Lifelike Apparel Mannequins from 3-D Human Data

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AIR FORCE RESEARCH LABORATORY

GENERAL DYNAMICS ADVANCED INFORMATION SYSTEMS

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Overview

- How has it been done in the past and what are the issues?
- How is our process different?
- Why our mannequins are better
- Demonstration of:

  Right information + Right process

  = Right fit
## How has it been done in the past?

**Process**

- Choose a fit model that “looks right”
- Use stylized Dressform
- Use draping or old patterns to create new styles
- Use fit model to test fit in base size only
- Use traditional grade of even amounts
- Sell product and see how well it sells

**Issues**

- Fit model & grade may not represent target market
- Fit model changes (weight, leaves job, pregnancy)
- Unrealistic Dressform shape
- Dressform properties ineffective for fit
- Fit problems not identified until after product hits market, or worse, not at all
- Grading uncheckable for fit
Where is your fit model?

**Fit Sweet-spot:** regression center line of target market:
- ASTM Size 12
  - Waist = 750 mm
  - Hip = 1016 mm

Equation

\[ \text{Hip} = 419.15 + 0.8046 \times \text{Waist} \]

Accommodation Range equals ± 40 mm for Hip

Any deviation from the center “Sweet Spot” will accommodate fewer people with same number of sizes.

CAESAR North America Women with 50% Confidence Band

Caesar Female Subject
Cost of missing Sweet Spot

CAESAR North America Women with Alternate Size Range

Alternate Size Range has equal Waist/Hip Grade
This grade veers from Sweet Spot Band
Only 36.5% of Target Market within 40mm
Base Size not in center of Sweet Spot

New Size Range ± 40mm for Hip
Sweet Spot ± 40mm for Hip 51.2% Accommodation

Same number of sizes
14.7% fewer people accommodated!

- Within 40 mm of Size Range (n=461:36.5%)
- Outside 40 mm of Size Range (n=801:63.5%)
Mannequin Shapes

SHARP mannequin

Standard workroom mannequin

Difference Map

Classic mannequins are not shaped like humans
Effect of shape on fit

Ready-to-Wear Dress

- Bunching
- Uneven hem

Unflattering

Made-to-3-D-Body Dress

- RIGHT size
- RIGHT shape

RIGHT size

WRONG shape

V (Checkmark)
Change your market:
Change your Sweet Spot

Australian Women with 50% Prediction Range
Hip = 405.43 + 0.7908 * Waist

Note different equation:
CAESAR US equation: Hip = 419.15 + 0.8046

Model’s plot position
Effect of shape on fit

Ready-to-Wear Jacket

Made-to-3-D-Body Jacket

RIGHT size
WRONG shape

Bunching

Uneven hem

RIGHT size
RIGHT shape

✓
Change your market:
Change your Sweetspot

Australian Sweetspot is about 1 inch smaller in the hip

1 ¼” different here
7/8” different here
How is our process different?

Use bone 3-D landmarks to produce underlying skeleton

- Bone not visible on surface in scans
- Must be palpated and pre-marked
- CAESAR provides 73 bone landmarks
- SizeUSA provides NO bone landmarks
- Shapely Shadows has NO bone landmarks
- Alvanon has NO bone landmarks
How is our process different?

• Use polygon data format to maintain precision (Not IGES128)
• Use numerically controlled milling & ALL of the approx. 300,000 3-D points
  – Other manikin manufacturers use 1-D measurements extracted from scan, or
  – Reduces data (smoothes) and then uses half so it is different than original
• Mannequin does NOT use mirroring
  – Line of symmetry is a myth
  – Mirroring degrades both size and shape
• Apparel pattern remains symmetrical
SHARP mannequins are:

- Real-body copies - captures size, shape AND posture
- Sitting in the “sweet spot” - representing the majority of your customers
- Grade is determined by sweet spot band - 3-D mannequins available to test grade
- Bio-fidelic - has skeleton and is squishy in the right spots - helps fit
- 3-D communication tool for product development team and QA whose copies can be in multiple locations at once
- Consistent fitting base - doesn’t get pregnant, change weight or age
Typical process

- Select sample from WEAR database to represent target market
- Measure & evaluate location of fit model
- Determine & machine a 3-D base form prototype
- Customer reviews size and shape & form is adjusted
- Produce mould for final form
- Insert accurate skeleton based on 3-D landmarks
- Pour the fleshy portion
- Finish – cover and landmark
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Scan provides 300,000 3-D data points for milling

Mannequin is exact copy of person including skeleton and real landmarks

Garments fitted on this real-body mannequin also fits real shoppers
Benefits

- Improved fit for more customers leading to
  - increased sales
  - increased customer satisfaction
  - brand loyalty
  - less wastage and markdowns
- Increased product development efficiency leading to
  - improved slopers and grading
  - less samples to approval
  - reduced lead times
  - increased through put - reduced opportunity cost
  - increased flexibility in styling
- Improved consistency of fit and QA control
• Hit your target market Sweetspot
• Shaped to fit
• Less dependence on fit model
• Right information
• Right process
• Right fit
• Better tools = better results
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