Anthropometric Activities in IBV

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IBV is a Non Profit Association. It was set up in 1976 by the Polytechnic University of Valencia (UPV) and the Institute of the Medium and Small Enterprises of Valencia (IMPIVA).

It consists of 250 professionals from different academic backgrounds (Engineers, Medical Doctors, Computer Sciences...) that work together in an interdisciplinary approach.
Activities

There are focused in the study of products adapted to the target USE and USER. The aim is to increase the wellbeing, comfort, satisfaction and performance.

- **MECHANICAL INTERACTION**

- **THERMIC INTERACTION**

- **COGNITIVE INTERACTION (COMFORT AND EMOTIONAL DESIGN)**
• The **fitting** is one of the main aspects to develop a comfortable product or environment with a high interaction with the human body.

• The IBV has an **Anthropometric Laboratory** with a 3D body scanner (Human Solutions), a 3D head scanner (I-ware), a 3D Foot/hand scanner (I-ware) and a generic 3D handle scanner (Polhemus).

• The IBV is generating **anthropometric databases of Spanish populations** to advice companies in the product design process to obtain an optimal fitting.
The IBV set up procedures to assess the subjective fitting (by means of questionnaires) and the objective fitting (using pressure sensors).

The IBV set up different systems to measure the pressure by means of sensors located in the surface between the human body and the product.

Crossing the information obtained from the pressure signal treatment, the subjective information, the user characteristics and the product specifications, it is possible to generate design criteria to develop ergonomic product.
Subjective assessment

Usability and performance

- The **usability and performance** of the product is also an important aspect of the product design. It is related to the following aspects:
  - The **interaction** of the product with other environment elements, (e.g., design of fire-fighters garment and their interaction with oxygen bottles, harness, helmet, etc).
  - Related to the **functionality**, the number and location of pockets, the closing systems and regulation, and the easiness to dress and undress are also relevant.
Main areas of activity

IBV activity is strategically focused on the market in the following areas:

- Garment and Footwear.
- Furniture.
- Workplace Ergonomics.
- Automotive.
- Sport equipment.
- Implants and surgical instruments.
- Technologies for the disabled people.
- Paving and floors.
- Tourism and leisure.
Anthropometric study of the female population in Spain
Nowadays, the Spanish cloth manufacturers are not using a common sizing system: a 40% of the females have problems to find their adequate size.
The Minister of Health sign a compromise with the main Spanish cloth manufacturers to integrate the results of the study in a term of 18 months:

- Spanish Association of Designers.
- INDITEX
- MANGO
- Grupo CORTEFIEL
- El Corte Inglés
- Carrefour
Objectives

- Characterize the dimensions and body shape of the females in Spain to:
  - Develop a standard sizing system for the garment industry.
  - Generate information to develop cloth patterns adapted to the real users, in order to improve the cloth fitting.

- Promote a healthy image of beauty with:
  - Mannequins in catwalks and shop windows similar to the mean of the population.
  - Messages to the society of healthy beauty.
Experimental design

• **Stratification**
  - 10 groups of age.
  - 7 geographic areas
  - Size of the city (3 levels)

<table>
<thead>
<tr>
<th>Group of age</th>
<th>Range</th>
</tr>
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<tbody>
<tr>
<td>1</td>
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<td>9</td>
<td>50-59</td>
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<tr>
<td>10</td>
<td>60-70</td>
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</tbody>
</table>

• **Accuracy**
  - The expected level of error is ± 1% for each group of age in the weight variable (level of confidence 95%).
  - For the whole population, the expected level of error is 0.25%.
Experimental design

**SPECIFICATIONS**

- **Sample:** 10,414
- **Locations:** 61 points of measure selected randomly (59 cities)
- **Schedule:** 5 months (field study + basic statistical analysis)
Participants

- **Random process** to select the participants. 8 levels were done to cover the case with no replay.
- A **letter inviting to the participants** was sent signed by the Minister of Health with a free phone to set the contact.
- The appointments were planned from the ‘call centre’ of the Ministry of Health.
- The list of appointments were daily sent to each scanner.
- A SMS was sent automatically to each participant the day before to remember the appointment.

