [18] just to name a few. Along with self-driving cars, Advanced Driver Assistance Systems (ADAS) have also captured a surge in the interest. Both self-driving cars and the ADAS require different levels of autonomy but some aspects of automation are still common. One of them is lane detection. Lane detection is critical in identifying and ensuring safe driving practices and an on-board system with this capability can alert the driver in case of an unsafe lane change and avoid it in the first place if it is a self-driving vehicle. Besides, it is also necessary in understanding the road layout and surrounding scene geometry for proper route planning for autonomous or semi-autonomous vehicles.

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