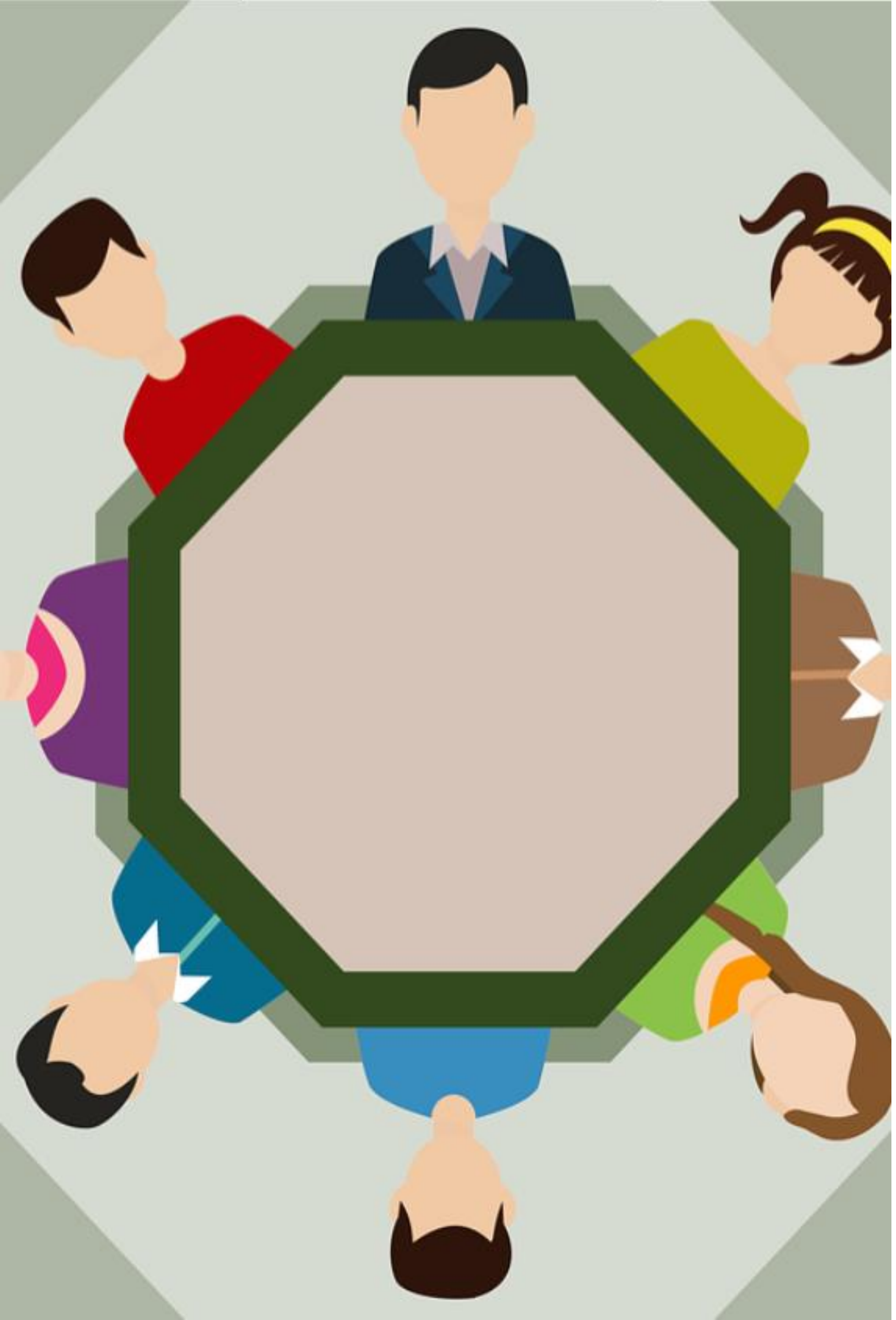
IMAGE DEHAZING

GROUP - 3



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

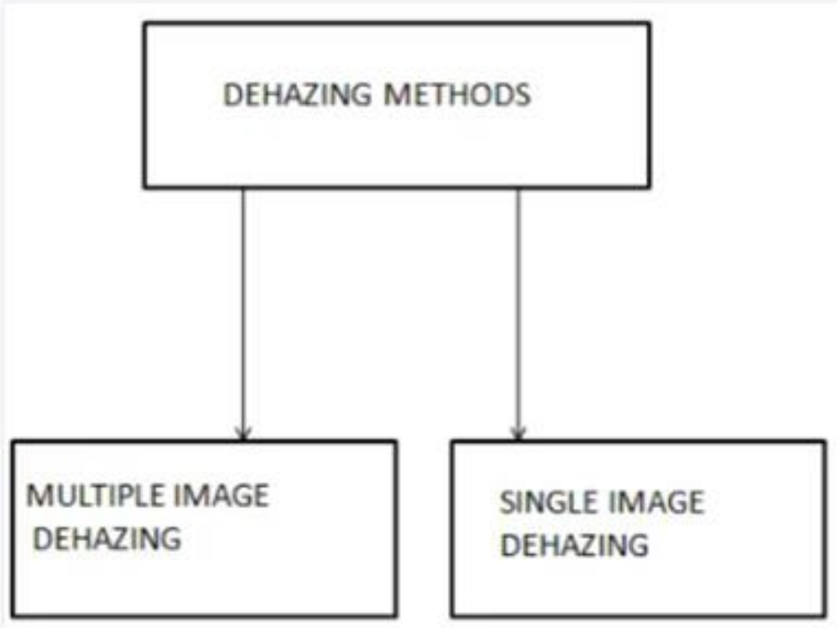
INTRODUCTION

- 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.



