How to Remove Haze from a Single Image

Related Research and Summary on image dehazing algorithms

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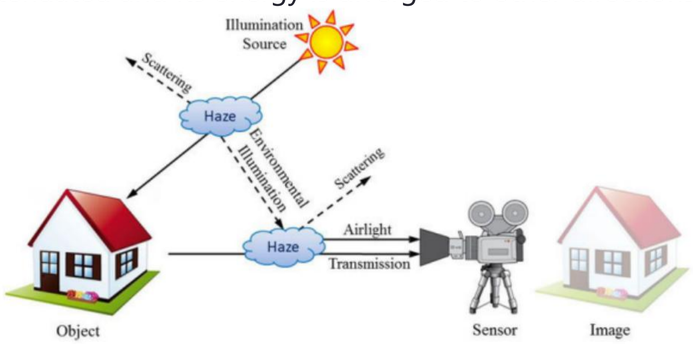
ABSTRACT

I realize some new and famous methods on single image haze removal algorithms. The priority that I want to mention is He Kaiming's paper Single image haze removal using dark channel prior, which is the only best paper in CVPR 2009. In that, they propose a simple but effective image prior - dark channel prior to remove haze from a single input image. And I would like to develop this method to an improved version using Guided Image Filtering. Besides, I successfully realize the Deep neural network method called Dehazenet.

BACKGROUND

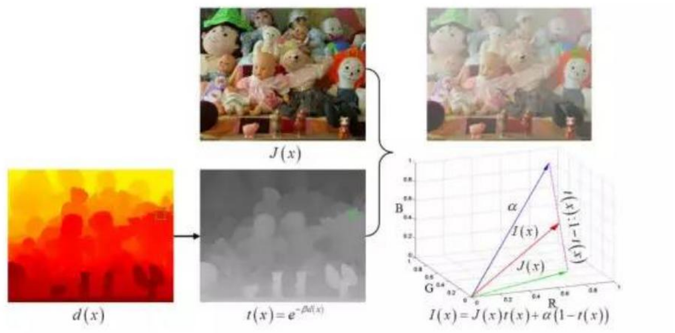
Atmospheric Scattering Model

-The atmospheric scattering model is first based on the phenomenon that after the light passes through a scattering medium, the intensity of the light in its original direction is attenuated and its energy is diverged to other directions.



the atmospheric scattering model: I(x)=J(x)t(x)+A(1−t(x))

- When the atmosphere is homogenous, the transmission expressed as t(x)=e^(βd(x))



ALGORITHMS

A. Estimating the Transmission

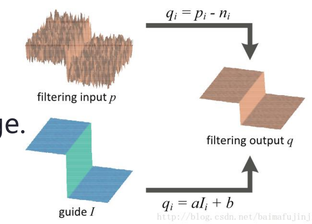
$$J^{dark}(x) = \min_{c\in\{r,g,b\}} \left(\min_{y\in\Omega(x)} (J^c(y)) \right)$$

In the image without fog, the RGB channel of the image always has a low value.The minimum value for this region is a very small value.Both the bright colors and the shadows show the minimum value of the dark channel.

B. Guided Filter

Guided Filter is a novel explicit image filter. The filtering output is locally a linear transform of the guidance image.

$$q_i = \sum_{j\in w_i} W_{ij}(I) \cdot p_j$$

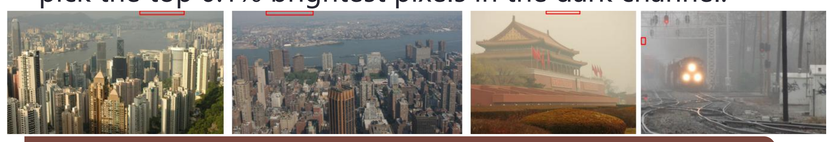


C. Recovering the Scene Radiance

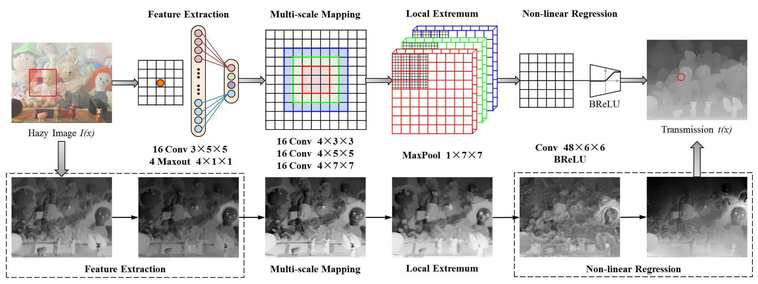
$$J(x) = \frac{I(x) - A}{max(t(x), t_0)} + A$$

D. Estimating the Atmospheric Light

pick the top 0.1% brightest pixels in the dark channel.

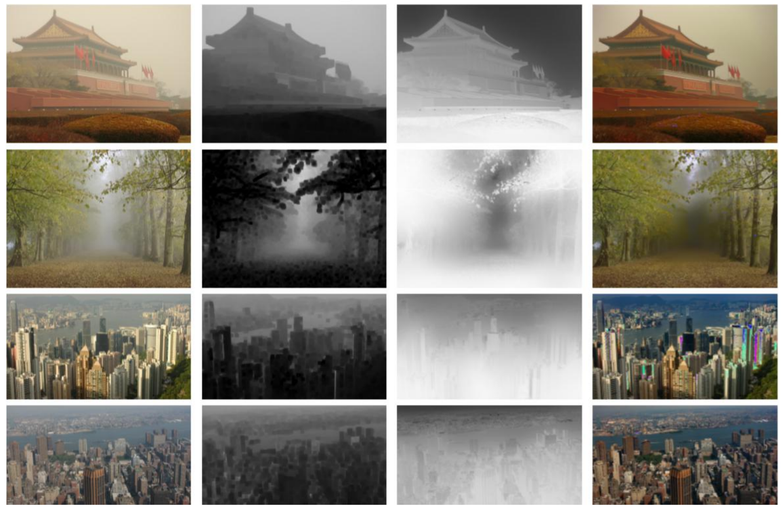


DEHAZENET: END-TO-END SYSTEM



RESULT

The Ruselt using dark channel proior



The result using Histogram Equalization and Dehazent

SHORTCOMING

Failure of blue sky region