ABSTRACT: Anthropometry and Biomechanics Facility Presentation to Open EVA Research Forum

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NASA is required to accommodate individuals who fall within a 1st to 99th percentile range on a variety of critical dimensions. The hardware the crew interacts with must therefore be designed and verified to allow these selected individuals to complete critical mission tasks safely and at an optimal performance level. Until now, designers have been provided simpler univariate critical dimensional analyses. The multivariate characteristics of intra-individual and inter-individual size variation must be accounted for, since an individual who is 1st percentile in one body dimension will not be 1st percentile in all other dimensions. A more simplistic approach, assuming every measurement of an individual will fall within the same percentile range, can lead to a model that does not represent realistic members of the population. In other words, there is no '1st percentile female' or '99th percentile male', and designing for these unrealistic body types can lead to hardware issues down the road. Furthermore, due to budget considerations, designers are normally limited to providing only 1 size of a prototype suit, thus requiring other possible means to ensure that a given suit architecture would yield the necessary suit sizes to accommodate the entire user population.

Fortunately, modeling tools can be used to more accurately model the types of human body sizes and shapes that will be encountered in a population. Anthropometry toolkits have been designed with a variety of capabilities, including grouping the population into clusters based on critical dimensions, providing percentile information given test subject measurements, and listing measurement ranges for critical dimensions in the 1st-99th percentile range. These toolkits can be combined with full body laser scans to allow designers to build human models that better represent the astronaut population. More recently, some rescaling and reposing capabilities have been developed, to allow reshaping of these static laser scans in more representative postures, such as an abducted shoulder.

All of the hardware designed for use with the crew must be sized to accommodate the user population, but the interaction between subject size and hardware fit is complicated with multi-component, complex systems like a space suit. Again, prototype suits are normally only provided in a limited size range, and suited testing is an expensive endeavor; both of these factors limit the number and size of people who can be used to benchmark a spacesuit. However, modeling tools for assessing suit-human interaction can allow potential issues to be modeled and visualized. These types of modeling tools can be used for analysis of a larger combination of anthropometries and hardware types than could feasibly be done with actual human subjects and physical mockups.