B21 Car Speed From CCTV Images

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After attending this presentation, attendees will understand some principles of calculating the speed of a car from CCTV images and how to gain insight in the measurement errors.

This presentation will impact the forensic community by providing a better understanding of measurement errors in speed calculations from CCTV footage.

In forensic investigation, on a regular basis the question arises whether the speed of a car shown in a video can be determined. The video is usually obtained from a Closed Circuit Television (CCTV) system containing time lapse, black & white, or color recording.

The speed of the questioned car is calculated by measuring the path of the car between two images and calculating the time difference between the two images given the time by the CCTV system. To measure the path of the car between two images a three dimensional computer model from the road and characteristic points may be used. The model can be looked upon from the same perspective as the questioned images, and with the computer model projected on the questioned images the position of the car can be determined. As for every measurement in real life, there will be a difference between measured and real path, so measured paths, and time intervals accordingly, are always estimates for actual values. In this case study, two different situations are discussed: in the first case a car was recorded by two different cameras from the same CCTV system; in the second case a car was recorded by just one camera from a CCTV system. Those two different situations have been approached with different methods for gaining insight into the estimation errors.

In the first method, referred to as the stationary method, the errors made in the path and the time estimation are separated. To measure the path between two images from the two different cameras, a similar car was positioned at the scene of crime, at the position as can be seen in the questioned images. For this, the cameras that took the original questioned video footage were repositioned using the questioned images. For both cameras, the positioning of the car was repeated by different operators, thus producing a variation around an average position per image. The different positions were measured using a land surveying device, and from the resulting drawing the paths between the positions were calculated. For the timing two clocks were started and recorded by the first camera. After this, without stopping the clocks, one clock was moved to the second camera and recorded. The recorded videos of the clocks were used to observe the difference in given time intervals by the CCTV system and the clocks. The variation in the observed errors of these time intervals and their paths were used to estimate a confidence interval for the calculated speed.

In the second method, referred to as the dynamic method, the estimation of the error made in the speed calculation is directly performed. Validation recordings from the same type of car, traveling with known speed along the path that was traveled by the car in the questioned video were made. For this, the same recording equipment was used as for the questioned video. These validation recordings of the car were made at different speeds, chosen around the estimated speed of the car in the questioned video. From the validation recordings the speed of the car was derived in the same way as for the questioned video. The difference between the calculated speed and the known speed was used to calculate the variation around the average difference. This variation was used to estimate a 95% confidence interval for the calculated questioned speed.

CCTV, Photogrammetry, Statistics

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