A37 Computational Anatomy: What Prospects for Forensic Anthropology?

Rémi Agier, CREATIS Research laboratory of Medical Imagery, 7 Avenue Jean Capelle O, Villeurbanne 69100, FRANCE; Remy Prost, PhD, CREATIS Research Laboratory of Medical Imagery, 7 Avenue Jean Capelle O, Villeurbanne 69100, FRANCE; Razmig Kechichan, CREATIS Research Laboratory of Medical Imagery, 7 Avenue Jean Capelle O, Villeurbanne 69100, FRANCE; Sébastien Valette, CREATIS Research Laboratory of Medical Imagery, 7 Avenue Jean Capelle O, Villeurbanne 69100, FRANCE; Laurent Fanton, MD, PhD, Hospices Civils de Lyon, Institut de Medecine Legale, 12 Avenue Rockefeller, Lyon 69008, FRANCE; and Angelique Franchi, MD, Hospices Civils de Lyon, Service de Medecine Legale, Faculté de Médecine, Lyon 69008, FRANCE*

After attending this presentation, attendees will be able to consider the prospects of using computational anatomy in forensic anthropology.

This presentation will impact the forensic science community by drawing the attention to sex determination by computational anatomy and by developing an automatic method to simplify the anthropological approach.

The steady advances in medical imaging are the source of many complex images stored in hospitals. Unfortunately, after an image of the patient is obtained for a specific diagnosis, this image is usually discarded, without further analysis. Hence, there are many images stored in hospitals that could be further analyzed to extract knowledge on human anatomy. Computational anatomy is a recent research field which seeks to help practitioners in their daily practice by analyzing many individuals, which yields large-scale statistics on human anatomy.[1]

The purpose of this study is to assess the relevance of computational anatomy for forensic anthropology, in particular for sex determination.

Toward this goal, a novel groupwise registration algorithm was used, based on a keypoint detection, and was able to register several hundreds of full body images in a common space. This algorithm is fully automatic and can robustly register one hundred images within a few hours.

Preliminary results will be presented for 83 Computed Tomography (CT) scans of living individuals from the VISCERAL database.[2] The first results will focus on the hip bone for sex determination, which is known to be one of the most dimorphic regions between men and women. Experiments demonstrate that the well-known criteria for sex discrimination (e.g., the opening angle of the pubic symphysis or the greater sciatic notch) are well preserved in the mean images of men and women. Moreover, the results with the Probabilistic Sex Diagnosis (DSP: Diagnose Sexuelle Probabiliste) method (a tool using worldwide variability in hip bone measurements) will be shown by manually placing only 20 anatomical landmarks in the common space.[3] Sixty-two percent of individuals had been correctly estimated, 37% had been undetermined, and 1% of individuals had been determined with error of sex. The placing of landmarks manually is difficult and insufficiently accurate. Further analysis will address the skull and femur.

Currently, the limiting factor is the population size and a future goal will be to significantly increase the size to improve global accuracy. The long-term objective is to automatically computer generate local points of interest in the common space image. This new approach provides an automated profiling method to determine the sex of an individual and possibly her/his age, origins, and body measurements in future works.

Reference(s):

1. Raimond L. Winslow et al. Computational medicine: Translating models to clinical care. *Sci Transl Med*. 2012 Oct 31.4(158):158rv11.
2. Medical Computer Vision. Large Data in Medical Imaging. *Third International MICCAI Workshop*, MCV 2013, Nagoya, Japan, September 26, 2013, Revised Selected Papers. Editors: Menze, B., Langs, G., Montillo, A., Kelm, M., Müller, H., Tu, Z.
3. P. Murail, J. Bruzek, F. Houët et E. Cunha. DSP: A tool for probabilistic sex diagnosis using worldwide variability in hip-bone measurements. 2005. *Bulletins et mémoires de la Société d'Anthropologie de Paris*. 17 (3-4): 167-76.

Computational Anatomy, Forensic Anthropology, Sex Determination