H63 Global Illumination in Postmortem Computed Tomography (CT): A Presentation of Its Use in Forensic Medicine

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The goals of this presentation are to: (1) introduce the global illumination technique; (2) explain the application of 3D reconstruction in forensic medicine; and, (3) explain the advantages and disadvantages of 3D reconstruction vs. visual examination.

This presentation will impact the forensic science community by improving the quality and accuracy of 3D reconstruction of postmortem CT. Forensic diagnosis prior to the autopsy will be easier and exposure to a non-medical audience more comprehensible.

Postmortem CT (PMCT) and 3D reconstructions are commonly used in forensic medicine and enable highlighting lesions before any forensic examination, especially the autopsy. They are also a good way to present medicolegal findings to a non-medical audience, such as state attorneys, judges, and juries. For a number of years, the technique frequently used for the modeling of 3D reconstructions was the Volume-Rendering Technique (VRT).

More recently, a novel technique has appeared in medical imaging: Global Illumination (GI) (also referred to as cinematic rendering technique in the literature). This technique simulates the complex illumination of an object and is commonly used in virtual cinematography. Its application in medical imaging enables the production of a more realistic and, therefore, a more accurate and comprehensible 3D reconstruction of the CT images.

The cases presented are from the Institute of Legal Medicine of Nancy, France. In some medicolegal cases (i.e., degraded cadavers, ballistic cases), a PMCT is systematically performed prior to the autopsy. This study treated these images with GI in order to explore the possibilities and interest of this new technique in forensic medicine.

In the case of bone study, three types of approaches were compared: the VRT reconstruction, the GI reconstruction, and the visual examination (during autopsy and/or after anthropologic preparation). Compared to the VRT, GI offers more realistic views of the skeleton: simulation of the shadows helps the observer better understand the reconstruction in 3D (depths and reliefs) and the illumination enables modification of the position of the light source and, therefore, the appearance of the bone lesions.

Compared to visual examination, GI has advantages and disadvantages: it enables the exploration of lesions before any dissection of the cadaver; the application of textures and colors according to the density level permit a reconstruction very similar to visual examination; the segmentation of each anatomical structure or bone fragment enables precise study of bone lesions and the reconstruction of complex fractures. However, the quality and accuracy of the 3D reconstruction depends on the resolution of the PMCT. Thus, in some cases, the finest fracture lines were not visible on VRT and GI but were observed by visual examination. A case is presented in which fine impacts of a blunt or spiky weapon were present on the left temporal bone around a major penetrating wound. All of these impacts were only seen during the autopsy.

In medical imaging, the algorithms of 3D reconstructions are more complex and accurate, permitting the realization of more realistic images. Among them, GI and the software it uses are not routinely employed in France, but the results are promising, both in forensic medicine and for clinical application. In the literature, some papers present clinical applications of GI, with only one in forensic medicine.[1] The examples presented here illustrate that they cannot replace the visual examination at autopsy.

Reference(s):

1. Lars C. Ebert et al. Forensic 3D Visualization of CT Data Using Cinematic Volume Rendering: A Preliminary Study. *American Journal of Roentgenology*. 208, no. 2 (November 8, 2016): 233–40, doi:10.2214/AJR.16.16499.

Postmortem CT, 3D Reconstruction, Global Illumination

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