

Combating Bad Weather Part II: Fog Removal from Image and Video

Synthesis Lectures on Image, Video, and Multimedia Processing

Editor

Alan C. Bovik, *University of Texas, Austin*

The Lectures on Image, Video and Multimedia Processing are intended to provide a unique and groundbreaking forum for the world's experts in the field to express their knowledge in unique and effective ways. It is our intention that the Series will contain Lectures of basic, intermediate, and advanced material depending on the topical matter and the authors' level of discourse. It is also intended that these Lectures depart from the usual dry textbook format and instead give the author the opportunity to speak more directly to the reader, and to unfold the subject matter from a more personal point of view. The success of this candid approach to technical writing will rest on our selection of exceptionally distinguished authors, who have been chosen for their noteworthy leadership in developing new ideas in image, video, and multimedia processing research, development, and education.

In terms of the subject matter for the series, there are few limitations that we will impose other than the Lectures be related to aspects of the imaging sciences that are relevant to furthering our understanding of the processes by which images, videos, and multimedia signals are formed, processed for various tasks, and perceived by human viewers. These categories are naturally quite broad, for two reasons: First, measuring, processing, and understanding perceptual signals involves broad categories of scientific inquiry, including optics, surface physics, visual psychophysics and neurophysiology, information theory, computer graphics, display and printing technology, artificial intelligence, neural networks, harmonic analysis, and so on. Secondly, the domain of application of these methods is limited only by the number of branches of science, engineering, and industry that utilize audio, visual, and other perceptual signals to convey information. We anticipate that the Lectures in this series will dramatically influence future thought on these subjects as the Twenty-First Century unfolds.

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Combating Bad Weather Part II: Fog Removal from Image and Video

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*SYNTHESIS LECTURES ON IMAGE, VIDEO, AND MULTIMEDIA
PROCESSING #17*

ABSTRACT

Every year lives and properties are lost in road accidents. About one-fourth of these accidents are due to low vision in foggy weather. At present, there is no algorithm that is specifically designed for the removal of fog from videos. Application of a single-image fog removal algorithm over each video frame is a time-consuming and costly affair. It is demonstrated that with the intelligent use of temporal redundancy, fog removal algorithms designed for a single image can be extended to the real-time video application. Results confirm that the presented framework used for the extension of the fog removal algorithms for images to videos can reduce the complexity to a great extent with no loss of perceptual quality. This paves the way for the real-life application of the video fog removal algorithm.

In order to remove fog, an efficient fog removal algorithm using anisotropic diffusion is developed. The presented fog removal algorithm uses new dark channel assumption and anisotropic diffusion for the initialization and refinement of the airlight map, respectively. Use of anisotropic diffusion helps to estimate the better airlight map estimation. The said fog removal algorithm requires a single image captured by uncalibrated camera system. The anisotropic diffusion-based fog removal algorithm can be applied in both RGB and HSI color space. This book shows that the use of HSI color space reduces the complexity further. The said fog removal algorithm requires pre- and post-processing steps for the better restoration of the foggy image. These pre- and post-processing steps have either data-driven or constant parameters that avoid the user intervention. Presented fog removal algorithm is independent of the intensity of the fog, thus even in the case of the heavy fog presented algorithm performs well. Qualitative and quantitative results confirm that the presented fog removal algorithm outperformed previous algorithms in terms of perceptual quality, color fidelity and execution time.

The work presented in this book can find wide application in entertainment industries, transportation, tracking and consumer electronics.

KEYWORDS

bad weather, image enhancement, fog, attenuation, airlight, atmospheric visibility, anisotropic diffusion, image contrast, temporal redundancy, video enhancement, outdoor vision and weather

*Dedicated to
our parents*

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