

Enhancement Techniques for Low-light and Hazy Images

Parth Shah, Suyash Bagad, Saurabh Kolambe

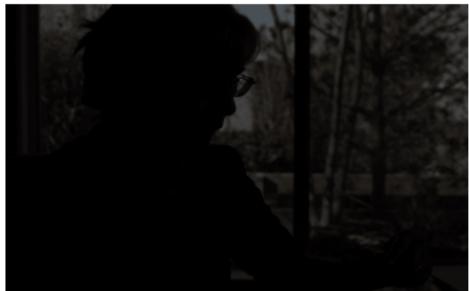
15D070004, 15D070007, 15D070011

Indian Institute of Technology, Bombay

25th November, 2018

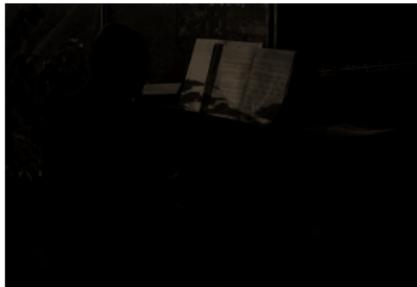
Low-light and Hazy Images

- ▶ Low visibility
- ▶ Faint colours



Goal of Enhancing Hazy and Low-light Images

- ▶ Scene restoration
- ▶ Depth estimation

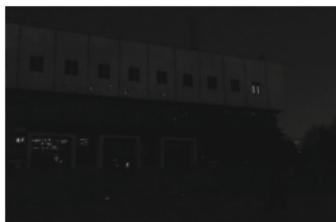


Haze Imaging model

$$I(m, n) = J(m, n).t(m, n) + A[1 - t(m, n)]$$

- ▶ I is the hazy image
- ▶ J is the underlying scene radiance
- ▶ t is the transmittance
- ▶ A is the global atmospheric light
- ▶ What about Low-light imaging model?
 - ▶ The inverted low-light images have high similarity with the hazy ones!

$$I_{inv}(m, n) = J_{inv}(m, n).t(m, n) + A[1 - t(m, n)]$$

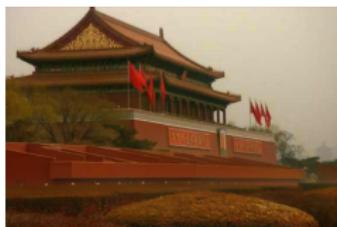


Example of Haze Imaging Model

$$I(m, n) = J(m, n).t(m, n) + A[1 - t(m, n)]$$



Hazy image



Scene radiance



Transmission

Priors in Computer Vision

- ▶ Statistical priors help in solving ill-posed problems by converting them to well-posed ones.
- ▶ Some examples are Smoothness prior, Sparseness prior, Exemplar-based prior, Dark channel prior, Luminance

Dark Channel Prior

$$D^{dark}(x) = \min_{c \in R, G, B} (\min_{y \in \Omega(x)} (I^c(y)))$$

Luminance Map

$$L(x) = 0.299 \times I^R(x) + 0.587 \times I^G(x) + 0.114 \times I^B(x)$$

Example of DCP and Luminance for a low-light image



Low-light image



DCP of inverted image



Luminance map of original image



Luminance map of inverted image

An important observation



Haze-free image



DCP of Haze-free image



Slightly hazy image



DCP of slightly hazy image

Estimating Transmittance and Atmospheric light

- ▶ In real hazy images the transmittance (t) is attenuated exponentially with the scene depth.

$$\hat{t}(x) = 1 - \omega \times D^{dark}(x)$$

- ▶ The pixel with the highest intensity in the degraded image is selected as the global atmospheric light (A) from the f fraction of pixels with the highest intensity in the prior.

Transmittance Optimization



Raw transmittance



Refined transmittance

Results



Results



Results



Results



Results



Results



Results



Results



Results



Results



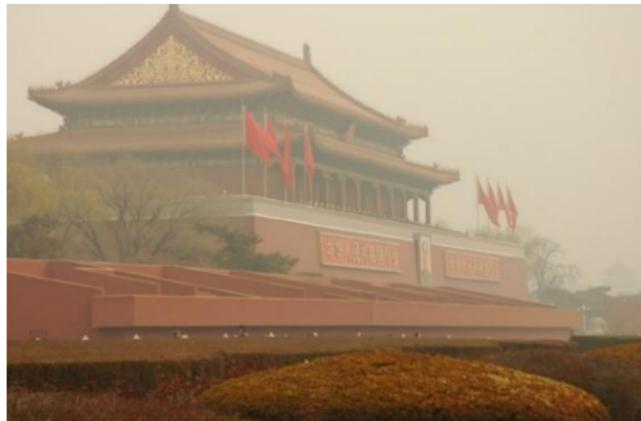
Results



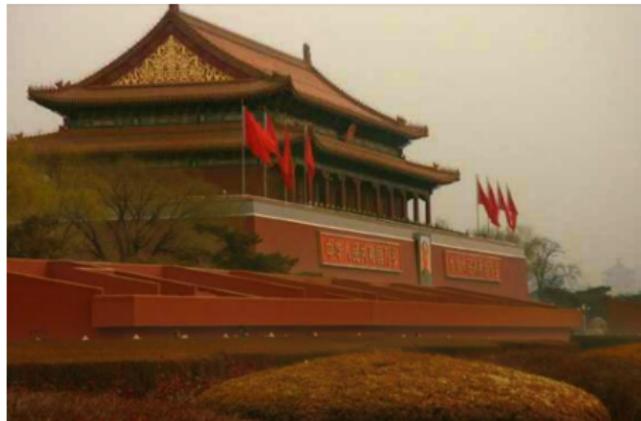
Results



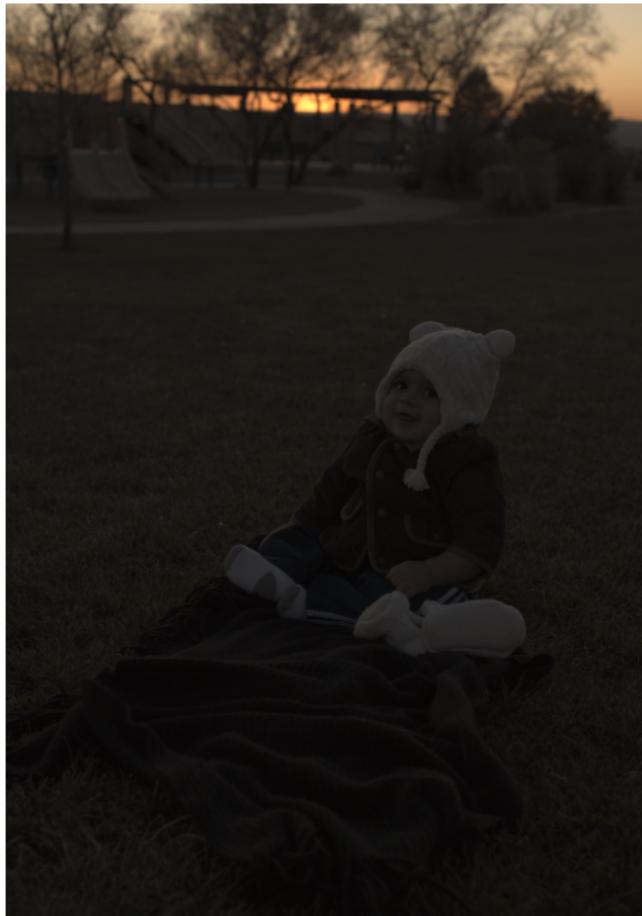
Results



Results



Results



Results