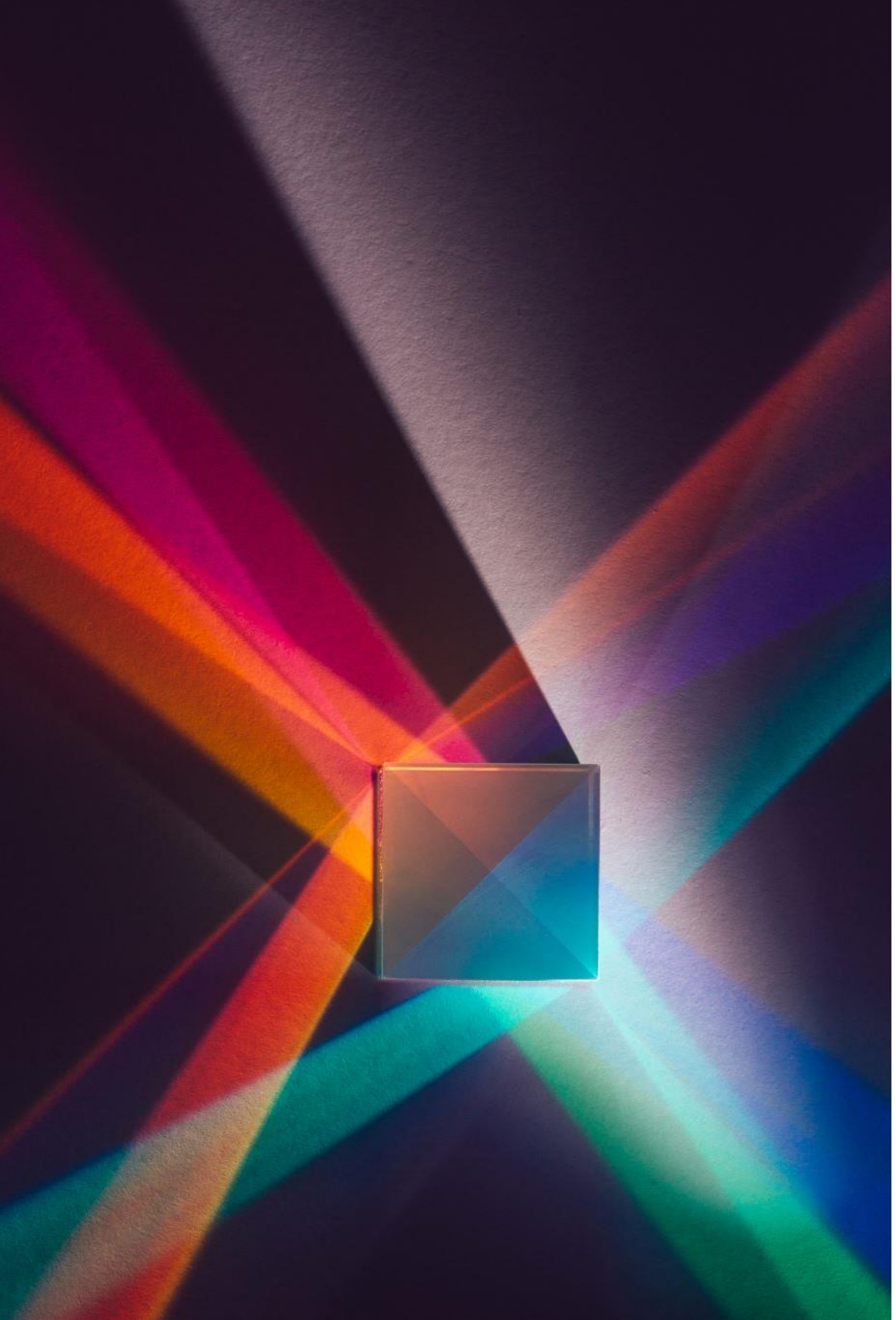
METHODOLOGY

- Atmospheric light estimation
- Imaging model and problem constraints

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

- Transmission Map Estimation
- Scene Radiance Recovery

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



Atmospheric Light Estimation

- One method is to 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).

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

- C0 and C1 are two relevant constant vectors for the given picture.
- I^c, A^c, C^c 0 and C^c , 1 are the color channels of I, A, C0 and C1, 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.

