



E83 The Application of 3D Motion Capture in the Analysis of Doubtful Forensic Cases

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Learning Overview: After attending this presentation, attendees will know how 3D Motion Capture (MOCAP) could help forensic pathologists in recreating a crime scene closer to reality and how it can be considered very helpful in shedding light on murders cases, accidents, or suicides, making the dynamic of the events clearer.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by demonstrating the utility to help both prosecutors and detectives to understand complicated dynamics, becoming a form of judicial evidence in court. For these reasons, this presentation highlights how the correct use of the 3D MOCAP could become an essential instrument in crime investigations over the years.

During the past few years, forensic sciences have quickly developed the application of new information technologies for the reconstruction of crime scenes. The MOCAP is the recording of the movement of the human body for the immediate or deferred analysis through virtual reproduction. Presented is a virtual model created through 3D MOCAP. This method is useful for realizing a 3D video that reproduces the dynamics of the scene of doubtful forensic cases. The proposed model is not used routinely in forensics but through the analysis of these cases, its applicative utility is demonstrated. In particular, the forensic purpose is to compare the injuries analyzed at the autopsy or the inspection of the victim with the possible dynamics compatible with the environments in which the event occurred and testimonies. A judicial inspection was conducted and a planimetry of the apartment was requested for each case. The device used for the acquisition of movements was a stereophotogrammetric system, composed of infrared OptiTrack® cameras capable of capturing movements up to 100 frames per second (fps). Some objects have been modeled in 3D manually, taking into account the original measurements. Two actors mimicked the movements of the aggressor and the victim in cases 1, 2, and 3. In case 4, only one actor was used. The rendering of the frames was entrusted to Supermicro systems with multiprocessor Xeon quad and Nvidia Quadro Plex® systems for Graphics Processing Unit (GPU) rendering projects.

Reported are four forensic cases with different death modalities: two murders, an attempted murder, and a suicide.

In the first case, the scene and the injuries were analyzed for a woman found dead in her home. Death was caused by two different weapons: a knife and a stick. In this case, the dynamics, the phases of the event, and the simultaneous use of two weapons were not clear. In the second case, the death of a young boy killed at the door of his home by multiple gunshot wounds was assessed. In this case, the murderer declared a legitimate defense and the unwillingness to kill. Therefore, in this case, the use of this method was important to clarify the truthfulness of the declarations and the possible compatibility of the witnesses' stories. In the third case, a boy was evaluated who suffered a stabbing that caused cutting wounds in the pubic region. The aggressor declared his unwillingness to cause death but only the will to hurt the victim. The reconstruction with the application of the 3D model proposed by this study clarified any possible dynamics with analysis of the authenticity of the aggressor's statements. In the fourth case, the death of a man due to a firearm injury was analyzed. The analysis of the scene did not clarify the mode of death, as the body site affected was the left axillary region. Several dynamics compatible with the weapon used and the lesion analyzed were presented through the proposed experimental model.

In all cases, the dynamics were reconstructed using 3D MOCAP technology. The use of the method clarified the phases of the murder in the first case and assessed the mismatch of the aggressor's statements in the reasons for the crime of the second case. In the third case, it clarified the aggressor's intent to kill. In the fourth case, it clarified the suicide-type modality organized by the victim. In all cases, the reconstructions had a crucial role in court as tools to explain the hypothesized dynamics.

Forensic Sciences, 3D Motion Capture, Autopsy