WEAR:
Worldwide Engineering Anthropometry Resource

26 September 2002

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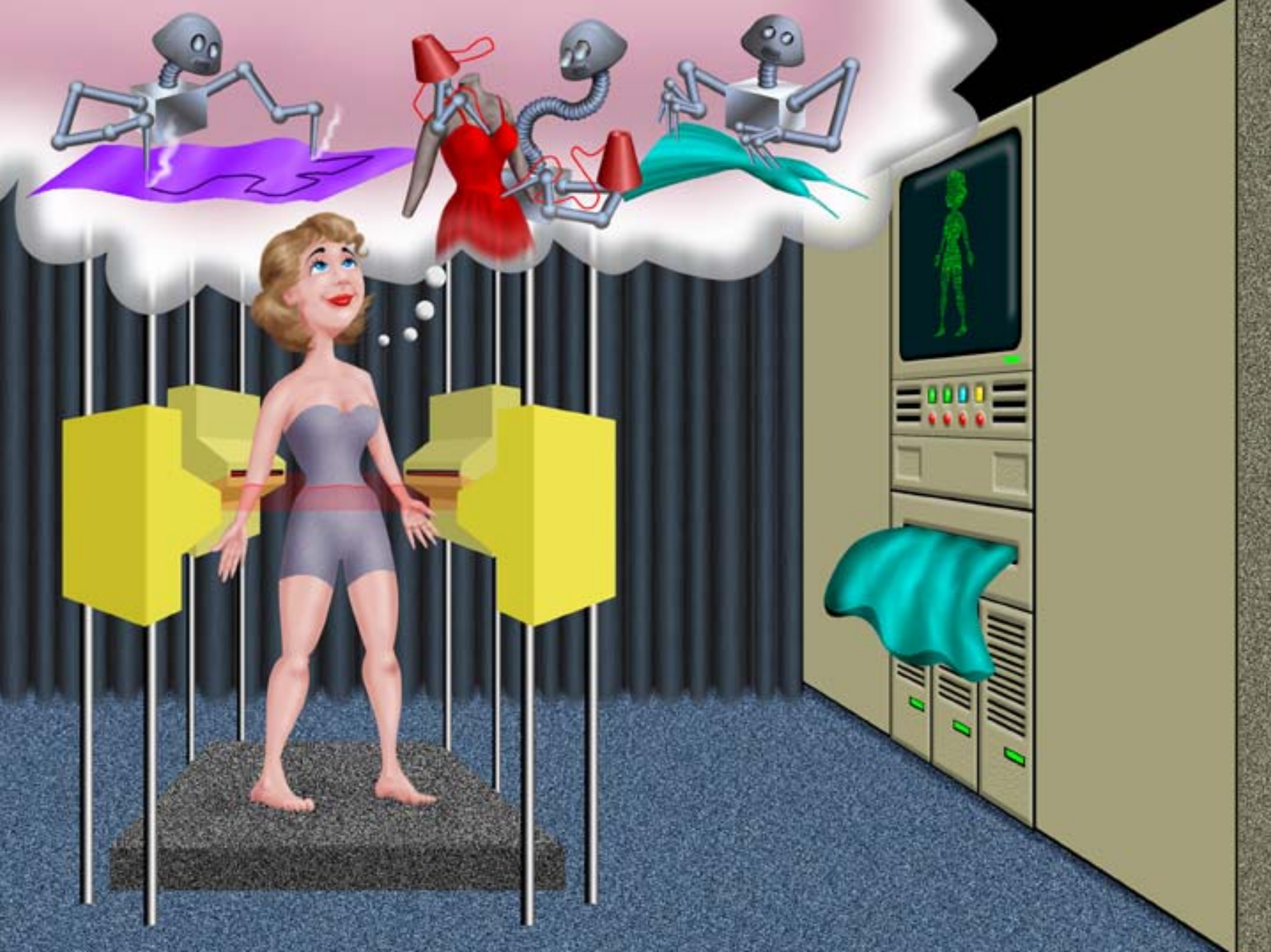



CHEST 35
WAIST 28
HIPS 37

Overview

- How is it done now and what are the limitations?
  - CAESAR and other 3-D Surveys
  - Fit Maps
  - Data Bases
- What is the new approach and how does this help?
- What are the challenges?
- Summary

How is it done now?

