

Perspective-Aware Road Obstacle Detection

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Abstract. While road obstacle detection techniques have become increasingly effective, they typically ignore the fact that, in practice, the apparent size of the obstacle decreases as their distance to the vehicle increases. In this paper, we account for this by introducing a scale map encoding the apparent size of a hypothetical object at every image location. We then leverage this information to improve learning data by including multiple objects with the same or a lower apparent distance than the bounding part of the detection network to guide the obstacle detector. Our results are validated both on synthetic data that require this new strategy significantly toward the obstacle detection performance, showing our approach to consistently outperform state-of-the-art methods in terms of intersection-over-union.

1. Introduction

While road driving scenarios become increasingly available [2] and accident statistics in cars are still the predominant obstacle space while avoiding other traffic, driverless, assisted and semi-automated obstacle flying on the road through a potential danger. Since not every vehicle has driver assistance or a LIDAR sensor to detect them in 3D, much effort has recently been made to achieve detection in a monocular setting via learning-based strategies. Road obstacle detection can also be beneficial for safety in aerial environments. Given that such objects are non-structured, obtaining reliable datasets of real images associated with such obstacles for training purposes is impractical. Hence, many studies either use deep learning approaches [24, 17, 34, 17] only on synthetically generated training data, for example by creating real objects and inserting them into individual frames of the Cityscapes dataset.

However, these methods fail to leverage, both when generating training data and performing the actual detection, the perspective properties underlying the images captured by cameras: identifying camera fr is a standard practice [14, 35, 7] to track objects of arbitrary sizes at any image location in the training data used to detect objects of multiple scales irrespective of where they appear in the image. The idea is to split the real camera fr into many distinct objects used to be smaller and thus given a calibrated camera, the relationship between real and perceived sizes in frames.

In this work, we show that leveraging the perspective information substantially improves performance. To this end, as shown in Fig. 1, we propose a scale map, where pixel values denote the apparent size of objects of a hypothetical meter-wide object placed at that point on the road. We then replace this information in our complementary steps:

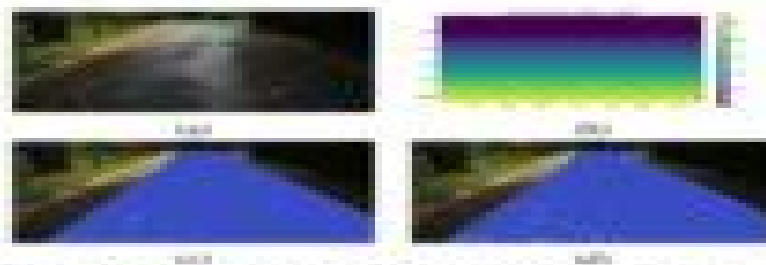


Fig. 1. Our scale method to detect and track cars through images. The **scale map** denotes a real obstacle (the car) and the **red bounding box** denotes the bounding boxes for the perspective map network, or each pixel, the size in pixels of a hypothetical meter-wide object at that location. (c) Our approach with the perspective map to distinguish between objects from background areas. It correctly flags as smaller pixels of the real obstacle while ignoring the background. (d) Without the perspective map, instead we are confused with a smaller background flag (blue px).

- 1. **Perspective-Aware Synthetic Object Injection.** Instead of uniformly injecting synthetic objects into road scenes to generate training data, as in [14, 16, 17] we use the perspective map to appropriately set the perceived size of the objects in frames.
- 2. **Perspective-Aware Architecture.** We feed the perspective map at multiple levels of a feature pyramid network, enabling it to learn the explicit relationship between distance and size controlled in our training set and in real road scenes.

The bottom part of Fig. 1 illustrates the benefits of our approach. It not only detects small far-away obstacles but also avoids false alarms arising from small imperfections near the car, such as the fence beam. Because there are at this image location there are much less of real objects in the vehicle. Our results show that these strategies together contribute to significantly improving the accuracy of road obstacle detection, particularly in terms of non-structured obstacles, which is critical for a self-driving car that need to identify all potential hazards on the road.

We evaluate our approach on the Synset [18] & the City [9] benchmarks's obstacle task and the RoadFormer [16] test subset. We demonstrate that it significantly outperforms most of the current approaches that use architectures similar to ours, but without explicit perspective handling. The code of our method and the results publicly available.

Obstacle Detection Answer Keys

Ying Liu



Obstacle Detection Answer Keys:

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Handbook of Deep Learning Applications Valentina Emilia Balas,Sanjiban Sekhar Roy,Dharmendra Sharma,Pijush Samui,2019-02-25 This book presents a broad range of deep learning applications related to vision natural language processing gene expression arbitrary object recognition driverless cars semantic image segmentation deep visual residual abstraction brain computer interfaces big data processing hierarchical deep learning networks as game playing artefacts using regret matching and building GPU accelerated deep learning frameworks Deep learning an advanced level of machine learning technique that combines class of

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A Project Manager's Guide to the Top 10 Obstacles to Project Success Lou Gasco, 2013-11-09. Thousands of project managers around the globe have participated in the Top 10 Obstacles to Project Success studies carried out by M T.

Advances in Social Computing and Multiagent Systems Fernando Koch, Christian Guttman, Didac Busquets, 2015-11-14. This book constitutes thoroughly revised selected papers of the proceedings of the 6th International Workshop on Collaborative Agents Research and Development CARE 2015 and the Second International Workshop on Multiagent Foundations of Social Computing MFSC 2015 held in Istanbul, Turkey, on May 4, 2015. Both workshops were held in conjunction with AAMAS 2015. The 5 revised full papers of CARE and the 7 full papers of MFSC presented were carefully selected from 14 CARE and 10 MFSC submissions. Both workshop address issues in relevant areas of social computing such as smart societies, social applications, urban intelligence, intelligent mobile services, models of teamwork and collaboration.

Introduction to Global Health Promotion Rick S. Zimmerman, Ralph J. DiClemente, Jon K. Andrus, Everold N. Hosein, 2016-05-03. Introduction to Global Health Promotion addresses a breadth and depth of public health topics that students and emerging professionals in the field must understand as the world's burden of disease changes with non-communicable diseases on the rise in low and middle income countries as their middle class populations grow. Now more than ever we need to provide health advocacy and intervention to prevent, predict and address emerging global health issues. This new text from the Society for Public Health Education SOPHE prepares readers with thorough and thoughtful chapters on global health promotion theories, best practices and perspectives on the future of the field from the individual to the global level. The world's biggest health care challenges including HIV, malaria, heart disease, smoking and violence among others are explored in detail in Introduction to Global Health Promotion. The state of the science including the latest empirical data is distilled into 19 chapters that update readers on the complex issues surrounding a variety of illnesses and conditions and disease epidemics and individual, social, institutional and governmental barriers to preventing them. Expert authors bring to the fore human rights issues, new uses of technology and practical application of theory. These perspectives along with the book's multidisciplinary approach serve to create a well-rounded understanding of global health today. Learn more from the

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