5 people working in this area
Participants

• 18 laboratory technician (physiotherapists, biologist) to take the measurements (3 in each scanner)
• 6 technician to set up the scanner in each location (aprox. 5-6 movements each week)
• 3 technician to review the data in the IBV
• Coordinating: Technical assistance, the development of the database (quality control, security copy, etc) , the flow of users), controlling the locations of the scanner.

35 people working in this area
Pilot study

Objectives

1. Evaluate the procedure to take the measurements.
2. Evaluate the robustness of the 3D scanner and the requirements of the location (space, temperature, light control, cuttings of energy, etc)
3. Flow of users.

Results to set up:
- Logistic structure
- Means of communication data transfer
- Design of the cloth to standardize the measures
- Measurement protocol
Procedure

• Laser scanner (Vitus from Vitronics)
• Antroscan software (from Human Solutions)
Procedure

- Acromion
- Escápula
- Borde inferior de la caja torácica
- Espina iliaca antero posterior
- Cresta iliaca
- Cóndilo medial de la tibia
- Trocanter

STANDARD CLOTH 15 MARKERS
Procedure

STANDARD

STANDING

SITTING
Only 25% of the measurements

POSTURES
Procedure

2D PROFILE OF THE HAND
Procedure

SKINFOLDS

- Accuracy: 0.2 mm
- Range of measure: 0-48 mm

SUPRAILIAC

TRICIPITAL

ESCAPULAR
Procedure

**SOCIODEMOGRAPHIC QUESTIONNAIRE**

- **User characterization**
  - Age
  - Born city
  - City of residence
  - Born city of the parents

- **Aspect related to the health**

- **Aspects related to the diet**

- **Problems buying cloth**
Results

- Percentage of participation in each group of age

![Bar chart showing percentage of population in different age groups.](image-url)
Explotation

- Basic statistical analysis of anthropometric data: mean, percentiles, standard deviation, correlations, graphs,…
- Study of morphotypes.
- PCA and clustering (1D measures).
- Basic analysis of the sociodemographic questionnaires.
- Correlations anthropometry-sociologic variables.
Explotation (work in progress)

- Integrate the basic results in a interactive web page (defining range of age, geographic region, etc.).

- Data analysis to implement the standards EN 13402 (CEN/TC 248/WG 10: **Size designation system of clothing**).

- Generate anthropometric profiles, crossing sociodemographic variables with anthropometric data.
Other anthropometry projects
Anthropometric survey of soldiers

NATO standard: STANAG 2177 (Ed2): Methodology for Anthropometric Data

- Body/foot/hand scanner
- Markers: 11 markers
- Postures: 3 postures
- Sample size:
  - Male: 303
  - Female: 213
- Expected error:
  - 1.2 mm foot length
  - (95% confidence)
- Year: 2007

Sociodemographic/product questionnaires
Anthropometric survey of the foot shape

- 3D anthropometric database of the Spanish adult population (18-70 years old).
  - Sample size: 442
  - Expected error: 1.5% (mean for each size group)
  - Year: 2003

- 3D anthropometric database of the Spanish children population (1-4 years old).
  - Sample size: Female: 394; Male: 434
  - 6 geographic areas
  - Expected error: 1.5% (mean for each size group)
  - Year: 2005
Anthropometric survey of fire-fighters (in progress)

**Objective:** Ergonomic design of the Protective Clothing

**Anthropometric Study**
- Sample size: 300 male
- 11 markers
- 3 postures
- Year: 2008

**Sociodemographic and Product questionnaire**
- Fitting
- Usability
- Interaction with other Personal Protective Equipment, …
Helmet and glove fitting maps criteria (in progress)