- First successful 3-D Surface Anthropometry survey
- Represent anthropometric variability of NATO
  - age (18-65), both genders, ethnicity
  - U.S. (most people), Netherlands (tallest), Italy (among shortest)

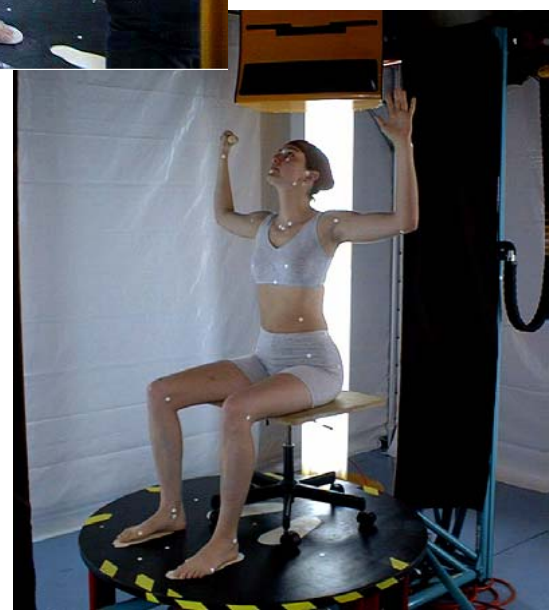
CAESAR™
3-D Anthropometric Database

Products:

✓ First Time Raw Data:
- ✓ More than 13,000 3-D scans
- ✓ 99 traditional style measures
- ✓ 73 3-D landmarks
- ✓ Demographics

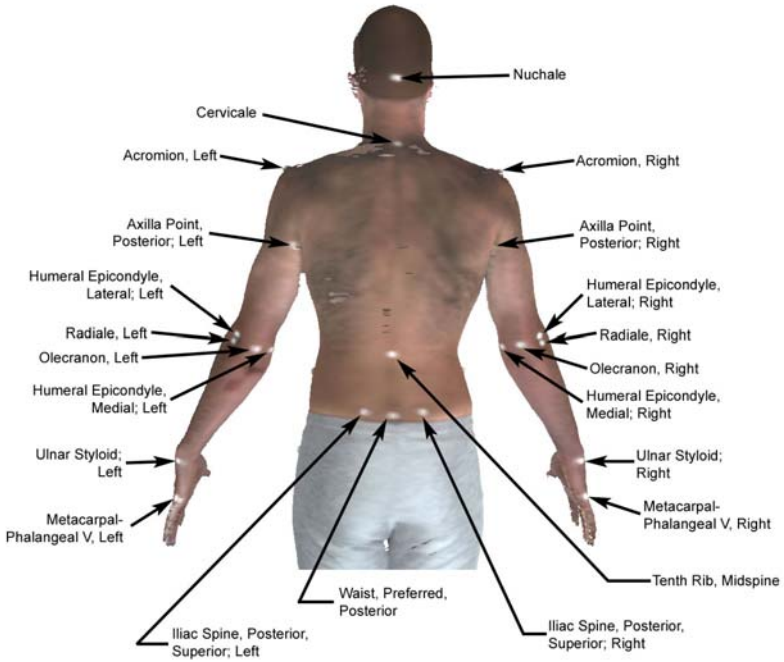
✓ Summary statistics

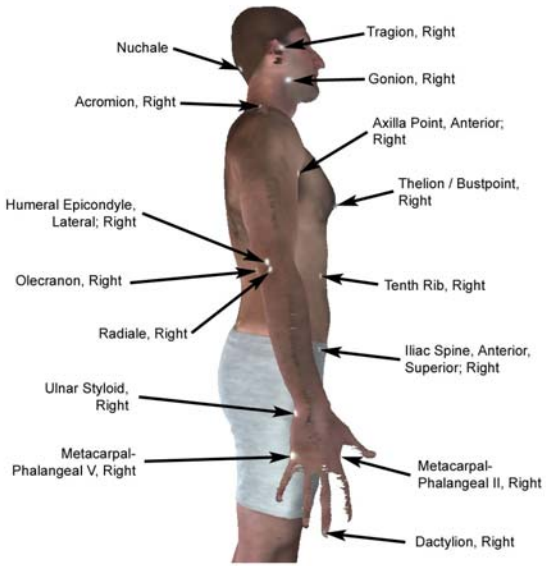
✓ Data collection manual



How is it done now?

