Paper Title: A Comparison of Methods for Assessing Space Suit Joint Ranges of Motion

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Abstract:
Through the Advanced Exploration Systems Program, NASA is attempting to use the vast collection of space suit mobility data from 50 years worth of space suit testing to build predictive analysis tools to aid in early architecture decisions for future missions and exploration programs. However, the design engineers must first understand if and how data generated by different methodologies can be compared directly and used in an essentially interchangeable manner. To address this question, the isolated joint range of motion data from two different test series were compared. Both data sets were generated from participants wearing the Mark III Space Suit Technology Demonstrator (MK-III), Waist Entry I-suit (WEI), and minimal clothing. Additionally the two tests shared a common test subject that allowed for within subject comparisons of the methods that greatly reduced the number of variables in play. The tests varied in their methodologies: the Space Suit Comparative Technologies Evaluation used 2D photogrammetry to analyze isolated ranges of motion while the Constellation space suit benchmarking and requirements development used 3D motion capture to evaluate both isolated and functional joint ranges of motion. The isolated data from both test series were compared graphically, as percent differences, and by simple statistical analysis. The results indicated that while the methods generate results that are statistically the same (significance level p= 0.01), the differences are significant enough in the practical sense to make direct comparisons ill advised. The concluding recommendations propose direction for how to bridge the data gaps and address future mobility data collection to allow for backward compatibility.