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

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

where ⊗ stands for the convolution operator, Dj is a first-order differential operator, Wj (j ∈ ω) is a weighting matrix

Estimation of Scene Transmission

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

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

- where F(·) is the Fourier transform and F−1(·) is its inverse transform, (·) represents the complex conjugate, and ◦ 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, uj is the auxiliary variable, Dj is a first-order differential operator

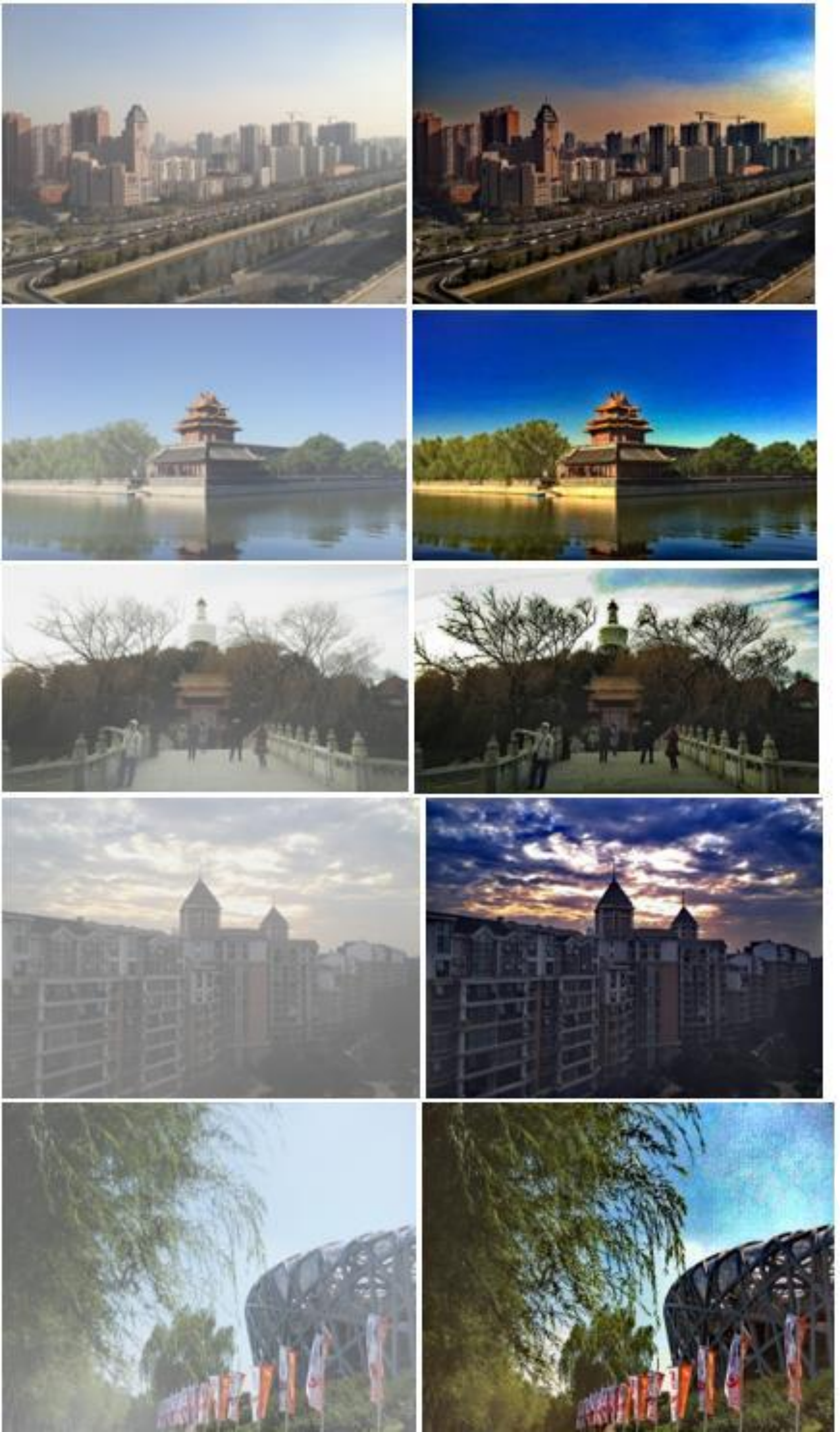
Evaluation Metrices: PSNR & SSIM

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

RESULTS

Image	PSNR (in dB)	SSIM
i	28.1209	0.7954
ii	27.9783	0.8017
iii	28.2006	0.7159
iv	28.1641	0.7936
v	28.0472	0.7712

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.
- Kaiming He, Jian Sun, and Xiaoou Tang. Single image haze removal using dark channel prior. In CVPR, pages 1956– 1963, 2009.
- P. Carr and R. Hartley. Improved single image dehazing using geometry. In Digital Image Computing: Techniques and Applications, pages 103–110, Dec. 2009.
- L. Kratz and K. Nishino. Factorizing scene albedo and depth from a single foggy image. In ICCV'09, pages 1701–1708, Oct. 2009
- Huiyan Liu, Wenzhang He&Rui Liu, "An improved fog degrading image enhancement algorithm based on Fuzzy contrast" on 2010 International conference on computational intelligence & security.


Thank you