- Landmarks are visible in the color file of the 3D scan
- Software is used to extract landmarks location in 3D

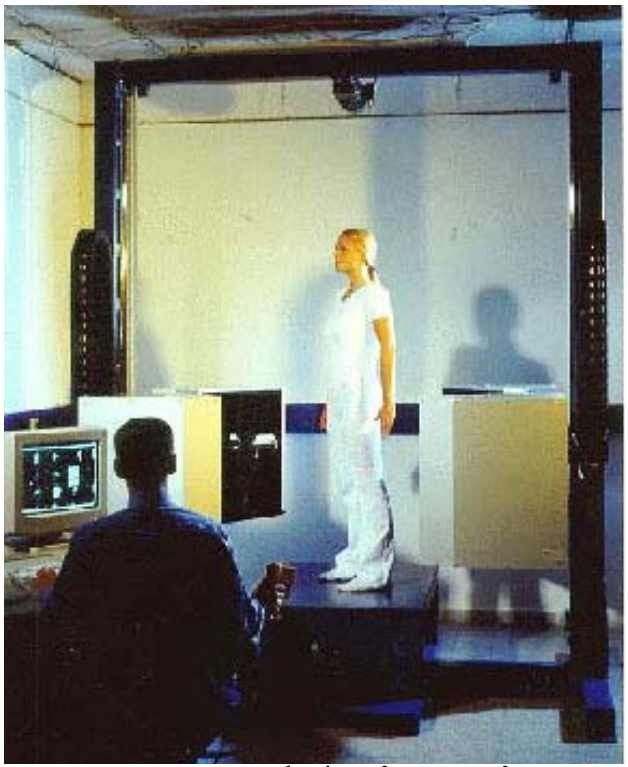




How is it done now?

3D Scanners Used in CAESAR

The Netherlands



Tecmath/Vitronic
Vitus Pro

North America & Italy

Cyberware WB4

BENEFITS

Military

- Why civilian? New roles for women requires body size data for a potential population
- Design for interoperability among NATO

Industry

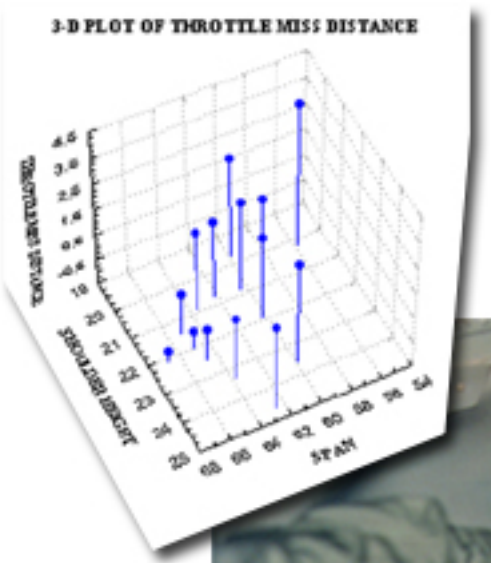
- Made-to-measure and personalized manufacturing
- Web based sales with virtual test drives

Both

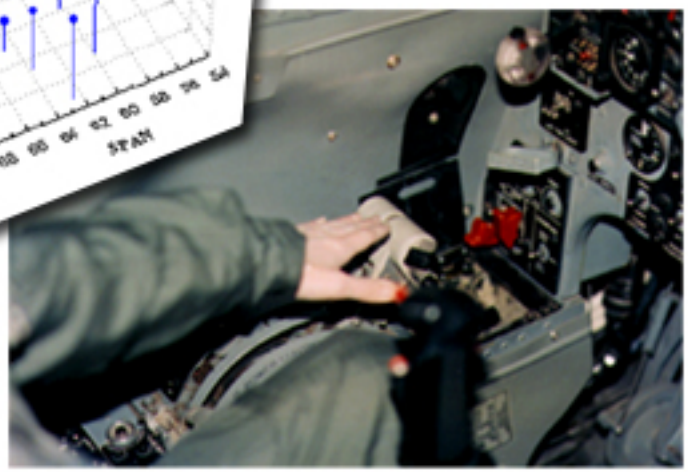
- Increased precision, quality and performance in human systems from apparel to vehicles
- Reduced design and production times and reduced cost.

