Automatic Fog Detection and Visibility Estimation From Camera Images Using Deep Learning Features

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Abstract:

Fog has a considerable impact on road traffic, marine transport and aviation operations. Therefore, accurately forecasting of reduced visibility conditions is crucial to decrease fog events' impacts. Obtaining forecast initialization and validation data is difficult due to the small scale of many events. Additionally, remote sensing observations are difficult due to the low altitude of fog. Traditional visibility measurement techniques, such as from visibility sensors and meteorological observers using landmarks, are insufficient to provide the required fog information over a large area since observations are limited due sensor cost, instrument issues, required maintenance, and availability of the meteorological observers.

In this study, we evaluate cameras as potential sensors to automatically derive visibility and identify areas with low visibility conditions. The approach that we follow is to use a data-driven model, in particular a deep neural network to determine the presence of fog and make real-time estimation of the visibility. For visibility determination, we started by creating a labeled data set from camera images captured under various weather conditions, especially a fog event. A set of features are extracted from the camera images, such as the number of edges, brightness, the transmission of the image dark channel, to develop a fog detection algorithm and a regression model to estimate the visibility. The regression model, in addition to the image features, are utilized to train the deep neural network. The evaluation data set is used to test the network and evaluate its performance.