Three-Dimensional Body Scanning Technology: Comparison of Four Different Acquisition Systems for Apparel Product Development

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Anthropometric measurements are the basis for apparel pattern development and standardized sizing of ready-to-wear (Kaiser & Garner, 2012). Recent technological advances in anthropometric data collection have focused on three-dimensional (3D) optical imaging devices (often called body scanners) that can rapidly acquire dozens of circumference, length and volume body dimensions. Full body scanners are currently used in the apparel industry in both the retail and product development sectors with the goal of improving apparel fit, customer satisfaction and ultimately increasing sales (Meality, 2017).

Commercially available full body scanners vary in hardware design, data collection method, software processing, and output options. 3D body scanners also vary in price and ease of use with some lower-end models available for home use by the general public. The theory of rational choice (Coleman & Fararo, 1992) proposes that when faced with a decision one will base that decision on rational calculations and comparison to maximize the benefit and minimize loss. With so many brands and types of 3D body scanners currently available for use by apparel researchers and product developers the following research questions were posed using the theory of rational choice as a framework: Are certain hardware and software features of 3D body scanners more appropriate for gathering and processing the particular data required for apparel research and development? How does the hardware and software of commercially available machines compare in terms of ease of use, accuracy of data collected, points of measurement, processing of files, and participant ease of use and comfort during the scanning process? Do the currently available machines differ in the type and location of anthropometric data collected and the data's suitability for apparel block development and fit? To answer these questions a study comparing four commercially available full body scanners was initiated.

Permission to conduct this mixed-methods research was granted by the Institutional Review Board prior to data collection. A cross-sectional, convenience sample of 55 males and females over the age of 18 participated in this research. Demographic data was obtained via survey. Participants were weighed and had their height taken while fully clothed. For a base comparison value of body segmental measurements participants were measured with a flexible tape measure while wearing undergarments and an exam gown. To assess the accuracy of body volume measurements recorded by the 3D body scanners volume measurements were then collected through air displacement plethysmography (ADP), and dual-energy x-ray absorptiometry (DXA). Both ADP and DXA are widely used in the medical field and regarded as the most accurate methods to collect body volume data. Participants were then asked to change into spandex bike shorts, a spandex tank top, and turban to contain hair if necessary, for the 3D body scans.

3D body scans were then taken with four different infrared depth sensor machines: Fit3D Proscanner; Styku; TC^2 KX-16; and Size Stream. Machines were photographed and notes taken on participant ease of use and comfort during the scan. Data were collected and processed using each brand's standard software available with purchase. Linear regression and Bland-Altman analyses were conducted for each 3D optical system with ADP total volume as the reference. Absolute measurement values for select length and circumference measurements were compared to data collected by flexible tape measure.

Results indicate differences in machine hardware affect both the accuracy of data collected, ease of participant use and comfort during the scanning process. Each brand of 3D body scanner uses its own proprietary software for land marking and measuring. Therefore, key measurements required for apparel production such as waist circumference varied in the location on the participant's body where the data was collected, resulting in different absolute values for the named location. Differences were also observed in the number and type of measurements generated by each brand's proprietary software, and the ability of researchers to adjust points of measure on the avatar. Data organization and presentation of measurements by the proprietary software, and the availability of the OBJ file, of two brands were found to be more aligned to the needs of the apparel industry.

Hardware differences among brands in terms of portability of machine, footprint needed for set up, and ease of set up and calibration made one brand particularly useful for multiple location data collection and in a retail setting. Photographs of each machine with information about how the hardware works, data generated by proprietary software, sample scans, and participant opinion of comfort and ease of use, and comparison of the accuracy of data collected, will be presented. The results of this research are useful for apparel researchers seeking to expand their knowledge of the hardware and software differences among the various brands currently available on the market. Results are also useful researchers considering the purchase of a 3D body scanner.

References:

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