How is it done now?
Accommodation and Fit Maps

Fit Mapping for Cockpits

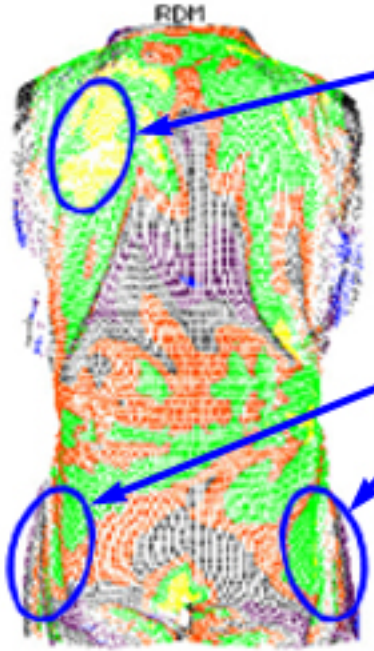


CASE 7 MISSES BY INCHES



EXCLUDES
- 60% JPATS FEMALES
- 2% JPATS MALES
- 23% FEMALE PILOTS
- 1% MALE PILOTS

3-D Fit Mapping for Apparel



Subject #39 Indicates It is Too Tight Here

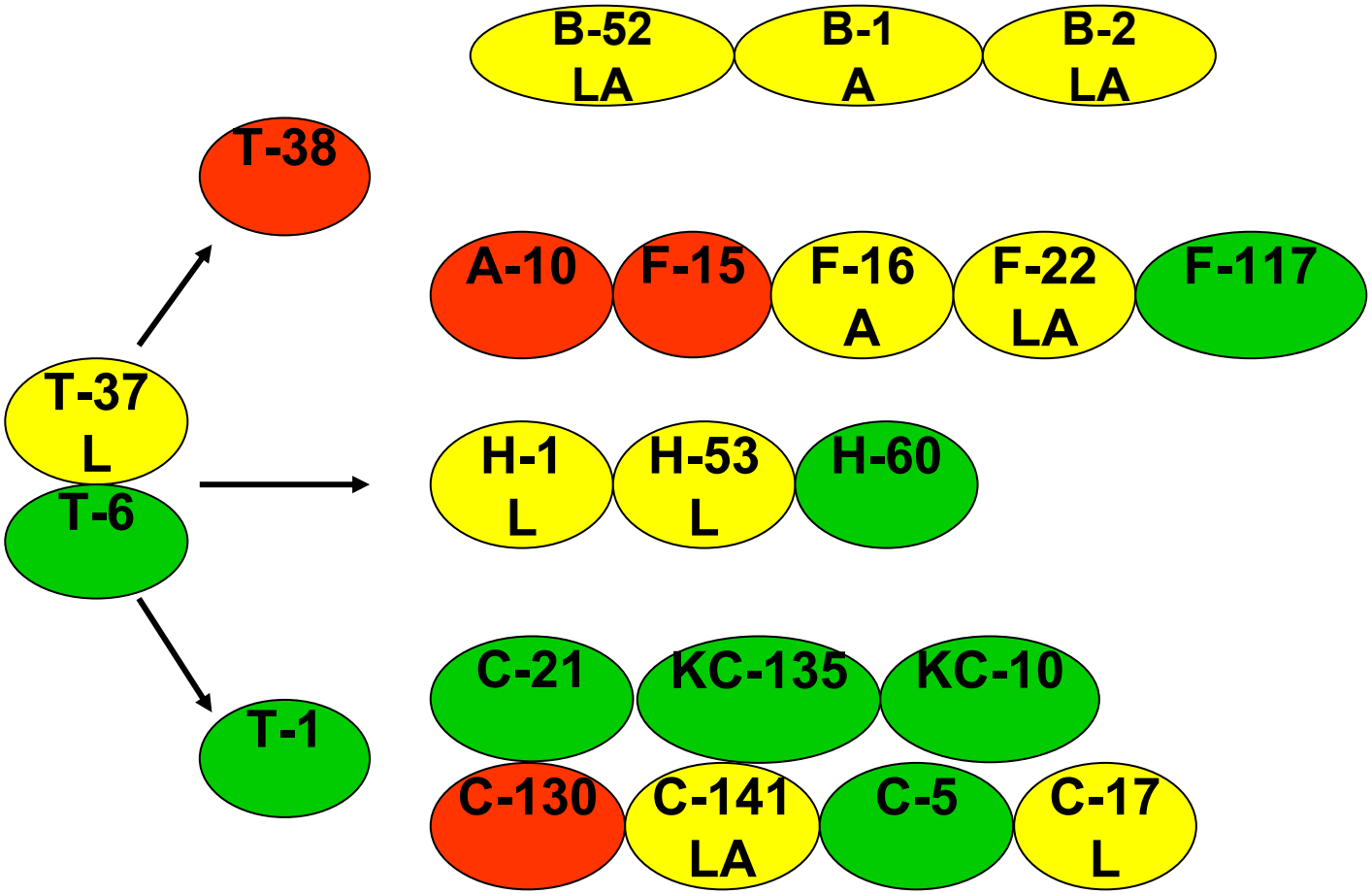
Subject #39 Indicates It Is Too Loose Here

