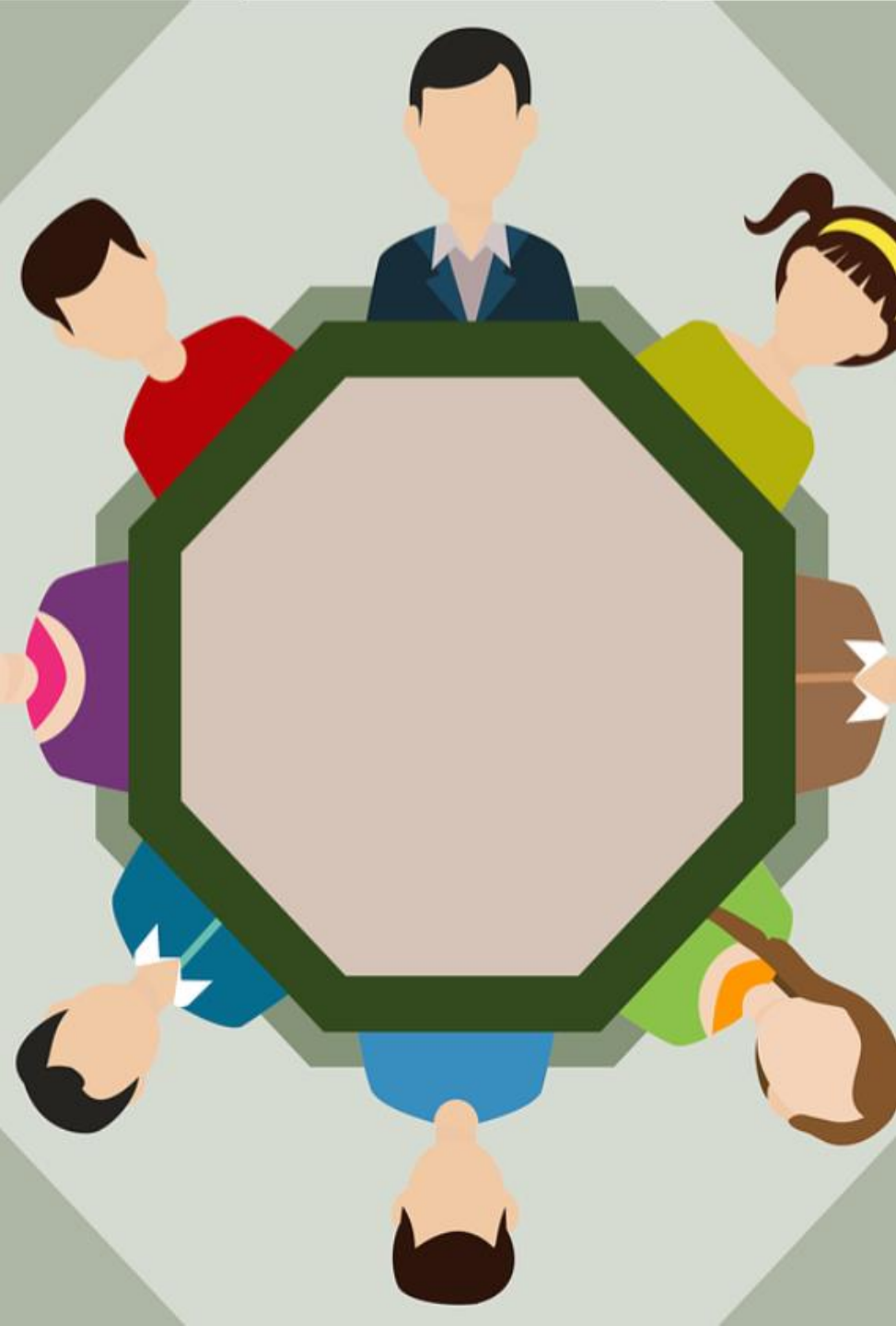




IMAGE DEHAZING

GROUP - 6



GROUP MEMBERS

- ABHIJITH A THAMPI - AM.EN.U4AIE20102
- ADITHYAN M NAIR - AM.EN.U4AIE20105
- AJAY G NAIR - AM.EN.U4AIE20108
- DEVAKRISHNA SANIL KUMAR - AM.EN.U4AIE20119
- GOVIND NANDAKUMAR - AM.EN.U4AIE20129

