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Comparison of Case Selection Method and Percentile in Anthropometry Seat Design

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ABSTRACT

Toward creating ergonomics products, anthropometry plays a significance role in the development process. The objective of this study is to compare the usage of the case selection method and the usual percentiles method in analysing the anthropometric data. The seat anthropometry for military truck was chosen for this study. Measurements were made using image processing system which was based on self-improved MATLAB program from the open source. From the measured parameter studied in the truck seat design, the seat could only fit 80% of the population if the design is based on 5^{th}- 95^{th} percentiles. However, when case selection method was applied, the parameters could accommodate up to 90% of the population. It can be concluded from this study that the anthropometry data that was established according to case selection method is more highly populated rather than using percentile method. Hence more people could be accommodated for the design parameters using the case selection method. This results show that the usage of case selection method is more accurate and precise in analysing the anthropometric data.

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INTRODUCTION

Anthropometry has been considered as the very basic core of ergonomics in an attempt to resolve the dilemma of 'fitting people to machine' (Wang, E.M.Y., 1999). Bridger (1995) and Chou and Hsiao (2005) believed anthropometry is a research area in ergonomics dealing with the measurement of human body dimensions and certain physical characteristics. Anthropometric data can be used in ergonomics to specify the physical dimensions of workspaces, workstations, and equipment as well as applied to product design. The use of anthropometric data in the early design concept stage can minimize the size and shape changes that might be needed later which can be very expensive and wasteful (Robinette, K.M. and J. Hudson, 2006). Database containing both anthropometry and fit-mapping data can be used as a lessons learned source for development of new product. Therefore, anthropometry and fit mapping can be taught of as an information core around which products are designed (McDaniel, J.W., 1996). Seat fit parameters studies in seat design had been studied by several researchers such as Daruis *et al.* (2010), Kolich (2003), Tilley (2002), Pheasant (1996) and Reed *et al.* (1994). From the studies, the fit parameters that usually important in designing seat are the backrest width, backrest height, cushion, length and cushion width. Their studies also show different value of seat fit parameters between diverse populations even from same Asian regions.

Traditionally, anthropometry measurements are done manually involving measuring tape and long ruler. There are also several modern methods in anthropometry measurement such as body scanner and Faro-Arm. However, these methods are very expensive and immobile. One solution is by using picture recognition or image processing method which is relatively low cost and transportable. Simple programming of Matlab can be used to develop picture recognition software. Mohamad (2010) discussed about integration of comfort into a driver car seat design using image analysis method. Both anthropometric data and postural angles collected in this study were measured and recorded by using the photographic technique and analysed further using software.

During the early development stage of seat evaluation, selecting the appropriate subjects that represent potential or real users of the seats is important. The height of subject is an important criterion and designing is commonly taken from the 5^{th} to 95^{th} percentiles. However, Robinette and Hudson (2006) suggested that percentiles only covered 90% of the population therefore proposed the case selection method as the alternative

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to select a particular value from anthropometry database. In this study, seat for military truck was chosen as a case study. The anthropometry data were analysed using two methods that are the case selection and percentiles. The objective of this study is to compare the usage of the case selection method and the usual percentiles method in analysing the anthropometric data.

Experimental Procedure:

A total of 100 respondents were selected as sample in this study. Low cost image processing system using normal camera were used and the system was run using simple MATLAB programming. The parameters measured were chest width, upper body height, buttock knee length and sitting knee height. The red markers were placed between the joints of the parameters. The picture recognition software was developed using improved MATLAB image programming. It is a window executable file. It is equipped with button for all the execution process and also command box to guide each step.

RESULTS AND DISCUSSION

The seat design parameters from the anthropometry measurement were analysed using case selection method and percentile method. Population coverage using case selection method is expected to be higher rather than using percentile method. The measurement for chest width and upper body height is under one constraint that is seat back design and for buttock knee length and sitting knee height is under seat design. The data for four critical dimensions above were recorded in histogram. As for percentile method, the value from 5^{th} and 95^{th} percentile could be taken directly from histogram as illustrated in Figure 1. The red intersection line represents the percentile value for sitting knee height and buttock knee length.