Hip Circ. = 97.9 cm
Shoulder Brdth. = 44.2

Difference	Color
0-10 mm	Green
10-20 mm	Orange
20-30 mm	Grey
30-40 mm	Purple
40-50 mm	Blue
>50 mm	Black
<0	Yellow

How is it done now?
Example: Using Fit Maps

Another visualization



A (63.58/34.65): Eye = 30.79/Leg = 39.92/Arm = 63.35

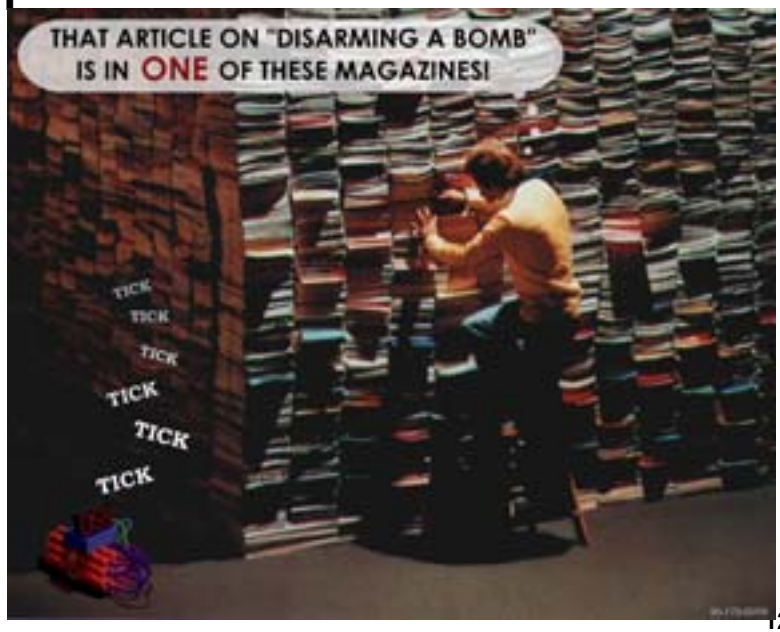
What Are Its Limitations? Accessibility, Searching, and Cost

CAESAR Data Base Alone

One Scan		8.0
3 Postures Per Subject		24.0
4,431 Subjects		106344.0
Number of CDs required		164
Cost Per Megabyte	$	56.42
Cost Per Subject ($2.7 million total)	$	609.34

How is it done today and what are the limitations?

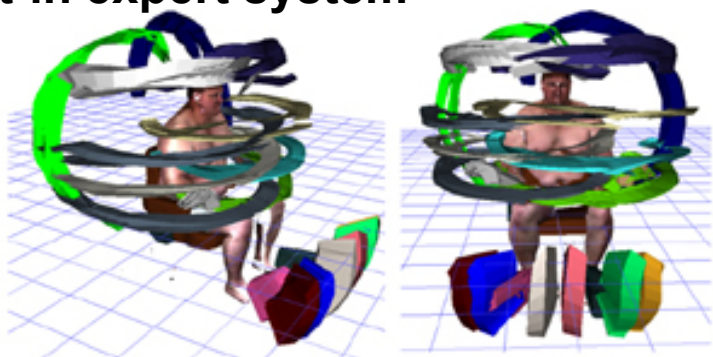
- Correct information is difficult to find and use
- Must contact an "expert" consultant who searches the most relevant resources available and provides a response
- Just data, not information and not on-line
  - Printed texts with summary statistics for 1-D data (mean, standard deviation and percentiles)*
  - One-dimensional data by survey in spreadsheets on CDs
  - Collections of 3-D scans in original scan form on CDs

