Process Considerations in 3D Hand Anthropometric Data Collection

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Abstract

Landmark placement and methods, scanning tools, and hand position are several considerations scientists need to obtain reliable 3D hand data, especially for data collected for product design. The researchers of this paper are experts in product design and personal protective equipment. Specific anthropometric hand data important for glove design include finger lengths, crotch depths, palm and padding, back of hand, and wrist opening; these measurements can improve dexterity, gripping, hand entry, adduction, abduction, squeezing, etc. in the glove design. Traditional hand anthropometric studies are missing several key landmarks that are important to designing gloves. The researchers developed a new method, including crease lines as used by hand surgeons, to understand where gloves need to flex, the fourteen joint locations of all five fingers, finger crotches, tips of fingers (especially when the subject has long fingernails), and wrist location. The researchers developed a protocol for landmarking that included notating the anterior and posterior sides of the hand, as they are different on each plane. Methods used to landmark hands is dependent upon the scanner used. Color scanners allow the use of felt tip, washable pens in color and stickers; whereas, non-color scanners require a bit more creativity, such as 3D shapes like pyramids so the scanner can see the shape. Heights of these 3D markers are also important, because if they are not tall enough the landmark will create an artifact on the hand.

There is also the need to consider how the hand is stabilized during scanning. For flatbed foot scanners, the process is simple, the subject places their hand on the bed and the scanning envelope captures the whole hand. With some portable technologies, the hand must be stabilized to limit sway due to the length of the scan. Different methods of stability frames were tested to enable reliable, smooth scans. In the past, only anatomical hand positions were measured for anthropometric data (not splayed or in ergonomic position). Several hands positions were tested, such as grasping positions and with fingers splayed, and measurements were compared across subjects to see how the dimensions of the hand changed depending on the position. Hand positions were also tested with and without gloves to test methods to visualize the glove to hand relationship and fit. The researchers developed methods to ensure repeatability and reliability of the data. Lastly, the subject needs to be considered. Because hands are so variable between subjects, several considerations are important, including: size of subject arm and hand, dominance, ethnicity (skin color), jewelry and nail length. All considerations for obtaining 3D hand scans are important to ensure accurate and useable data for product development and sizing.

Keywords: Hands, Anthropometrics, 3D Hand Scanning