Access to Data on the Body Size and Shape of Target User Populations

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Thrust Area New Design Paradigms and Processes
Current TRL 3 - Analytical and experimental critical function and characteristic proof of concept
Final TRL 6 - System prototype demonstration in a relevant environment
Project Type Proposed
Percent Complete 10%

Industrial Relevance

People are often the largest source of variability in the designs with which they interact. Data quantifying the variability in preference and body size, shape, and capability of target user populations are not broadly available. This results in products, manufacturing operations, and environments that range from uncomfortable to dangerous for some of their users.

Application Areas

This project is relevant to the design of anything—a product, a task, an environment—with which individuals might interact. This interaction can occur during the fabrication, use, or maintenance of a product, for example.

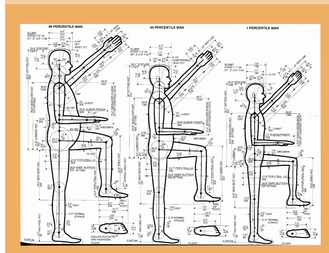
Expected Benefits

This work will enable designers to improve the user-related performance (e.g., safety, comfort, fit) of the products, tasks, and environments with which we interact. It specifically targets the US population and the emerging markets of Brazil, Russia, India, China, and South Africa—populations for which few data are currently available.

Industrial Practice

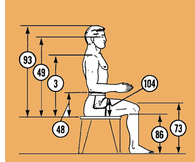
In a study of design professionals, educators, and students, we found that most engineers and industrial designers have few tools to support their Design for Human Variability activities. As a result, they use oudated practices and data or simply design for themselves.

Templates



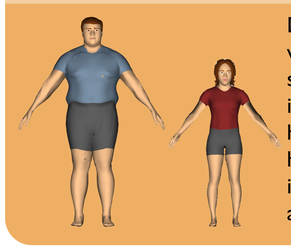
Templates were created in the 1950s as a means of summarizing the body size and shape of target user populations. While initially useful, they have since been shown to produce bad outcomes.

Outdated or Incorrect Populations



Since studies measuring specific populations can be time-consuming and expensive, existing databases are often used. The most common is from the US military in the 1980s.

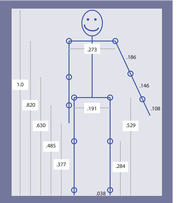
Boundary Manikins



Designs are often evaluated with a single small female and a single large male. This can include the use of digital human models. This approach has also been shown to give inaccurate estimates of user accommodation.

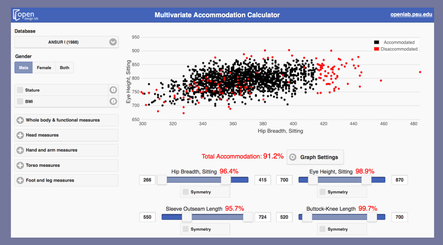
Research Opportunity

Data for a specific target user population can be estimated or "synthesized". Early methods relied on proportionality constants. We now use more sophisticated approaches.



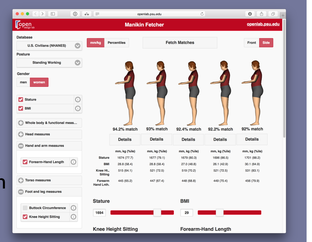
Design tools and processes should be improved to simultaneously consider all the relevant body measures as well as preference uncorrelated with anthropometry.

Previous Work



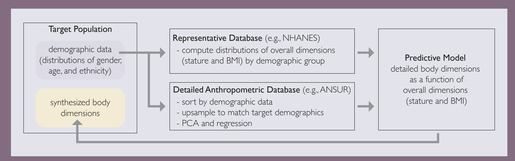
In previous research efforts we have created new methods for synthesizing anthropometry based on Principal Components Analysis (PCA) and a regression strategy that retains the residual variance in the model. These have been validated for the US population and populations in Asia. Designers can specify the demographics of their target user population and we can provide detailed anthropometry.

We have also developed web-based design tools that provide access to the synthesized anthropometry. They allow designers to specify constraints based on a candidate design and obtain an overall population accommodation estimate.



Approach and Methods

The large difference between available data and target user populations necessitates new approaches for synthesis.

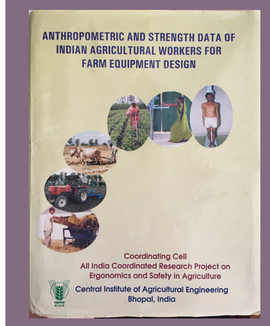


In the US we use data from the National Health and Nutrition Examination Survey (NHANES) to estimate the gross anthropometry (inputs to the model).

For Brazil, Russia, India, China, and South Africa we will use data from studies conducted by the World Health Organization.

Having detailed anthropometry instead of just summary statistics enables new types of multivariate analysis, specifically Virtual Fitting Trials (VFT).

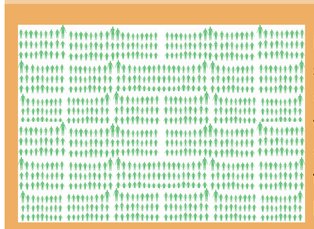
Validation



The method has been validated against detailed published anthropometry for the US and Japan.

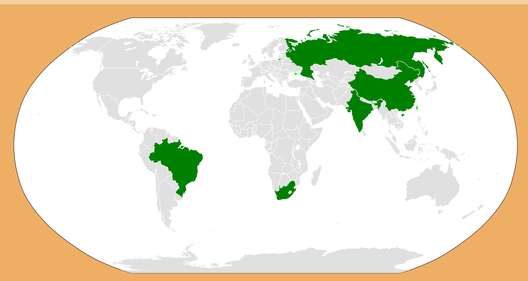
For some populations (e.g., India) we will be able to validate the synthesized anthropometry against published summary statistics.

New Practice



Detailed anthropometry for a large number of individuals enables Virtual Fitting Trials which provide accurate estimates of accommodation for the target user population.

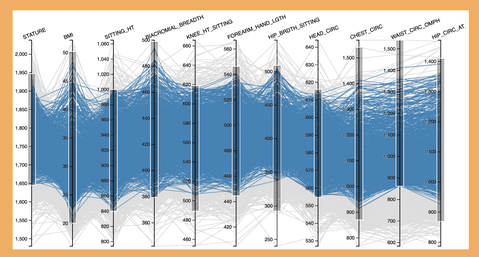
Global Populations



This effort will result in, for the first time, publicly available data on the body size and shape of the BRICS civilian populations.

Multivariate Analysis

New techniques for multivariate analysis will enable the simultaneous consideration and visualization of relevant measures.



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