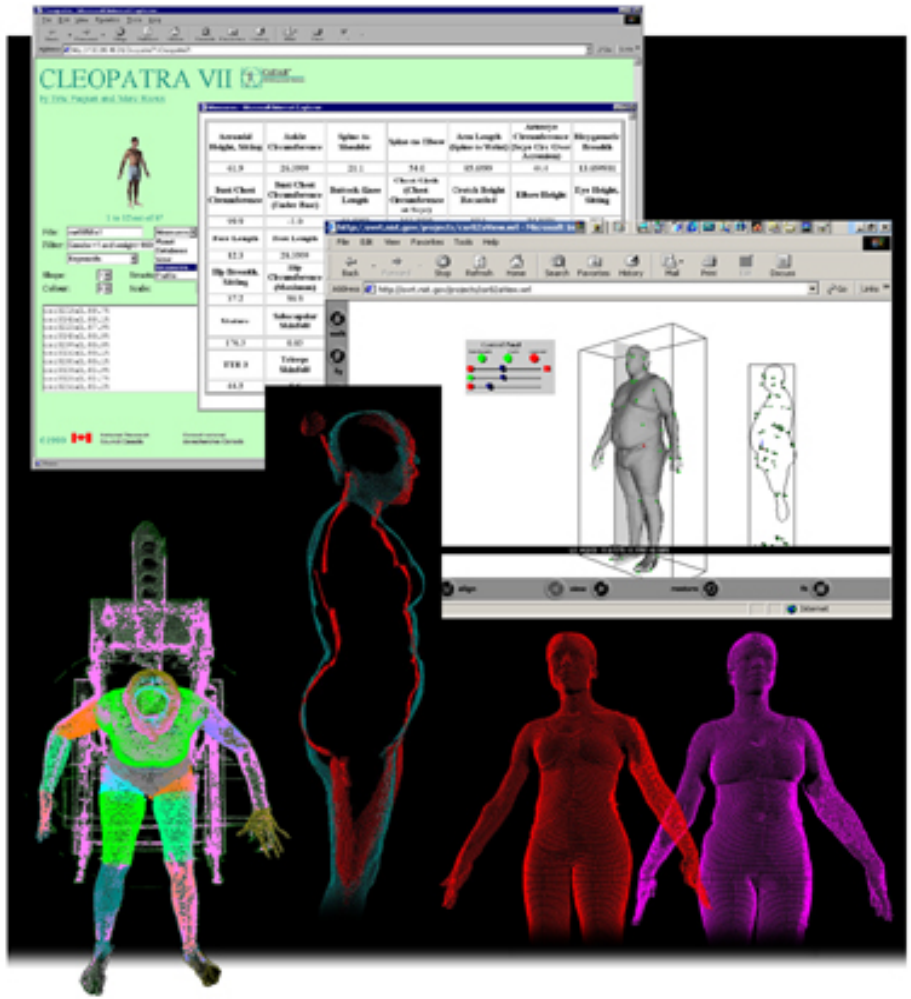


* Note this is the wrong thing to use in engineering!

What is the new approach and how will it help? WEAR

- **Web-based,** comprehensive, international, 3-D size, shape, fit and performance data
- Easier to access information for a large number and variety of users
- **Current, correct solution** obtainable for the problem at hand
- Information is immediately accessible…faster answers
- 3-D visualization
- Built-in expert system





Input

0 END USERS

1 Tasks

2 Environment

3
Users of Product
Origin
Sex
Educational level

4 Product constraints

5 Life cycle of the product and delay before production

Online system

11 Private database

20 Estimate of missing data

6 Database in
1-D
3-D
raw data

21 Statistical tools

Query tools

12 User action log

22 Measurement and sample selection Aid tool

7 Visual index
Dictionary of measurements on morphology

23 Editor of results

8 Databases in biomechanics
- joint
- strength
- motion
- visual field

13 Fit database

24 Statistical Modeling
Secular trend

14 Fit scores database linked to products

9 Digital Man Model Tools

15 Digital Products Prototype

10 Definitions
Glossary + pictures
(domain of validity)

16 Examples
Case studies

26
Maintenance and Update of databases

17 Standards

18 Tutorials

25 Debate forum

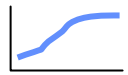
19 Ergonomic guidelines

Output

27
Basic statistical results
1-D 3-D
Tables, mean, σ, histo...

28 Reports about fit mapping

29
Population "customized"
Definition



30
3D models anatomical
1- reference points
2- arcs
3- surface IGES
4-individual scan data

