THREE-DIMENSIONAL BODY SURFACE DOCUMENTATION IN FORENSIC PATHOLOGY

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Introduction

Careful and precise documentation of an original pre-autopsy state, perishable findings and consecutive steps of an autopsy allows preserving forensic evidence, revisiting original conclusions, and preventing misdiagnoses while maintaining a high level of quality control. As an alternative to 2D photography 3D surface documentation represents an advanced technique which surpasses the traditional approach at various levels. For any physical evidence it offers a three-dimensional digital representation where the depth information is present without being distorted. Therefore, it is fitted to be a suitable archiving option or a subject of revisions and differential diagnostics exploitable by a variety of quantitative or qualitative method.

For postmortem documentation of a human body, technologies based on laser or white light scanning, passive photogrammetry, video-imaging or contact measurement may be employed. In the present study we tested two relatively low-cost approaches to 3D external body documentation – single camera photogrammetry and stereophotogrammetry-based handheld surface scanner on forensic cases admitted at the Department of Forensic Medicine, Hradec Králové, Czech Republic.

Scanning procedure

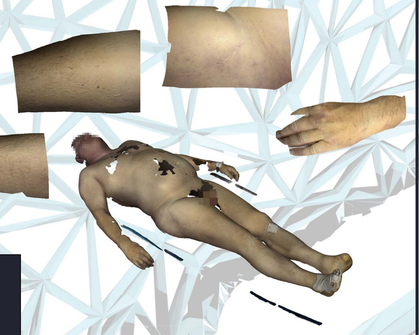
Single camera photogrammetry

Digital camera - Nikon D7000
Agisoft PhotoScan software
High-performance personal computer

- 2D photography from different viewpoints
- target surface depicted in multiple images
- a set of images processed into a 3D model

Optical surface scanner

Vectra® H1 optical scanner
Mirror® Medical Imaging Software
High-performance personal computer



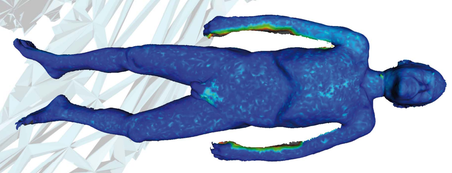
- production of double-images
- post-processing into a 3D surface model
- multiple scans combinable into larger units

Subject 1
- male, 63 years old
- cause of death - traumatic, self-inflicted injuries, suicide by hanging
- livores mortis, tattooed

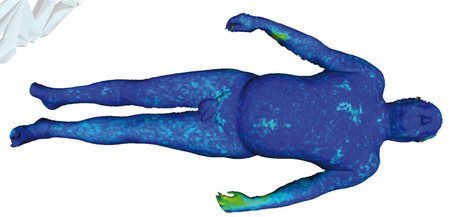
Subject 2
- male, 63 years old
- cause of death - cardiac insufficiency associated with diabetes mellitus
- multiple amputations

Comparison

Generated 3D models were assessed visually and compared quantitatively using Iterative Closest Point (ICP) alignment algorithm and dissimilarity measures based on closest vertex to vertex distances. Numerical differences were visualized by color maps illustrating spatial distribution of observed variations. All computations and graphics were carried out using FIDENTIS Analyst software (www.fidentis.cz).



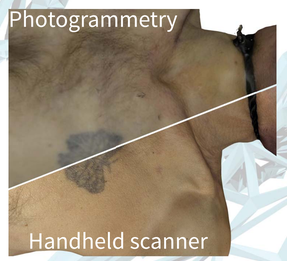
Subject 1 - full body scan, threshold set to 98% of maximum distance - 3.65 mm



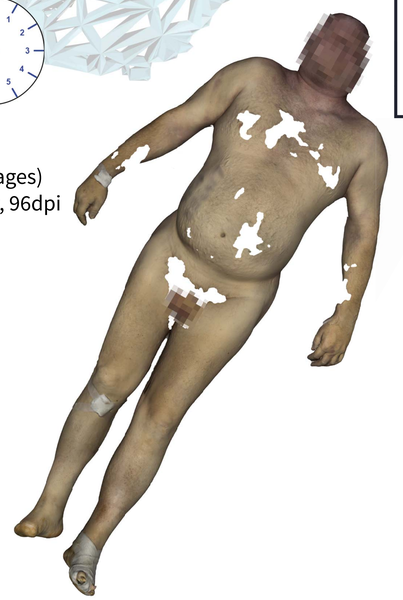
Subject 2 - full body scan, threshold set to 98% of maximum distance - 1.70 mm

Performance

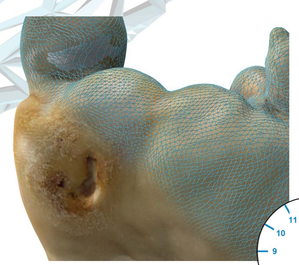
Subject 1
photogrammetry
cca 100 digital images
200k points, 4,000px, 96dpi

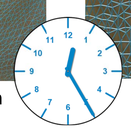


Subject 2
handheld scanner
102 scans (double images)
400k points, 20,000px, 96dpi

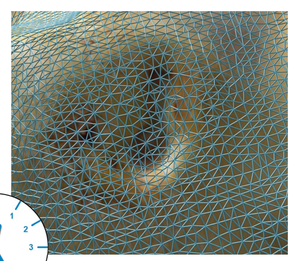


Subject 1 ft. a butterfly tattoo
a single scan (double image)

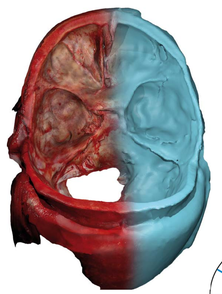




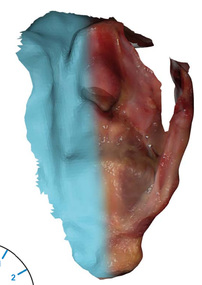
Subject 2 ft. foot with amputated toes
20 scans (double images)



Subject 2 ft. an ulcer
20 scans (double images)



Subject 1 endocranial cavity
handheld scanner
10 scans



Subject 1 harvested larynx
handheld scanner
10 scans

Funding
The study was carried out with a financial support provided by Project Grant at Masaryk University, project No. MUNI/A/0983/2013 and EU programme FITEAMP CZ.1.07/2.3.00/20.0181

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