3D Body Scanning Opportunities for Custom Manufacturing

Dr. Susan P. Ashdown
Cornell University
The Cornell Body Scan Research Group

Understanding Body Scan Data

Mass Custom and Custom Manufacturing

Issues on Body Shape, Posture, and Custom Fit
The Cornell Body Scan Research Group
Research group in sizing and fit of apparel started in 1991

Small research projects using a tape measure as the primary measurement tool
First Human Solutions scanner purchased in 2000, donated by Rebecca Quinn Morgan
Current Scanners:

- Vitus XL, Human Solutions
- Vitus aHead, Human Solutions
- Infoot USB High Type, I-Ware Lab.
Current Software:
- AnthroScan
- Polyworks (Innovmetric)
- Geomagic
- [TC]2 Body measurement software
- Matlab, Photoshop
- Rhinoceros

Human Solutions AnthroScan and TC2 Body Measurement Software provide automated linear measurements from the scans. AnthroScan uses anthropometry measures, TC2 measurements are derived from tailor’s measures, and provide more choices of landmarks.
Human Solutions Vitus XL

- 8 Cameras and 4 laser lights evenly spaced around the scan area
- Data point grid density: 2x2 mm, 27 points per cm²
- Scan volume: 1.2m x 1.2m x 2.1m (h)
- Point, triangulation, and surface visualization – excellent imaging of scans
- Automated merging, point reduction and patching, optimized for scan posture
- Automated measures based on anthropometric measures, landmarks identified by body geometry

Large scan volume and good visualization of scans are important for our research
Eye safe laser light, allows scanning with curtains open, so that we can monitor and correct posture.
Human Solutions Vitus aHead

- Similar laser lights and cameras in smaller format
- Data point grid density: >30 points per cm²
- Scan volume: 0.4m x 0.4m x 1m (h)
- Similar point, triangulation, and surface visualization
- Automated merging, point reduction, and patching optimized for head scans

Smaller scan volume, higher resolution
Research topics

- Sizing and fit of both fashion and functional clothing.
- Anthropometric measures, conventional and active, body shape analysis.
- Automated customization and mass customization of apparel.
- Development and use of half scale dress forms in the industry
Scanning participants in a minimally clothed state, and then scanning again in clothing provides us with two scans that can be merged for visualization and analysis of fit.
Anthropometric measures

- Body posture and complex body angles
- Change in body measurements in active positions
- New body measurements for garment fit and body shape
Body posture and complex body angles
Change in body measurements in active positions
New body measurements for garment fit and body shape
Understanding Body Scan Data
XYZ point data
Overlapping camera patches
Points triangulated, surfaced to visualize 3D model
Camera patches merged
Redundent and less reliable points deleted
Missing areas patched
The reliability of the scan data: dependent on validity of the merging and patching process

Automated linear measurements:
Landmarks located from body geometry
Variation in body shape introduce error
Manual placement of landmarks is more time consuming but more reliable.
Mass Custom and Custom Manufacturing
Mass customization
Custom manufacturing

- Levi Strauss – body shape options, based on 3D data
- Alton Lane - custom tailoring from body scans
Apparel firms choose target markets based on:

demographic variables
lifestyle (psychographic) variables

Assumption:
Age, social and economic status, lifestyles and interest in specific activities = preference for specific clothing styles.
Apparel companies need:

- Anthropometric data to define body sizes and shapes
- Associated with specific demographic and psychographic variables.
A ‘successful’ sizing system requires:

Fit, style, quality, and cost acceptable for the portion of the population (the target market) that the system is designed to accommodate

Communication to enable target market customers to interpret and adopt the system appropriately.
Advancing technologies, especially the body scanner:

can make new sizing systems possible through rapid, inexpensive, targeted measurement of populations

but need updated measurement databases that can be sorted by multiple demographic factors.
Businesses will succeed in an increasingly fragmented world if they:

- identify and focus on specific target markets
- create sizing systems specifically for their market using anthropometric data
- provide good fit for the full range of body sizes and proportions of this market
- address issues regarding design, production and distribution
- communicate effectively and appropriately with the market.
Body scan data for Mass customization
  • Identify target market clearly

1. Support national anthropometric surveys -- that include collection of appropriate demographic and psychographic data
2. Scan your own customers (retail outlets)
3. Scan at venues your target market attends

Have a strategy for applying scan data to improve sizing and fit
Small scale testing of custom fit conducted by the Cornell Body Scan Research Group with industry partners
Used Lectra, Gerber, Optitex automated custom fit software
Results: Only about 90% "custom fit garment fits as well or better than RTW size"
Problems:
  • Automated measurements not located on body landmark
  • Few guidelines for assigning values for changes based on body measurement changes
  • Alterations in X-Y grading direction did not provide shape and balance modifications when needed
A tale of two jackets

This jacket, made from linear measurements automatically derived from my body scan, does not fit my forward rolling shoulder, and is short in the back. The jacket I wore for the presentation was made on a half scale dress form made from my body scan, and fitted my posture and proportions exactly.
Understanding the limits of linear measurements

Play video at
https://www.youtube.com/watch?v=RafLM_KaN7I&feature=youtu.be
Issues on Body Shape, Posture, and Custom Fit
Variation in body shape, posture, proportions
Body proportions are complex, simple shape descriptions do not capture range of variation.
We used anthropometric data from 3D studies to analyze and classify complex body shapes.
Analysis of lower body shape using proportional measures, and including depths and breadths.

Side seam line = Mid-point between abdomen prominence point and buttocks prominence point.
Classification into different shape categories
Created a base size for each body shape
Used the different base shapes in automated system
Retained proportions and posture for each body type
Results from this study suggest that dividing the target market into different body shapes, and creating a well fitted base pattern for each shape to be used for the starting point in an automated custom patternmaking system will provide better fit, as this will accommodate variation in body posture and body proportions.
Project Managers
Katharine Schoenfelder, Erica Carnrite, 
Lindsey Lyman-Clarke, Catherine Devine

Visiting Faculty
Jeong Ran Lee, MeeSung Choi, 
Fang Fang, Wolhee Do, Huantian Na, 
Hyunsook Han, Xiao Ping

Post-Docs
Kyung Ja Paek, Sun Yoon Choi

Graduate Students
Adriana Petrova, 
Fatma Baytar, Hwa Kyung Song, 
JinHee Nam, Julia (Voellinger) Griffey, 
Lynn Boorady, Tasha Lewis, Young-A Lee, Kristen Morris. 
Yingying Wu, XiaoFeng Yao