31 Design criteria

World Engineering Anthropometry Resource

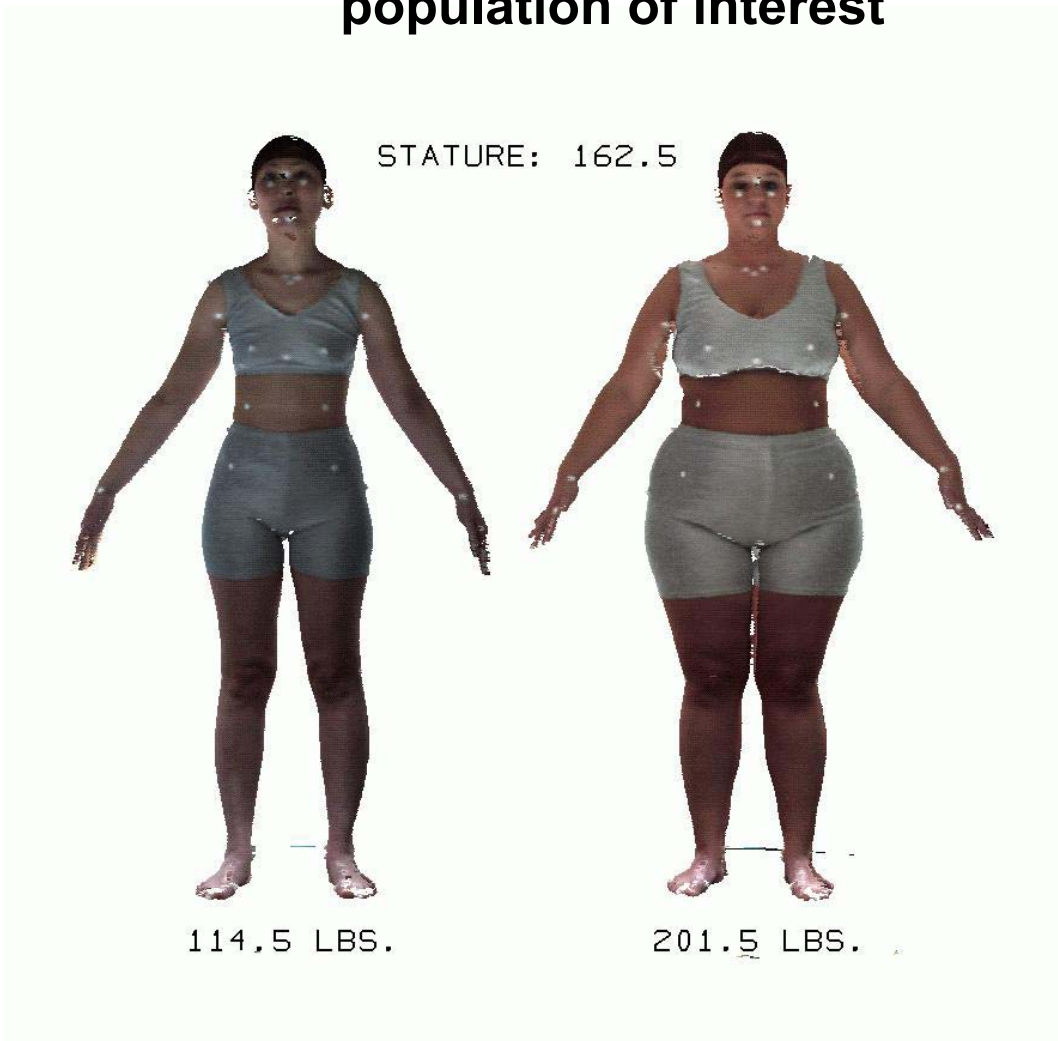
I-wear
Ideal wear

32 Off line
Tutorials - Workshop - End user working group

WEAR
Workshop
Paris-June 2002

How will this help?

Engineer can find sizes and shapes of interest for the population of interest



How will this help?

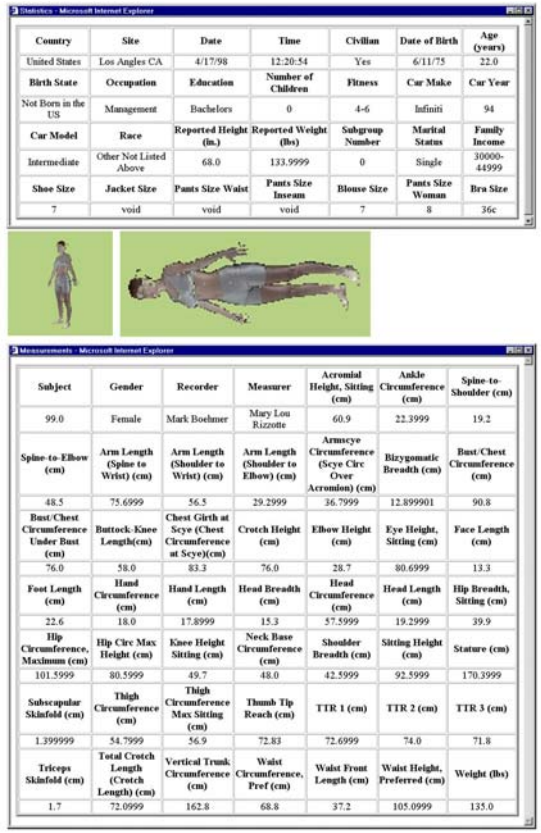
Analysis tools available as part of the system for immediate analysis

