DIGITAL ELDERLY HUMAN BODY MODELING FOR CRASH SAFETY SIMULATION

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INTRODUCTION

Elderly populations in our society are on the rapid increase. Accordingly, their growing traffic accident injury and fatality rate becomes one of the important societal problems. There is a pressing demand for the elderly human body model reflecting the vulnerable biological characteristics of the elderly people in automotive crash safety applications

METHODS

Our study on developing a Korean standard elderly human body model, which is a part of government R&D project titled "Enhanced Safety Comfort for Older People on Road Transport" supported by Korean Ministry of Land, Transport, and Maritime Affairs, has been started with the first mission of determining the representative body size and shape of domestic elderly population. The target group in our study is Korean males over 65 years old and there were 527 male subjects with average age 72 years old in two-year ('03-'04) notional survey database, SizeKorea, (total surveyed number in SizeKorea database was 14,200 of 0-90 years old). The 50th %tile height and weight of the subjects in target group were 162.8cm and 63kg, respectively. A factor analysis on fifty nine direct measurements of body dimensions was performed to decide primary anthropometric parameters for the volunteer selection. Four other primary parameters than height and weight were waist height, waist girth, bust girth, and sitting height. One third of standard deviations from the 50th %tile height and weight were chosen as a band width for the volunteer recruitment which is the first stage selection process. The volunteers were recruited by local advertisements and the second stage selection process to pick up the final volunteer (Table 1) for the study was carried out in the Lab. by measuring the four other primary parameters.

Table 1 Anthropometry of select volunteer

Items	SizeKorea	Volunteer
Age	72.4	71
Height (cm)	162.8	162.7
Weight (kg)	63.0	63.9
Sitting height (mm)	787 ~ 917	856
Waist height (mm)	914 ~ 1005	977
Bust girth (mm)	847 ~ 973	920
Waist girth (mm)	780 ~ 932	873

RESULTS AND DISCUSSION

The exterior geometry of selected volunteer were obtained by 3D full body laser scanning (scanning equipment model: Cyberware WB4) in occupant posture (Figure 1). The internal anatomy measurements were also performed through the medical imaging techniques such as CT scanning, X-ray, and ultrasonic to secure precise skeleton and organ positions and shapes. Eight domestic fresh cadavers which has similar anthropometry and age of standard 50th %tile elderly were employed to measure average cortical bone thickness and trabecular BMD (bone mineral density) distributions. The collected geometric information will be utilized to build anatomically detailed finite element elderly human body model.

Figure 1: Scanned images of 50th %tile standard elderly

Some smoothing and minor modifications of the data was required to combine the exterior and interior CAD models for the sitting posture when the interference between adjoining parts was encountered. The flesh margin and bone depth data obtained by ultrasonic measurements was used for fine-tuning during the fitting process. The constructed CAD models consist of skin surface and skeletons in both supine and sitting postures are shown in Fig. 2. There are noticeable differences in lumbar spine curvature and hip/knee/shoulder/elbow joint angles between supine and seating postures.

Figure 2: Comparison of skeletal articulations in supine and sitting postures

CONCLUSIONS

A 50th %tile elderly human body model for crash safety simulation is under development. The target group is Korean male population over 65 years of age. The collected morphologic data of elderly human body was all put into a single CAD model. The ageing affect on tissue properties and joint characteristics are under the investment. The following step of this study will be a finite element modeling of elderly human body based on the developed CAD geometry.

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