



C57 3D Computer Models Used as an Investigation Tool in Forensic Investigations

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After attending this presentation, attendees will understand the value of using 3D computer models in forensic investigation.

This presentation will impact the forensic community and/or humanity by demonstrating a variety of important uses of forensic photography.

The value of the use of 3D computer models in forensic investigations is discussed. Examples of cases are given in which 3D computer models are used to get more information about the position and/or size of an object seen in a picture and as a tool for scenario testing.

Photographs and video footage are a 2D representation of the 3D world. One way to get more information from these 2D images is the use of 3D computer models. With software like 3D Studio Max it is possible to construct a 3D model and place a virtual camera. This camera can be placed anywhere in the scene, so it is also possible to place a virtual camera at the location of the original camera that shot the original image. The positioning of this camera can be done automatically by the software since it is provided with a camera-match algorithm that calculates the camera position and Field Of View on the basis of corresponding points in the original image and the 3D model. By superimposing the original image over this virtual camera view of the 3D model it is now possible to place 3D objects in the model and see them in the original image at the same time. If one of the degrees of freedom of the object in the original image is known the 3D object can now be placed at the position of the object in the original image. By this the position and/or size of an object can be determined.

The uncertainties in the extracted information using this method are caused by:

- errors made in the 3D model
- lens distortion of the camera that shot the original image
- errors made in position and FOV of the virtual camera
- positioning of the 3D object

The last two errors are not just caused by measuring errors, but are also dependent on the interpretation of the image by the investigator. For this reason it is recommended that a measurement should always be repeated by a second independent investigator.

An estimation of those errors can be done by making reference images with the original camera system. When taking these reference images one should place objects of known size at a known place in the vicinity of the place of interest from the original image. By measuring them later in the 3D model one can estimate the errors. To keep the errors low it is important to avoid getting information from outside the boundaries of the 3D model, since the propagation of errors outside this volume can be enormous.

Examples of the use of this technique are the estimation of the height of a robber, the speed of a motorcycle or the reconstruction of a bullet trajectory in shooting incidents. We dealt with cases from CCTV recordings of shooting incidents in which one could not see the shooting itself, but the impact of the bullet was visible. With the reconstruction of the bullet trajectory it was possible to point out the position of the shooter. The advantage of the use of a 3D computer model in these kind of cases is that it can also be used as a visualization tool.

3D computer models can also be of help in the visualization of complex incidents. This visualization can help the investigators to understand what happened but can also be used as a scenario testing tool. This technique has been used in the investigation of a mid air crash between two airplanes and for the investigation of a disaster with an exploding fireworks factory.

Another example of this technique is a case in which we modeled a crime scene with two people murdered. Several pictures of blood spatters from three different locations were added in the model. From DNA analysis it was known that for every location the blood came from a different person (the two victims and a third person). With bloodstain pattern analysis three volumes were reconstructed that indicated the origin of the blood for these three different locations. In combination with a model of the two victims and their wounding channels, and other evidence like the position of bullets found, different scenarios were tested.

By generating a sequence of images, or even making an animation, it is possible to visualize a scenario. However, precaution should be taken, because animations suggest a reality that might not leave options open for other ideas about what happened.

Literature:

1. Richard Medeck, Photogrammetric evaluation and computer animation of a crime scene, *Proceedings of the 6th International Rolleimetric Police Workshop 2001*

3D Computer Modeling, Photogrammetry, Blood Spatter