DISTANCE	COLOR
Negative	Pink
< 20 mm	Blue
20-40 mm	Green
40-60 mm	Slate
60-80 mm	Gray
80-100 mm	Orange
>100mm	Blue Green

Cost of the data collection and data base input can be shared

Challenges

- 3-D Data collection standards
- Terminology standards
- 3-D shape image searching
- Languages
- Capturing the expert
- International privacy laws
- Image cataloging and data collation
- Intellectual property rights
- Data modalities
- Size of data base
- Security



Country	Site	Date	Time	Civilian	Date of Birth	Age (years)
United States	Los Angles CA	4/17/98	12:20:54	Yes	6/11/75	22.0
Birth State	**Occupation**	**Education**	**Number of Children**	**Fitness**	**Car Make**	**Car Year**
Not Born in the US	Management	Bachelors	0	4-6	Infiniti	94
Car Model	**Race**	**Reported Height (in.)**	**Reported Weight (lbs)**	**Subgroup Number**	**Marital Status**	**Family Income**
Intermediate	Other Not Listed Above	68.0	133.9999	0	Single	30000-44999
Shoe Size	**Jacket Size**	**Pants Size Waist**	**Pants Size Inseam**	**Blouse Size**	**Pants Size Woman**	**Bra Size**
7	void	void	void	7	8	36c

Subject	Gender	Recorder	Measurer	Acromial Height, Sitting (cm)	Ankle Circumference (cm)	Spine-to-Shoulder (cm)
99.0	Female	Mark Boehmer	Mary Lou Rizzotte	60.9	22.3999	19.2
Spine-to-Elbow (cm)	**Arm Length (Spine to Wrist) (cm)**	**Arm Length (Shoulder to Wrist) (cm)**	**Arm Length (Shoulder to Elbow) (cm)**	**Armscye Circumference (Scye Circ Over Acromion) (cm)**	**Bizygomatic Breadth (cm)**	**Bust/Chest Circumference (cm)**
48.5	75.6999	56.5	29.2999	36.7999	12.899901	90.8
Bust/Chest Circumference Under Bust (cm)	**Buttock-Knee Length(cm)**	**Chest Girth at Scye (Chest Circumference at Scye)(cm)**	**Crotch Height (cm)**	**Elbow Height (cm)**	**Eye Height, Sitting (cm)**	**Face Length (cm)**
76.0	58.0	83.3	76.0	28.7	80.6999	13.3
Foot Length (cm)	**Hand Circumference (cm)**	**Hand Length (cm)**	**Head Breadth (cm)**	**Head Circumference (cm)**	**Head Length (cm)**	**Hip Breadth, Sitting (cm)**
22.6	18.0	17.8999	15.3	57.5999	19.2999	39.9
Hip Circumference, Maximum (cm)	**Hip Circ Max Height (cm)**	**Knee Height Sitting (cm)**	**Neck Base Circumference (cm)**	**Shoulder Breadth (cm)**	**Sitting Height (cm)**	**Stature (cm)**
101.5999	80.5999	49.7	48.0	42.5999	92.5999	170.3999
Subscapular Skinfold (cm)	**Thigh Circumference (cm)**	**Thigh Circumference Max Sitting (cm)**	**Thumb Tip Reach (cm)**	**TTR 1 (cm)**	**TTR 2 (cm)**	**TTR 3 (cm)**
1.399999	54.7999	56.9	72.83	72.6999	74.0	71.8
Triceps Skinfold (cm)	**Total Crotch Length (Crotch Length) (cm)**	**Vertical Trunk Circumference (cm)**	**Waist Circumference, Pref (cm)**	**Waist Front Length (cm)**	**Waist Height, Preferred (cm)**	**Weight (lbs)**
1.7	72.0999	162.8	68.8	37.2	105.0999	135.0

Summary

- New kinds of data are here
  - methods, and software to use it is lacking
  - accessibility is limited
- Worldwide need for worldwide data
- Here to discuss how to put the world of anthropometry in the hands of engineers