

Chapter 2

A Survey of Approaches for Estimating Meteorological Visibility Distance Under Foggy Weather Conditions

Faouzi Kamoun

ESPRIT School of Engineering, Tunisia

Fatma Outay

Zayed University, UAE

Hazar Chaabani

ESPRIT School of Engineering, Tunisia

Ansar-Ul-Haque Yasar

Hasselt University, Belgium

ABSTRACT

The immaturity of fog abatement technologies for highway usage has led to growing interest towards developing intelligent transportation systems that are capable of estimating meteorological visibility distance under foggy weather conditions. This capability is crucial to support next-generation cooperative situational awareness and collision avoidance systems as well as onboard driver assistance systems. This chapter presents a survey and a comprehensive taxonomy of daytime visibility distance estimation approaches based on a review and synthesis of the literature. The proposed taxonomy is both comprehensive (i.e., captures a wide spectrum of earlier contributions) and effective (i.e., enables easy comparison among previously proposed approaches). The authors also highlight some open research issues that warrant further investigation.

DOI: 10.4018/978-1-5225-9019-4.ch002

INTRODUCTION

According to the U.S. Federal Highway Administration (FHA), fog is a significant contributor to fatal road accidents as it creates the most dangerous type of adverse weather conditions for motorists. In fact, fog can take drivers by surprise, impair their driving behavior and distort their perception of depth, distance and speed (Hamilton et al, 2014). Earlier studies (see for example (Abdel-Aty et al, 2011)) revealed that although the numbers of reported car incidents due to fog are not substantial, the resulting vehicle crashes are often associated with large-scale chain accidents and higher fatality rates. For instance, in the US, the American Automobile Association (AAA) Foundation for Traffic Safety identified fog as the top causal factor of fatal multi-vehicle crashes involving 10 or more vehicles (Hamilton et al, 2014).

Fog abatement technologies for highway usage have not reached yet the desired level of efficiency and cost effectiveness. As a result, several advanced roadside and driver assistance systems have been proposed for safer driving in the presence of fog. Among these we can cite beaded lane delineators, lane departure warning systems, forward collision warning systems, adaptive light control, adaptive cruise control, reflectorized paints on pavement edge striping, electronic message signs, and highway advisory radio messages, among many others (Chaabani et al, 2017).

Among the driveway assistance systems that received peculiar attention during the past decade were programmable speed limit signs and variable message signs that can automatically adapt to degraded visibility conditions and warn drivers accordingly (Hautière et al, 2009). There has been a growing number of research initiatives towards connected vehicular systems based on V2V (Vehicle-to-Vehicle), V2I (Vehicle to Infrastructure) and I2I (Infrastructure to Infrastructure) technologies that would allow intelligent road-side units (RSUs) and vehicles to cooperate for enhanced awareness of driving conditions and for a more proactive approach to counter low visibility conditions that can take motorists by surprise. However, as highlighted by Hautière et al (2009), in order to react to their surrounding environment, these assistance systems depend on efficient mechanisms to detect the presence of fog and estimate the visibility range. This information can for instance be fed as input to (1) electronic traffic warning signs, (2) speed-limit recommender systems or (3) adaptive cruise control and emergency braking systems. In addition, autonomous vehicles are equipped with navigation systems that rely on some sort of image processing to analyze images from vehicle's on-

26 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/a-survey-of-approaches-for-estimating-meteorological-visibility-distance-under-foggy-weather-conditions/232024

Related Content

Semantically Linking Information Resources for Web-Based Sharing

Junsheng Zhang, Yingfan Gao, Yanqing He, Hongjiao Xu, Chongde Shi and Peng Qu (2013). *International Journal of Cognitive Informatics and Natural Intelligence* (pp. 65-79).

www.irma-international.org/article/semantically-linking-information-resources-for-web-based-sharing/101818

Digitally Mediated Art Inspired by Scientific Research: A Personal Journey

John Antoine Labadie (2015). *Handbook of Research on Maximizing Cognitive Learning through Knowledge Visualization* (pp. 436-471).

www.irma-international.org/chapter/digitally-mediated-art-inspired-by-scientific-research/127491

The Cognitive Informatics Theory and Mathematical Models of Visual Information Processing in the Brain

Yingxu Wang (2011). *Transdisciplinary Advancements in Cognitive Mechanisms and Human Information Processing* (pp. 215-224).

www.irma-international.org/chapter/cognitive-informatics-theory-mathematical-models/54222

Learning Hierarchical Lexical Hyponymy

Jiayu Zhou, Shi Wang and Cungen Cao (2012). *Developments in Natural Intelligence Research and Knowledge Engineering: Advancing Applications* (pp. 205-219).

www.irma-international.org/chapter/learning-hierarchical-lexical-hyponymy/66449

Improved Teaching-Learning-Based Optimization Algorithm and its Application in PID Parameter Optimization

Fahui Gu, Wenxiang Wang and Luyan Lai (2019). *International Journal of Cognitive Informatics and Natural Intelligence* (pp. 1-17).

www.irma-international.org/article/improved-teaching-learning-based-optimization-algorithm-and-its-application-in-pid-parameter-optimization/226936