B4 Comparison of Super Resolution Image Enhancement Algorithms for Forensic Image Analysis

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After attending this presentation, attendees will gain an understanding of some principles of multi-frame Super-Resolution (SR) image enhancement techniques; various SR algorithms have been proposed, quality of the resulting images are different depending on the algorithm, and the optimum algorithm depends on the type of processing images.

This presentation will impact the forensic science community by providing the experimental results showing the best SR algorithm varies depending on the nature of source images. Even if image quality is not improved with a specific SR algorithm, there is a possibility of obtaining a better resulting image by using a different algorithm. This knowledge will be useful for forensic image analysts who think that the multi-frame SR techniques are not functioning well for real-case images.

Videos or images that were recorded by surveillance or any other cameras can be objective evidence leading to criminal investigation. However, in many cases, the recorded images cannot be effectively utilized due to insufficient spatial resolution of the image. For such image degradation factor, multi-frame SR processing is highly effective for image quality improvement: it is possible to improve the spatial resolution of the image by integrating information from many images. Various algorithms have been proposed for multi-frame SR, and their effectiveness has been shown in the literature.[1,2] However, from the experiences of some professionals, it did not work well to most actual case videos even though clear results are shown in academic papers.

This study will present experimental results of the performance of various multi-frame SR algorithms using various image sequences including images taken by surveillance cameras. For the experiments, more than five registration algorithms (Keren, LK, Farneback, Brox, Dense LK, Simple Flow, etc.) and five reconstruction algorithms (Interpolation, POCS, NC, BTV, MAP) were implemented; usually multi-frame SR processing is performed in two steps (registration and reconstruction). These SR algorithms were written in C++ language and they were implemented using the computer vision library OpenCV 2.4. For the combination of these algorithms and input image sequences, the resulting image quality was assessed. The input image sequences included both computer-generated and camera-recorded image sequences.

The results show that some surveillance camera images can be improved with the SR image processing under a specific condition so as to identify unknown characters. However, in comparison with the images that were generated in a computer, image quality improvement was lower for the camera recorded images. Furthermore, it was found by the experiment that the optimum algorithm was different from the source images. The reason for this was assumed to be due to the difference of the image observation model that each algorithm hypothesized. Therefore, from the aspect of the actual image analyses on crime investigations, it is considered important to implement various SR algorithms and to select the optimum one according to the source video; because a wide variety of evidentiary materials are treated in the forensic activities.

References:

1. Milanfar P, editor. Super-Resolution Imaging. Boca Raton: CRC Press, 2011.
2. Chaudhuri S, editor. Super-Resolution Imaging. Dordrecht: Kluwer Academic Publishers, 2001.

Image Enhancement, Super Resolution, Algorithm

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