B17 Testing of Image Quality of In-Car Video Systems

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After attending this presentation, attendees will gain knowledge on how in-car digital video systems are to be tested in the future and how this might affect forensic video analyses.

This presentation will impact the forensic community by showing that the use of in-car digital video is expected to continue growing and that the IACP has promulgated requirements that departments can utilize in the acquisition of systems. The result is expected to be an increase in the quality and some degree of predictability of performance of these systems. This will have an impact on how forensic video analysts interpret their findings in the future. It will help anticipate what sized objects might be reproduced, what colors might be reliable, and how movements can be interpreted.

The use of in-car video systems in police and other emergency vehicles is growing rapidly. Unfortunately, there are many aspects that are important to a successful system and guidelines for these systems are just emerging. Some of these aspects deal with: physical properties, electrical properties, system integration properties, and image quality. Setting requirements for image quality is very difficult and a set of properties has been selected for use at this time. This paper will deal with those properties, how they are measured, and what performance details they cover.

Over the past few years, a team lead by the International Association of Chiefs of Police (IACP) has been working to determine the physical layouts that are involved in in-car video recording and they have set some basic indications of the types of objects that should be resolvable. They have measured the lighting conditions that might be encountered and the colors that might appear in scenes. They also have indications of the movements of interest in a typical scenario. The testing routines are based on these findings.

The properties measured are static resolution, dynamic modulation, dynamic range, aspect ratio, and color fidelity. Static resolution is measured both vertically and horizontally using targets that are consistent with the objects of interest at a typical scene. Bar charts are used and the test is designed to show if the system can reproduce a certain standard or not. It is a pass fail test and not an engineering measurement. Dynamic modulation started out as a test of resolution of a moving target, but testing has shown that what is really being measured is the degree of modulation an image maintains as the target moves faster and faster. This turns out to depend on the sensitivity of the light levels, sensor and the shutter speeds of the camera. Hence, this property is now referred to as modulation of a dynamic target. The system's compression routines can have a significant impact on these results. Dynamic range is measure using a sensitometer with a 10,000:1 test target. The system's monotonic response above noise threshold point and below the saturation point is examined. Most of the cameras were in the range of about 100:1, which is a bit short of the range found in a number of typical scenes. Comparisons to digital still cameras are shown for context. To measure color fidelity, a Macbeth Corporation Color Checker is used along with 5,000° Kelvin lamps. Frames are then taken from the video as an officer would when analyzing a recording is sampled. The CIE/Lab values for the primary colors and gray level patches are measured and individually compared to the correct values for those patches. Then a figure of merit is calculated base on a mean square error calculation.

The result of measuring a number of cameras, each with its respective software, is shown. As a general rule, the analog cameras are better at dynamic modulation, but worse in the other respects. The high definition cameras are very good at color fidelity and static resolution, but sensitive to light levels when examining dynamic modulation. Dynamic range measurements are comparable across all the cameras tested, and all are marginal relative to the application requirement. All are low relative to the range that can be achieved with digital still cameras.

The testing described in this paper is the basis for the image quality portions of the current IACP, in-car digital video specification. These may change as new technology is developed and as practical experience under the current regime is recorded. For example, there was discussion of moving color test targets, but this in not measured in the current specification.

In-Car Video, Forensic Video, Testing

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