HIKVISION

Hikvision Advanced Image Processing

Noise Reduction

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The reasons and influences of the image noise

The video image data produced by an image sensor or the scanner circuitry of a digital camera contain both the signal as well as the noise information. Noise is always present in an image, especially when the images are produced in a low light environment. The signal-to-noise ratio is used to compare the level of signal to the level of background noise. A higher ratio means better image quality. While the existence of noise is a critical factor in image quality, it also adds an extra burden to encoding process as well. It significantly increases the data size for transmission and storage, resulting in the waste of bandwidth and storage space. Accordingly, reducing the noise from an image is a critical function of video processing technology.

The theory and classification of the noise reduction technologies

Distinguishing between the noise and the details of the image, the current noise reduction technology used in video surveillance products reduces the noise from an image via linear filtering and non-linear filtering. Based upon the signal and noise content of video data and the analysis of noise estimation and reduction requirements, noise reduction techniques can be classified into spatial filtering, temporal filtering, motion adaptive filtering and motion compensation filtering, etc.. All these technologies have been adopted in most surveillance products sold today.

A comparison of noise reduction technologies

The complexities and effects of different noise reducing filter algorithms are distinctly different. Generally, the spatial and temporal filters are low complexity algorithms. The spatial filter reduces the noise in the image but damages the image details resulting in fuzzy edges, while the Temporal Filter causes a ghosting artifact on moving objects. Therefore those two kinds of filter technologies are normally used in the low-end products.

Figure 1   from the left to right:

Original Image;   Spatial Filtered Image;   Temporal Filtered Image;   Motion Adaptive Filtered Image

The motion adaptive filter analyzes by comparing two successive frames and identifies the motion area and still area. Motion adaptive filtering is based on the difference between the before and after each image whether it is on motion or stationary. Within the filter, the Temporal Filter will apply more on the stationary part of the image and Spatial Filter will apply more toward the motion part of the image. Better detail will remain on the stationary details and less ghosting on the moving object in the image

Figure 2   Zoomed-in Image Details

Clockwise: Original Image;   Spatial Filtered Image;   Temporal Filtered Image;   Motion Adaptive Filtered Image

The motion compensation filter is a further development from the motion adaptive filter; it combines the technologies of a spatial and temporal filter and applies a matching or predictive calculation for processing the motion area of the successive frames to enable an ideal noise reduction effect without affecting the image detail.
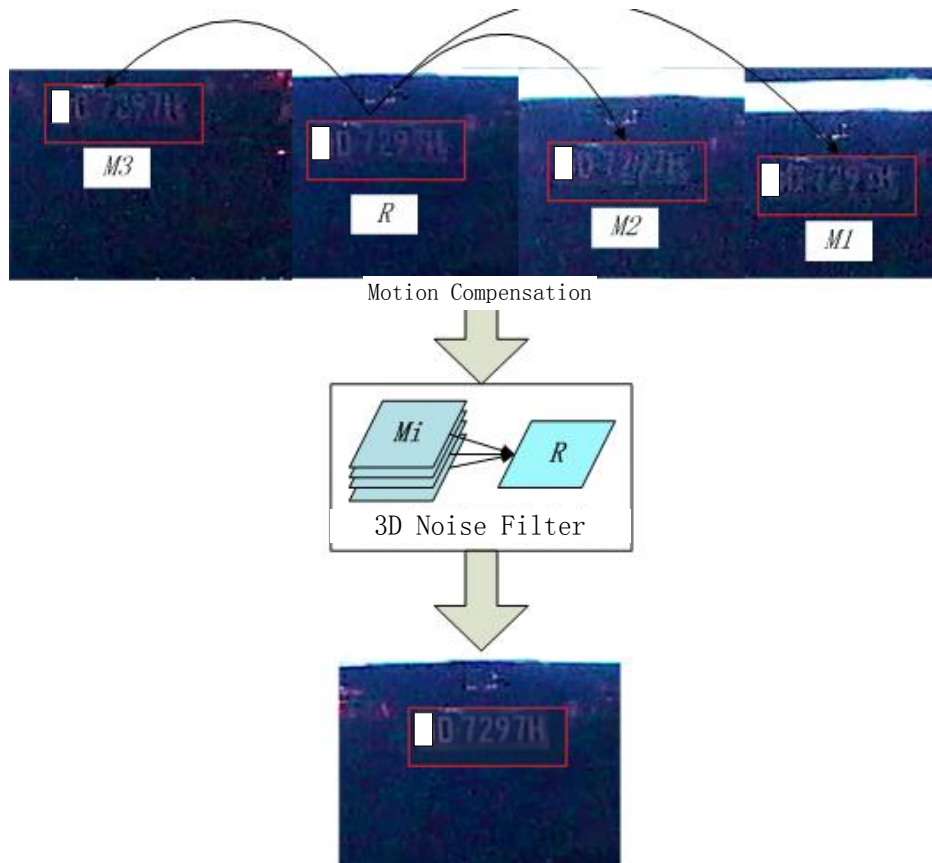

Figure 3 Theory of Motion Compensation Filter

It should be noted that the image effect shown in the above figure is the result of adopting the current mainstream noise reduction technologies for denoising application, but this does not mean that all the technologies on the market at a same level can achieve the same denoising effect. Actually the various noise reduction technologies are continuously investigated, researched and improved by the academic circle and the video industry. The application of new technologies will increase the noise reduction effect in the future. Meanwhile, no matter what technology you applied, in actual usage, the effect can never be perfect. When the SNR is lower than a certain level, you can't remove all the noises and the image details are inevitably influenced by the noise reduction. At

that time, you need to choose a balance between the levels of noise versus the noise reduction effect to achieve an acceptable quality of image.

Conclusion

Combining with the accurate noise intensity estimation algorithm, the production of Hikvision mainly adopts the motion adaptive filter and the motion compensation filter technologies. The image of the Hikvision cameras presents distinguished details in ideal illumination, and suppresses the noise to produce high-quality image in low illumination. Meanwhile, the perfect combination of the outstanding noise reduction technology and the advanced H.264 encoding technology decreases the data compression storage and network transmission bandwidth, massively saving resources.

The images from Hikvision cameras are based on motion adaptive filtering and motion-compensated filtering. In conjunction with current filtering algorithms and an ideal lighting environment, low noise and clear detail image can be produced. When under a low light environment, noise can be inhibited when the current noise reduction technology is applied, with the resulting clearer detail and improved overall image quality. Furthermore, with the perfect combination of outstanding noise reduction and optimized H.264 encoding technology, a dramatic improvement in the area of data transmission and storage of compressed video is achieved. As a result, the user needs fewer resources to have better quality and smooth video.

HIKVISION

About Us

Hikvision is the world's largest supplier of video surveillance products and solutions. The company specializes in video surveillance technology, as well as designing and manufacturing a full-line of innovative CCTV and video surveillance products. The product line ranges from cameras and DVRs to video management software. Since its inception in 2001, Hikvision has quickly achieved a leading worldwide market position in the security industry.

Hikvision possess the world's largest R&D team and state-of-art manufacturing facilities; both allow Hikvision's customers the benefit of world-class products that are designed with cutting-edge technology. As further commitment to its customers, Hikvision annually reinvests 7% of its revenue into R&D for continued product innovation and improvement.

Hikvision operates 31 domestic branches in China and 14 overseas regional branch offices, in conjunction with over 30,000 partners all over the world to achieve a truly global presence. Hikvision is now publicly listed on the Shenzhen Stock Exchange. For more information, please visit Hikvision's website at www.hikvision.com.