

DEVELOPMENT OF ANALYTICAL TOOLS TO PROCESS AND APPLY DIGITALLY SCANNED ANTHROPOMETRIC DATA

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Anthropometric data are needed to determine whether or not a device or tool can be designed to accommodate most of the population; on the other hand, anthropometric data is also used to ensure that an item fits a specific group of people. For example, when automakers design cars, their goal is to ensure that their cars can accommodate most of the population. Hence, they use population-based anthropometric data to provide adequate adjustability within each car so that each and every car can accommodate almost everyone. There are instances, however, where it is not possible to provide adjustability in each device to accommodate the whole population. The clothing industry is a very good example of this case. The clothing manufacturers' goal is to come up with a certain number of sizes in such a way that each size will accommodate some of the population. In both cases, one needs anthropometric data that are specific to the application. Until recently, almost all anthropometric analyses as well as computer graphics generated human figures were based on anthropometric data that were gathered uni-dimensionally. There are numerous databases that provide volumes of information that were collected using this traditional method (Anthropometric Survey of U.S. Army Personnel, 1988; NASA Reference Publication No. 1024, 1978; Japanese anthropometric data handbook, 1988). The Anthropometric and Biomechanics Facility (ABF) at the Johnson Space Center has also been responsible for gathering and analyzing the physical dimensions of astronauts and astronaut applicants. The ABF maintains a database of anthropometric data from over 900 astronaut applicants (including astronauts who were selected since 1985). The ABF gathers about 28 joint specific and body segment specific anthropometric data which have been used to conduct specific workplace, hardware evaluations.

Unfortunately, uni-dimension based anthropometric databases are not adequate enough to generate human models with computer graphics. It is primarily due to the fact that uni-dimensional anthropometric data are not comprehensive enough to perform volumetric analyses and are therefore, cumbersome to develop human-like figures. In addition, uni-dimensional anthropometric databases do not include surface contours of body segments and volumetric data. Hence, graphical representations of human figure models have not been accurate and appealing. With the advent of laser scanning technologies, it has become possible to gather two- as well as three-dimensional anthropometric data. Three-dimensional anthropometric data are capable of providing a better representation of physical attributes in computer-graphics-based human models and may enhance the analytical capabilities of conducting human-work interface evaluations.

The primary objective of this funded project is to enhance the capabilities of the Anthropometry and Biomechanics Facility (ABF), specifically in the areas of handling and developing analytical tools for three-dimensional anthropometric data. The ABF will

be acquiring 3-D scanned data of 126 astronauts from the CEASAR project (Wright Patterson Air Force Base). The whole-body scanned data is a relatively new way of gathering anthropometric data and there are simply no complete sets of analytical tools anywhere in the market. In order to accomplish the objective of this project, the following three goals are identified:

- 1) Develop analytical software tools to process whole-body scanned data.
- 2) Verify, modify, and validate the analytical software results
- 3) Develop statistical analysis software to perform Gap analysis on existing space hardware.

The secondary objective of this project proposal is to develop a methodology to perform whole-body percentile analyses. Percentile data are useful to determine the limit range of certain body segment or a dimension (such as arm reach, height, etc.). Normally, these data are available in several of the above mentioned anthropometric hand books. However, to represent a 5th percentile or a 95th percentile American male in a computer-generated graphics environment, users were limited to predicting other dimensions through analytical models outlined by Chaffin and Andersson (1984). While these models are helpful to accomplish the task of developing human models, our experience with these models has shown that the results from manipulating human figures based on predictive data are often inaccurate and yield imprecise results. Hence, we are working with the anthropometric personnel at the U.S. Army R&D Center (NATICK) and the WPAFB personnel to create an analytical tool that will generate a human model based on an actual person's whole body scan whose specific uni-dimensional or a composite dimension (leg reach at a specific knee and hip angle) is representative of user-defined percentile.

In our presentation at the upcoming Space Human Factors workshop, we will outline our objectives and goals and present our accomplishments so far. Finally, we will also present a roadmap that details milestones and intended major accomplishments.