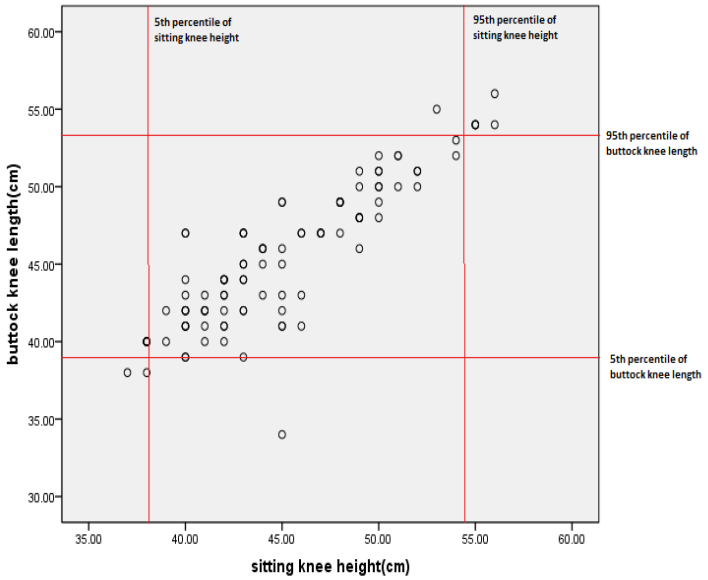

Fig. 1: Percentile method using buttock knee length and sitting.

For case selection method, the critical dimensions the 90% population of sample were selected by enlarging the elliptical boundary. Boundaries are representing extreme combinations of the measurements as illustrated in Figure 2. The symbol star represents the extreme combinations between buttock knee length and sitting knee height. The enlarged elliptical boundary represents the 90% of the population between buttock knee length and sitting knee height.

Anthropometry data that was established according to case selection method can cover more population than using the usual percentile method. The critical dimensions using case selection method is recognized to be more extreme and able to accommodate more ranges of people in their design parameters. This result is aligned with the statement from Robinette & Hudson (2006) that suggested more population can be included in the design parameters as compared to using percentiles. Table 1 show the comparison in value for seat parameters between case selection method and percentiles method.

Table 1: Comparison anthropometry data for truck seat design parameters between case selection method and percentile.

Parameter	Percentile	Case selection method
Chest width	48cm	49.5cm
Upper body height	53cm	54.5cm
Buttock knee length	39cm	38cm
Sitting knee length	38cm	37cm

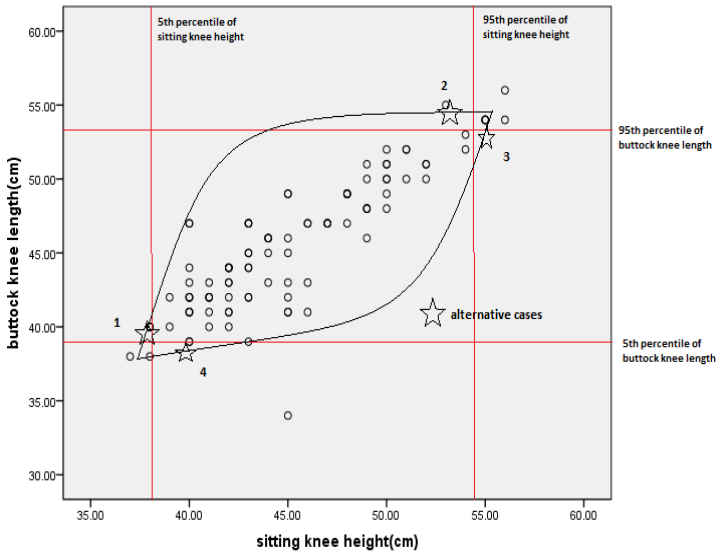

Fig. 2: Case selection method using buttock knee length and sitting knee height.

Conclusion:

In conclusion, this study had able to analyse the seat anthropometry for military truck focusing on case selection method and percentiles method. Results shows that the anthropometry data established using percentile method are; chest width, 48 cm; upper body height, 53 cm; buttock knee length, 39 cm and sitting knee height, 38 cm. However for anthropometry data using case selection method more extreme dimensions were included. Measurement parameter for chest width is 49.5 cm, upper body height is 54.5 cm, buttock knee length is 38 cm and sitting knee height is 37 cm. These parameters could accommodate up to 90% of population. It can be concluded from this study that the anthropometry data that was established according to case selection method is more highly populated rather than using percentile method. Hence more people could be accommodated for the design parameters using the case selection method.

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