

Visibility Restoration in Infra-Red Images

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Fog Visual Effect

- ⦿ Bad weather reduces visibility



Visibility Restoration

- ◉ Fog visual effect = Koschmieder law :



In Infra-Red ?

- Visual Effect in RGB, NIR, SWIR, LWIR :



In Infra-Red ?

◉ Visibility restoration results :



Visual effect in LWIR

- ◉ Contrary to NIR and SWIR, fog visual effect in thermal Infra-Red (LWIR) is reduced to the attenuation's law :

$$I = I_0 e^{-k' d}$$

- ◉ Due to warm air, a thermal veil may appear
 - ◉ The scene geometry is mainly a flat world
- ➔ LWIR dedicated visibility restoration method can be based on an image row processing

LWIR Restoration Method

- ⊙ Let $I(i, j)$ be the input image where (i, j) are a pixel coordinates
- ⊙ Let $R(i, j)$ be the restored image to be built
- ⊙ $R(1, \dots) = I(1, \dots)$ i.e the first row is not modified
- ⊙ For each row i from 2 to the last one, $R(i, \dots) = f_i I(i, \dots)$ with f_i the factor which minimizes the quadratic error between vectors $f_i I(i, \dots)$ and $R(i-1, \dots)$

Experiments

- ⊙ Tested on 4 vidéo datasets :
 - > Col de La Fageole, France (fog, rain, snow, clear sky...)
 - > CEREMA's Fog chamber, Clermont-Ferrand, France (fog, rain)
 - > Simulated by the company OKTAL SE (day and night, clear sky, cloud and fog)
 - > Aboard a VALEO vehicle in both urban and countryside environment (rain and night)
- ⊙ Comparison with CLAHE and Multiscale Retinex

Results

- ⦿ Planar assumption is rather robust but a dedicated denoising is necessary
- ⦿ Improved visibility in different bad weather conditions during day and night