INTRODUCTION

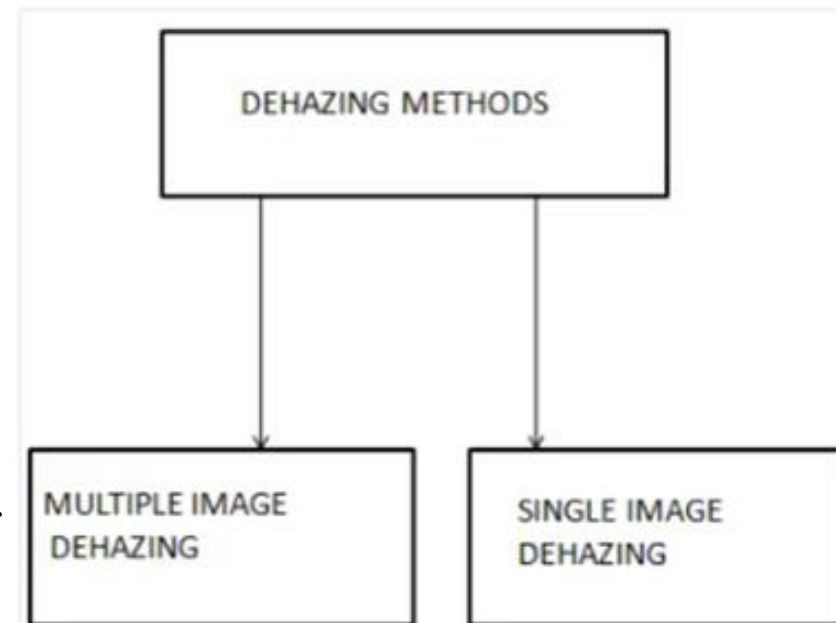
- Defogging is a common de-weathering issue that involves removing the weather effect generated by suspended aerosol and water drops.
- The goal of defogging is to increase the contrast of hazy photos and restore visibility to the scene.
- Physical degradation process of a foggy image is a linear combination of two components: attenuated scene reflectance and intensified atmospheric luminance.
- The transmission medium magnifies the atmospheric luminance, which is dispersed by suspended particles and perceived as ambient air light by the spectator.
- Due to the linear nature of light propagation, the two components are additive. Both visibilities and contrast are degraded as a result of this physical process.



DEHAZING

→Image dehazing is a well-known ill-posed problem, which usually requires some image priors to make the problem well-posed. Single image dehazing aims to estimate a haze-free image from a hazy image. It is a classical image processing problem, which has been an active research topic in the vision and graphics communities within the last decade.

→As numerous real-world tasks (e.g., traffic detection and environmental monitoring) require high-quality images, and the hazy environment usually leads to deprecated images, it is of great interest to develop an effective algorithm to recover haze-free images.



METHODOLOGY

- Atmospheric light estimation
- Imaging model and problem constraints

$$I(x) = t(x)J(x) + (1 - t(x))A$$

- Transmission Map Estimation
- Scene Radiance Recovery

$$J(x) = \frac{I(x) - A}{[\max(t(x), \epsilon)]\delta} + A$$

An abstract background on the left side of the slide. It features a dark, almost black, central area from which several bright, overlapping light rays or beams emanate. These rays are colored in shades of orange, red, yellow, green, and blue, creating a prismatic or rainbow-like effect. In the center of this light pattern, there is a small, semi-transparent square with a dark border, possibly representing a camera lens or a focal point.

Atmospheric Light Estimation

- We take the top 0.1% brightest pixels in the dark channel, and then select the one with the highest intensity as the estimate of A .
- The following method produces a similar result but performs more efficiently.
- The method begins with filtering each color channel of an input image by a minimum filter with a moving window. Then the maximum value of each color channel is taken as the estimate of the component of A .

Patch-wise Scene Transmission

- A hazy pixel $I(x)$ will be geometrically closer to the global atmospheric light, A . As a result, using a linear extrapolation from A to I , we may reverse this procedure and obtain the clean pixel $J(x)$ (x).

$$t_b(x) = \min \left\{ \max_{c \in \{r,g,b\}} \left(\frac{A^c - I^c(x)}{A^c - C_0^c}, \frac{A^c - I^c(x)}{A^c - C_1^c} \right), 1 \right\}$$

- C_0 and C_1 are two relevant constant vectors for the given picture.
- I^c, A^c, C_0^c and C_1^c are the color channels of I, A, C_0 and C_1 , respectively.

$$\hat{t}(x) = \min_{y \in \omega_x} \max_{z \in \omega_y} t_b(z).$$



Weighted L1-norm based Contextual Regularization

- To address the problem of having abrupt depth jumps in adjacent pixels in a local patch, we apply a weighting function.

$$W(x, y) (t(y) - t(x)) \approx 0$$

$$W_j(i) = e^{-\sum_{c \in \{r, g, b\}} |(D_j \otimes I^c)_i|^2 / 2\sigma^2}$$

Estimation of Scene Transmission

- Dehazing an image requires to estimate an appropriate transmission function $t(x)$ and the global atmospheric light A .

$$t^* = \mathcal{F}^{-1} \left(\frac{\frac{\lambda}{\beta} \mathcal{F}(i) + \sum_{j \in \omega} \overline{\mathcal{F}(D_j)} \circ \mathcal{F}(u_j)}{\frac{\lambda}{\beta} + \sum_{j \in \omega} \overline{\mathcal{F}(D_j)} \circ \mathcal{F}(D_j)} \right),$$

- where $\mathcal{F}(\cdot)$ is the Fourier transform and $\mathcal{F}^{-1}(\cdot)$ is its inverse transform, (\cdot) represents the complex conjugate, and \circ denotes the element-wise multiplication. The division is also performed in an element-wise manner. λ is the regularization parameter, β is the medium extinction coefficient, u_j is the auxiliary variable, D_j is a first-order differential operator

