Characteristics of Passenger Motion Response in Autonomous Emergency Braking System Operation with Alteration of Body Type and Posture

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I. INTRODUCTION

In general, the role of the Automobile Emergency Braking System (AEBS) is to prevent collisions and protect passengers from possible collisions. Installation of AEBS has been regulated in many countries for safety of passenger and prevention of pedestrian accident by vehicle **[1]**. However, the general control method of AEBS is not consider for all collision situations. Furthermore, researches performed recently related to AEBS are insufficient to address the effects of AEBS operation with alteration of body type and posture of the passenger. **[3][4][5][6]** The purpose of this study, therefore, is to identify the characteristics of occupant motion response in AEBS operation with alteration of body type and posture for explanation in detail of the effects of AEBS operation.

II. METHODS

Body Type Model

All Hybrid III dummy models (Hybrid III 50th percentile Male (M50), Hybrid III 5th percentile Female (F05) dummy and Hybrid III 95th percentile Male (M95) dummy) were selected based on representative three body types. Of these, the M50 dummy was considered the body type of the standard adult driver.

Test Protocol

The experimental control protocol in the Sled Test was set similar to the behaviour of the actual vehicle, and the braking rate of 0.8 G was performed within 7 seconds(700ms). Assigned variable conditions are the seat-back angle (17°, 32°) and the pre-safety belted (PSB) control with seat position(Fore, Mid, Rear); Total 36 cases(see Table I). Measures included seatbelt pre-tightening, seatbelt force control and seat-back motion control. Three-dimensional motion capture system with 16 infrared cameras (T-10s, Vicon Motion Systems Ltd., UK; sampling rate: 200 Hz) and 74 reflective markers were used to quantify kinematic characteristics by measuring four anatomically based segments of body. (see Fig. 1)

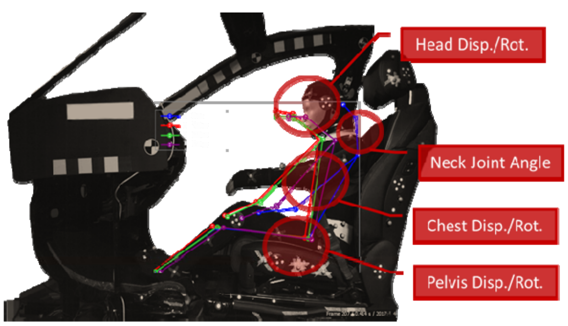

Fig. 1. The AEBS sled operation with dummy(the red circles is main measurement range in test)

Table I. Test Matrix

Model	Seat Position	Seat Back Angle	Pre-Safety Belt
F05	Fore	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off
	Mid	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off
	Rear	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off
M50	Fore	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off
	Mid	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off
	Rear	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off
M95	Fore	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off
	Mid	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off
	Rear	17°	PSB On
			PSB Off
		32°	PSB On
			PSB Off

III. INITIAL FINDINGS

According to the test results, the control with all body types showing the minimum amount of displacement is a model with seat-back angle of 17 °, PSB control. However, the amount of rotation and neck joint angle varies depending on the characteristics of the body. Through the distribution of the result data, the following can be

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deduced. Customized active control of ABES by body types requires differentiation of lead time. Because, it is effective to increase the time about reduce the weight inertia. The average ranges of maximum displacement and rotation of each posture in the experiment are shown in Fig. 2(The red squares indicate the minimum displacement activity; Ideal behavior range; The analysis data, including the Seat position, will be mentioned in

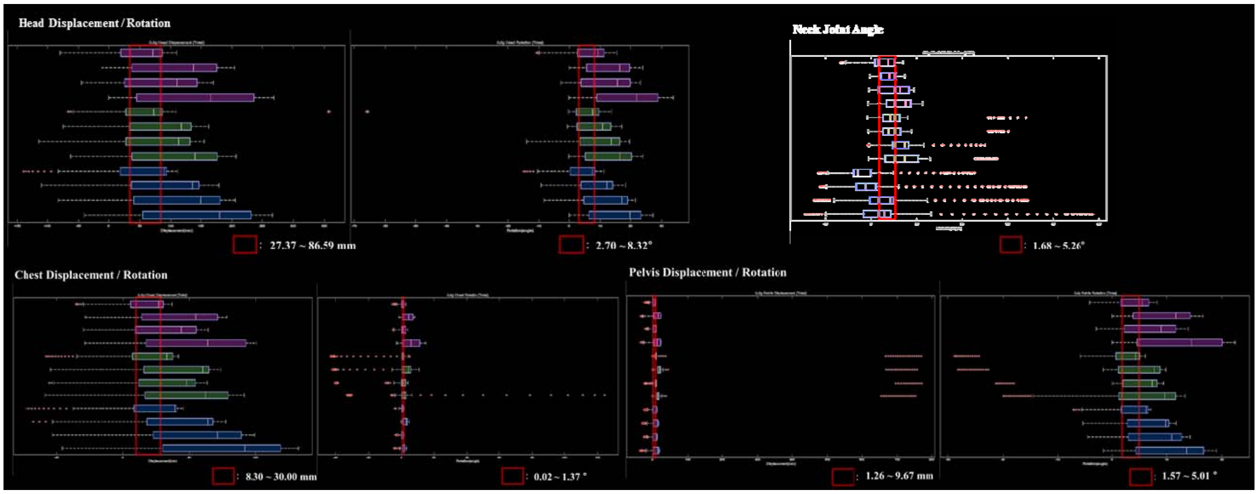

Fig. 2. Comparison ranges of displacement and rotation data graph on tests(Boxplot).

the short communication because of the large quantity.).

Through the above data, dummies other than M50 (F05, M95) showed greater fluidity at out of position (OOP). The difference between the standard body type M50 (total sitting height: 883.9 ± 5.1 mm, W: 77.70 ± 1.2 kg) and the other case is the increase of displacement and rotation amount for different reasons. I think the cause may be found in the neck joint. Another interesting point is data on the chest and pelvis. Data of displacement and rotations was shown similar trends with crossed in each other.

IV. DISCUSSION

In this experiment, we analyzed passenger's motion response according to the recline angle with seat position and three body types with the behavior in terms of belt control. However, the current study did not consider the lead time (operating time) and slide position of a standardized AEBS system even though it is important to the occupant’s motion responses **[2]**. The results may indicate that a new safety system should be developed for consideration of the body type and posture of the passenger to strengthen the safety of them in AEBS operation. The current study may be valuable in that we can identify and suggest first the fact that the body type and posture of the passenger may be considered in AEBS operation to strengthen the safety of them.

V. REFERENCES

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