G61 From VIRTOPSY to VIRTOBOT: Photogrammetry Based Optical Surface Scanning and Radiological Virtual Autopsy

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After attending this presentation, attendees will learn the newest cutting-edge technologies of 3D forensic documentation.

This presentation will impact the forensic community and/or humanity by demonstrating an upgrade of the newest techniques using 3D body surface documentation merged with radiological data sets.

Goal: 3D body-surface documentation and minimal-invasive, image-guided virtual autopsy utilizing optical and radiological scanning: Pushing low-tech documentation and autopsy procedures in a world of high-tech medicine to improve scientific value, to increase significance and quality.

Background: A main goal of forensic medicine is to document and to translate medical findings to a language and / or visualization, which is readable and understandable for judicial persons and for medical laymen. Therefore, in addition to classical methods, scientific cuttingedge technologies can and should be used.

The Institute of Forensic Medicine, University of Bern is, in collaboration with an internationally well selected research team, evaluating and validating several cuttingedge technologies such as 3D optical and photogrammetric surface scanning, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Magnetic Resonance (MR) Spectroscopy, Micro-CT, Micro-MR and synthetic body models (www.virtopsy.com).

Methods and Results: Through the use of the forensic, 3-D/CADsupported photogrammetric and 3D body surface scanning method the documentation of so-called `morphologic fingerprints` has been realized. Forensic, 3-D/CAD-supported photogrammetry and and 3D body surface scanning create morphologic data models of the injury and of the suspected injury-causing instrument allowing the evaluation of a match between the injury and the instrument. In addition to the photogrammetric body surface registration and 3D body surface scanning, the radiological documentation provided by a volume scan (i.e., spiral, multi-detector CT, or MRI) registers the sub-surface injury, which is not visible to Photogrammetry and 3D body surface scanning. The new, combined method of merging photogrammetry/3D body surface scanning and radiology data sets creates the potential to perform many kinds of reconstructions and postprocessing of (patterned) injuries in the realm of forensic medical case work. Using this merging method of colored photogrammetric surface and gray-scale radiological internal documentation, a great step towards a new kind of reality based, hightech wound documentation and visualization in forensic medicine is made.The combination of these methods has the advantage of being observer-independent, non-subjective, non-invasive, digitally storable over years or decades and even transferable over the web for second opinion.

Results: Body surface and radiological imaging techniques are particularly beneficial for reconstruction and visualization of forensic cases, allowing the opportunity to use the data for expert witness reports, teaching, quality control and telemedical consultation. The preliminary results based on the concept of 'Virtopsy' are promising enough to introduce and evaluate these techniques in forensic medicine. Documentation by these methods is observer-independent, objective and non-invasive. Digitally stored data may be recalled at will and provide fresh, intact topographical and anatomico-clinical reconstruction. Quality control and expert supervision becomes possible in a new manner, as well as image transmission and forensic "telemedicine" consultation. Image and data processing allows twoand three-dimensional views of forensic and anatomical findings. MR Spectroscopy has the possibility of metabolic-chemical analysis. In certain cultural circles where conventional autopsy is stigmatised or even forbidden, virtual autopsy would allow sound medico-legal practice and support for the judicial system without violating religious prohibitions or personal reservations. Also, in the post-mortem examination of highly infectious cadavers this technique could be of particular use (bio-terrorism). Minimally invasive autopsy would reduce the number of conventional autopsies, which are often difficult to bear for relatives. This development could be similar to that observed with the advent of minimally invasive percutaneous or laparoscopic surgery. Our results showed that we strive to lead forensic medicine to new horizons by utilizing the newest technologies.

Discussion and Perspectives: Based on our results, we hope that the combination of forensic-pathologic "know-how" (experience) with high-tech imaging will open new horizons in forensic medicine and other forensic sciences, leading towards a minimally-invasive virtual forensic autopsy (www.virtopsy.com). The automatisation of this process will lead to the development of a "Virtobot."

Forensic Radiology, Photogrammetry, 3D Body Surface Imaging

 ** Presenting Author*