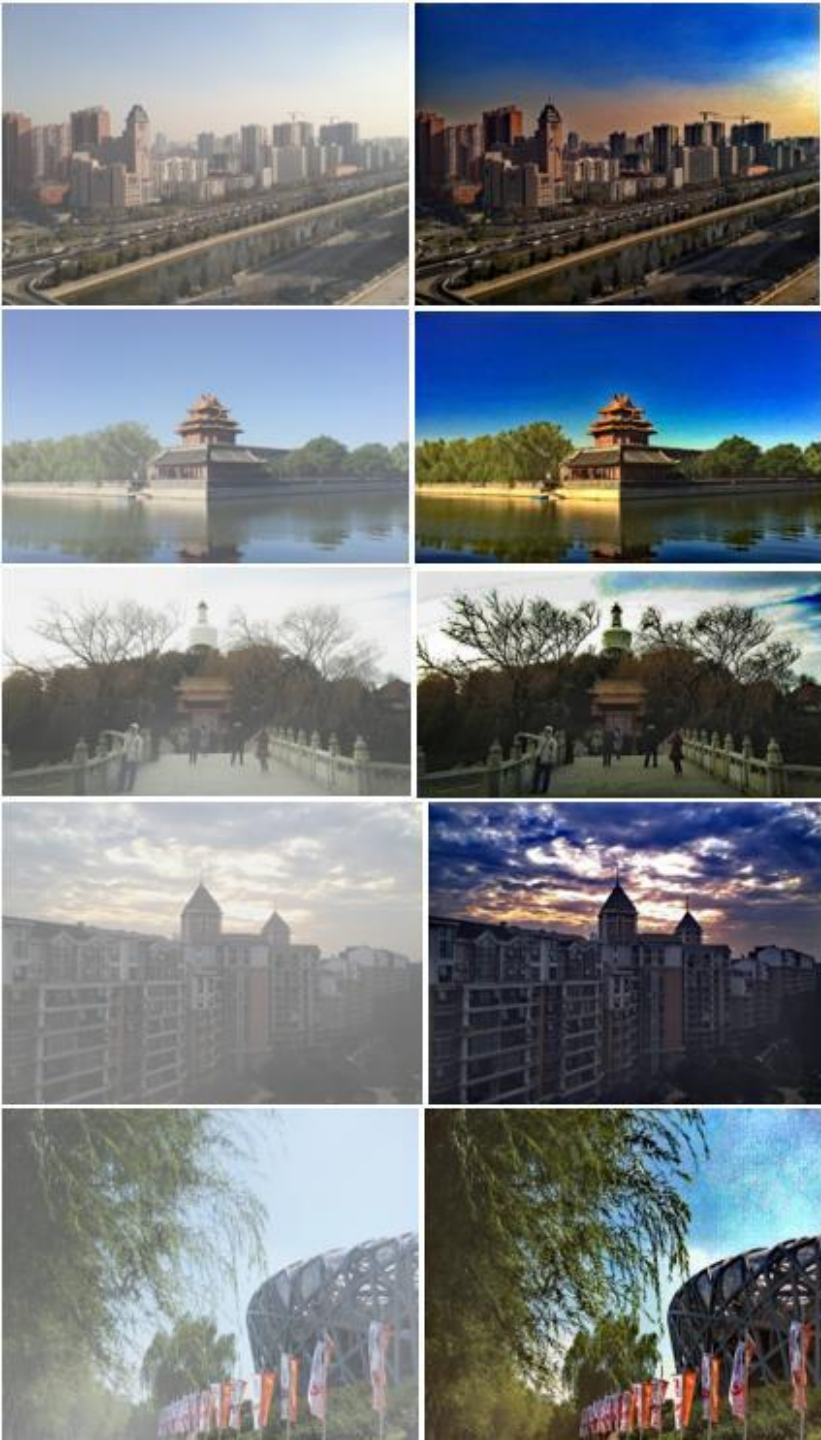
Evaluation Metrics: PSNR & SSIM

PSNR:

- Peak Signal to Noise Ratio is the proportion of highest signal power to noise power.
- It helps in comparing the quality of original and dehazed image.
- The higher the value of PSNR, the greater the quality of the image.

SSIM:

- Structural Similarity index analyses picture deterioration as a change in structural information.
- This reference metric requires two images – a reference image and processed image.
- Once images are taken, It calculates the perception difference between them.



Dataset

- The Dataset used for this project consist of images of both jpg and png formats. The link below contains all the dataset image we use for dehazing.
- [Dataset](#)

Base Papers / Code



- Paper 1 :

[Base paper 1](#)

- Paper 2 :

[Base paper 2](#)

- **Github :**

[GitHubLink](#)

- **Results Obtained :**

[ResultsLink](#)



References

- Dana Berman, Tali Treibitz, and Shai Avidan. Non-local Image Dehazing. In CVPR, pages 1628–1636, 2016.
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