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Abstract:

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Pilot validation for anthropometric measures of offshore workers using 3-D laser scanning

INTRODUCTION: When developing workspace design and clothing sizing strategies, anthropometric databases are used to obtain measurements appropriate for the design task. (Das & Grady, 1983) Notably missing from ergonomics literature are databases focussed on industrial populations and most relevant to this study, offshore workers. Databases are difficult and expensive to obtain, however recent imaging technology shows promise in rapid data collection, acceptable measurement accuracy, and repeatability at a low cost. The purpose of this pilot study is to evaluate the validity of measurements extracted from a commercial three-dimensional laser scanner relevant to the offshore worker population. Representative dimensions of both linear and volumetric characteristics were obtained on a sample of subjects.

METHODS: Twenty participants (11 males and 9 females) underwent manual palpation of anthropometric landmarks over 24 sites. Spherical white markers (1-cm) were attached to the skin surface over the landmarks. Trained assistants measured 33 linear and 14 volumetric dimensions on each participant using standard anthropometric equipment and techniques. Each dimension was collected three times. Participants were then scanned three times; each scan took approximately 45 seconds. Using an independently developed software package designed in the OEAB Lab, the linear and volumetric dimensions were extracted from the scans for comparison to the manually-collected measurements.

The scan-extracted measures were compared using the methodology provided in ISO20685:2010(E) (only applicable to linear measures). The 95th percent confidence interval of the mean differences (manual-scan) for all dimensions were calculated. Given our previous work on error measurement in the laser scanner (Westhaver, Ladouceur & Kozey, 2013), linear regressions analyses were used to model the scan-extracted measurements (models that included some combination of scan-extracted measures, manual stature, and manual mass). The 95th percent confidence intervals of the residuals of the regressions were computed and compared to the ISO allowable errors.

RESULTS: In the majority of cases the use of the regression analysis allows us to obtain linear measures close to, or within the ISO guidelines (24 cases of 33). Furthermore, in 11 of 14

segmental volume measurements, the 95th percent confidence interval of residuals of regressed volume values were less than ±10% of the value of the mean regressed values. Given an absence of standardization for allowable error for segmental volumes, on a preliminary basis this is an acceptable amount of error.

CONCLUSIONS: Given that ISO20685:2010(E) suggested a sample size of 40 for the validation of laser scanning apparatus, our regressed results show promise, with a significantly smaller sample size. The next phase of the study will involve making recommended changes to hardware and software in order to increase the quality of scan-extracted measurements. It has been shown that modeling scan-extracted measurements with regression equations can greatly improve the quality of measurements extracted from a three-dimensional laser scanner.