Defog Image Processing

Introduction

Expectations for a camera’s performance, no matter the application, are that it must work and provide clear usable images, regardless of any environmental or mechanical challenges the camera is exposed to.

These performance expectations have, and always will, drive technology solutions to compensate for difficult conditions and external challenges. Some of the more notable performance challenges where technology has made significant improvements are:

- **Poor lighting** - Day/Night Filtering, Increased Sensor Sensitivity, Supplemental Illumination
- **Difficult lighting scenarios** – Wide Dynamic Range, Back-Light Compensation
- **No light** - LWIR, MWIR, SWIR Imaging Technology
- **Vibration effects** – Electronic Image Stabilization, Gyro Stabilizers
- **Atmosphere effects** – Fog/Haze/Dust/Smoke

As you can see, many challenges have been addressed and further improvements will be offered as video technology evolves. Until recently, the ability of visible wavelength cameras to see through moderate to heavy fog/haze/dust/smoke conditions has been either unavailable or far outside the price range of most customers.

That is, until now... CohuHD™ has once again risen to the occasion by leveraging increased computation power and image processing algorithms to improve video performance. CohuHD has introduced within its Helios product family a high definition 720p 30x optical zoom video camera that offers the first defog image processing feature available.

Defog Image Processing Benefits

- Extends visibility
- Improves video quality (contrast, sharpness, color)
- Effectively removes fog
- Enhances real-time video
- Provides better situational awareness in poor visibility, including incident detection

Applications

- Traffic monitoring
- Video surveillance
- Video security
- Marine surveillance

Read this paper to discover:

- How CohuHD provides better video quality in bad weather and in the presence of atmospheric obscurants
- How using CohuHD’s defog feature improves video image quality in poor visibility conditions, and helps to increase awareness in critical situations such as car accidents, traffic monitoring and outdoor security surveillance
Defog Video Enhancement for Better Video Quality

Video quality is a critical factor in video applications, especially in security surveillance and traffic monitoring. The cameras must be able to see clearly and to produce clear video. Manufacturers have introduced megapixel and high definition cameras with high quality lenses. However, image quality depends not only on the number of pixels on the object, but also on color, contrast, gamma adjustment, etc.

Weather greatly affects video image quality captured by outdoor camera systems. Depending on weather conditions, the color and contrast of video can be degraded dramatically. “Bad weather” factors such as rain, haze, vapor, dust, and fog affect the quality of captured video. Traffic monitoring and border control must be done under all weather conditions. It’s a major limitation to not be able to recognize if a moving object is a person or an animal, or to not be able to see a license plate number. Outdoor camera systems, especially for surveillance, need to have functionality that can remove unwanted bad weather effects - “fog” - from the video, to improve video quality.

CohuHD Video Defog Solution

CohuHD’s Helios™ family of HD products is now available with the latest in HD (High Definition) 720p camera imaging and optical technology, providing defog video enhancement processing capability. CohuHD’s real-time defogging feature produces improved images in obscuring haze and foggy conditions commonly encountered during surveillance and traffic monitoring.

How does the defog function remove the obscuring effect (fog, mist, dust, smoke, etc.)? A contrast enhancement algorithm is applied to the video signal before it leaves the camera. This is done in order to use all video data without any loss during compression. The algorithm analyzes the density of obscurants, pixel by pixel, and applies contrast and sharpness adjustments to the video using histogram analysis and other forms of image enhancement. Since the algorithm executes within the camera, no additional latency occurs and the analysis is done in real-time. The amount of image enhancement is dynamically modified based on fog density.

The algorithm works in two steps: first, fog density of the scene in the frame is determined. Then, restoration of the frame (signal correction) is done. The algorithm is fast enough to be applied in real-time on a frame-by-frame basis.
Ensuring Security with CohuHD’s Defog Functionality

**Figure 1**

- **Defog Function Off**
  - Step 1: Fog density is measured
  - Signal level

- **Defog Function On**
  - Step 2: Video correction (contrast modification) is made
  - Signal level
Figure 2 demonstrates fog removal using the defog function. The picture on the left is taken on a foggy day with the defog function off. The picture on the right is the same scene taken with the defog function on. Both pictures were captured with a CohuHD 3960 HD camera.

For another example that demonstrates the effectiveness of the CohuHD defog function on a rainy, foggy day, please click here to see it.

The defog feature adjusts contrast, color, and sharpness. Figure 3 shows CohuHD’s current Defog Control, which operates in manual mode. In this mode, the user selects one of three levels of enhancement, depending on fog thickness – level 1 for light fog density, level 2 for medium, and level 3 for heavy. In the automatic mode, available soon, the camera will automatically recognize the fog density and apply the necessary correction level. The Auto-Defog mode will allow the defog function to be enabled full time. When no fog is detected there is no compensation. Still, the user will be able to select to turn the Auto-Defog mode on or off.
Conclusion

CohuHD’s video enhancement functionality responds to the growing demand for outdoor camera systems that provide increased visibility under bad weather and atmospheric conditions. CohuHD’s real-time defogging feature produces enhanced video in haze and fog environments commonly encountered in surveillance and traffic monitoring. Many of the factors that influence video quality can be controlled, but weather and atmospherics cannot. Using CohuHD’s latest 720p camera imaging technology - defog as discussed here, as well as electronic image stabilization, improvement of low light sensitivity, and increased zoom magnification - ensures high quality video under varied and changeable outdoor conditions.

About CohuHD

CohuHD is a leading manufacturer of high-definition video systems designed to satisfy the demanding performance requirements for critical infrastructure applications. CohuHD solutions integrate the latest high-definition video imaging and compression technologies into our ruggedized camera products. CohuHD is a high-value provider for monitoring in critical, sensitive environments. For more than 50 years, we have been manufacturing the most reliable, rugged video cameras available on the market. For more information on CohuHD’s products, please visit www.cohuHD.com. Follow us on youtube.com/cohuhd, twitter.com/cohuhd, linkedin/company/cohuhd, and facebook.com/cohuhd.