Image With Fog

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1. Formation of fog

As we all know, fog is a natural weather phenomenon. Especially recent yeays, due to the distruction of the environment, this phenomenon is more and more serious. The buildings is higher and the air isn't free, all this reasons lead to the formation of the fog. And our common life has been effected seriously.

Fog consists of visible cloud water droplets or ice crystals suspended in the air at or near the Earth's surface[1]. So fog can be considered a type of low-lying cloud and is heavily influenced by nearby bodies of water, topography, and wind conditions.

we can learn Concentration level of fog explicitly at the table 1.

Table 1. Concentration level of fog

Level	Horizontal Visibility Distence
mist	1000-10000
fog	500-1000
heavy fog	200-500
smoke fog	50-200
strong fog	<50

2. Smog

Given that the air pollution has been unprecedentedly severe in recent years, "smog" is more and more widly mentioned by everyone. This word is consist of two words, smoke and fog. We can learn it clearly from these words. Smog is different from fog, we can seen it at Fig. 1, and it's a type of air pollution derived from vehicular emission from internal combustion engines and industrial fumes that react inthe atmosphere with sunlight to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

3. Atmospheric light scattering model

The atmosphric light and the light reflected by the object itself combine with each other.And then, they

Figure 1. The difference of the fog and smog

enter the image acquisition device to form image.As is shown at Fig. 2 So the suspended particles in the air and the incident light all effect the scattering effect of the atmosphere. When fog weather occurs, the amount of suspended particles increases. Therefore, in the process of image collection, the scattering and absorption of the radiated light is strengthened, and this resulted the color degradation and blurred details in the image.

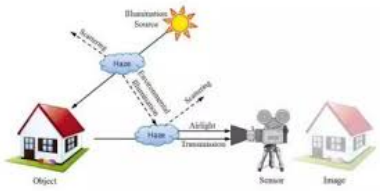

Figure 2. Atmospheric optical imaging model

4. Image degradation model

The degradation model is derived from the "Atmospheric light scattering model", proposed by McCartney et al. [2]. A haze image formed as show in Fig. 3 can be mathematically modeled as follows

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

This degradation model is consist of two parts, the first term of Eq. 1, $J(x)t(x)$is the direct attenuation, and the second term of Eq. 1, $A(1-t(x))$is the airlight.

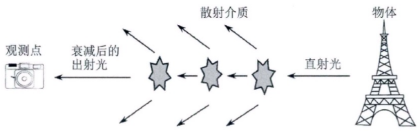

Figure 3. Formation of a hazy removal

References

[1] Ismail Gultepe. Fog and boundary layer clouds: fog visibility and forecasting. Springer Science & Business Media, 2008.

[2] E. J. Mccartney and Freeman F. Hall Jr. Optics of the Atmosphere: Scattering by Molecules and Particles. WILEY, 1976.