C18   Body Length Estimation From Surveillance Video: Procedures and Validation

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The goal of this presentation is to describe procedures and validation techniques for estimation of the height of a person in surveillance video.

The Netherlands Forensic Institute uses a technique with 3-D computer models to estimate the length of a person in a surveillance video. The 3-D-computer model is made with commercial photogrammetry software from photos taken at the scene. The model is then imported into commercial software for 3-D modeling and animating. The model can be viewed from every desired perspective in this software. This implies that the model can also be viewed from the same perspective as the camera that has taped the (video) image. To find this perspective, the software is provided with a camera match algorithm. This algorithm calculates the position and field of view of the camera through the similarity of points between the image and the 3-D model. The user in both the image and the 3-D model must point out these points. The model can now be looked at through a virtual camera with the video as a background. By positioning a 3-D modeled object in the 3-D space in such a way that they fit the person in the image, the height of the person is measured.

Mistakes and inaccuracies in this procedure are caused by:
• The quality of the 3-D model
• The choice of the virtual camera
• Uncertainties in the interpretation of the (video) image. (Which pixel on which video line belongs to a certain point of the 3-D model?)

Inaccuracies in the 3-D model will systematically affect all the measurements. A mistake or inaccuracy in the interpretation of the (video) image can be random, but also a systematical error from the investigator. For this reason it is wanted that the camera match and the measurement is repeated several times by several investigators.

Reference images are made to validate the measurements and to get a better understanding of the measuring errors. This means shooting images with the same equipment and at the same location that was used for the questioned images.

The shooting takes place under controlled circumstances and the camera view is checked for changes. If the camera view has been changed compared to the questioned image, the view will be restored as good as possible. Reference objects with a known size and location are placed in view of the camera. Also, several persons will stand still at known locations. At the lab of the Netherlands Forensic Institute, these reference images are treated the same way as the questioned images.

When performing a height measurement on a person in a (video) image it is necessary that the person be fully displayed. In other words: both the head and the feet of the person should be visible in the image. The gait and pose of a person is of great influence to the result of the height measurement. For this reason the aim is to use an image in which the person stands tall and still. When this is not the case an extra error should be taken into account for the height measurement. The quantity of the error for not standing tall can only be estimated for every individual case. However, the influence of the gait of a person to the height measurement has been studied by several people [1,2]. These studies show a maximum variation of the measured height of a person of 8 cm.

At this moment there is a study going at the Netherlands Forensic Institute to the influence of the pose of a person, camera view, lighting, and also interpretation of the images by the investigator on the result of height estimation. One of the experiments includes measurements on about twenty people shot by the surveillance cameras from the institute. On the day they were shot on camera and where they were also measured in real live by the investigators. The purpose of this study is to narrow the errors in future cases on height measurements.

Literature:
[1]   David Compton, Clair Prance, Mark Shears and Christophe Champod, A Systematic Approach to Height Interpretation from Images, in Proceedings of SPIE Vol. 4232, Enabling Technologies for Law Enforcement and Security, 2001

[2]   Antonio Criminisi and Andrew Zisseman, Luc van Gool, Simon Bramble and David Compton, A new approach to Obtain Height Measurements from Video, in Proceedings of SPIE Vol. 3576, Investigation and Forensic Science Technologies, 1998

Height Measurement, 3-D Computer Models, Surveillance Video