H82 3D Body Surface Documentation in Forensic Pathology

Petra Urbanová, PhD, Kotlarska 2, Brno 611 37, CZECH REPUBLIC; Petr Hejna, PhD, Charles University in Prague, Šimkova 870, Hradec Kralove 500 38, CZECH REPUBLIC; and MIkolas Jurda, MSc, Masaryk University, Kotlarska 2, Brno 61137, CZECH REPUBLIC*

After attending this presentation, attendees will understand the cost and benefit of employing innovative 3D body surface documentation techniques in the course of forensic postmortem investigation; they will comprehend technological and methodological advances that allow documenting physical evidence in 3D in a rapid, affordable, yet photorealistic and accurate manner.

This presentation will impact the forensic science community by presenting results that advance currently available documentation techniques employed in the course of routine forensic postmortem examinations.

For the last few years, several projects have invested in establishing image-guided postmortem examination in the framework of forensic pathology — utilizing either medical imaging technologies (Computed Tomography (CT), magnetic resonance imaging) or optical surface scanning. Cross-sectional and surface data are both stand-alone techniques which bring a number of benefits but also a few shortcomings into postmortem examinations. While CT-based images have the capacity to generate a 3D model of any internal structure, under the condition that the contrast between two neighboring tissues or structures is sufficient, they provide little or no information about surface coloring (bruises, lesions), spots, or subtle morphological interferences. Optical surface models, in contrast, lack information on what is going on beneath the surface, but feature high-resolution geometry and surface color information.

Several 3D surface technologies, in particular photogrammetry and optical and laser scanning, have recently advanced into affordable, flexible, and accurate techniques involving a reasonably long learning curve; however, forensic postmortem investigation as performed on a daily basis has not benefited from their full potentials and the currently utilized methods are far behind what 3D surface documentation can provide. Conventionally, 2D photography presents the gold standard utilized throughout the entire process of postmortem examination, documenting the pre-autopsy state of preservation of the corpse, the presence of unique somatic traits or perishable findings, and injuries and/or pathological changes; however, photography discards surface depth — information highly valuable in terms of damage assessment or trait uniqueness.

In this study, two approaches to 3D external body documentation were tested — traditional digital camera-based photogrammetry combined with commercial photo-scan software and stereophotogrammetry-based scanner VECTRA H1®, a novelty product among portable hand-held surface scanners. In order to conduct the study, two forensic cases admitted for postmortem examination at the Department of Forensic Medicine, Hradec Králové, Czech Republic, were selected. A 63-year-old male, who died of traumatic, self-inflicted injuries (suicide by hanging) and a 63-year-old male diagnosed with heart failure. Both cases were photographed in 360° manner with a digital camera mounted on a tripod. Altogether, 35 to 70 images per case were taken, corresponding to 20 to 40 minutes of capturing time. Approximately the same time was required to document the body surface with the hand-held scanner, where up to 120 scans were taken.

The optical surface scanner proved itself to be a useful tool for being able to document small-to-large areas of the body surface. As not being specifically designed to scan objects on a larger scale, post-processing requires rather time-consuming manual image alignment; however, the device produced high-resolution 3D images, comparable in quality to any professional digital camera. The photogrammetry also provided photorealistic records of body surface capable of capturing, for instance, ligature marks, tattoos, and skin lesions in high quality. Moreover, the utilized software was able to create the whole body 3D surface mesh automatically; however, both methods failed when the surface was covered with body hair or reflective, moist areas were being documented.

In conclusion, both methods produce realistic, actual-size, or easy-to-calibrate 3D surface models useable as an advanced method of postmortem documentation and were easily fit to be the subject of further examinations, such as 3D mesh comparison or indirect measurement (e.g., body measurements, angles of penetrations). Digital 3D data can be easily archived, transported, and shared between laboratories; they provide a real-time access for re-examination of physical evidence. Furthermore, no requirements for calibration or operating skills make them ideal to be easily integrated into a daily workflow.

3D Body Scanning, Image-Guided Examination, Photogrammetry