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Experimental moose test

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1. Introduction

For evaluation and further development of vehicle safety technologies, it is essential to be able to anticipate how human occupants will react in both precrash scenarios such as driver-induced or autonomous braking and steering maneuvers [4] and in-crash circumstances [2] In order to allow for anthropomorphic occupant reaction in pre-crash conditions, human body models are being fitted with muscle control systems [1]. These models, known as active human body models (AHBMs), must be using volunteer data, such as body kinematics and reactions, in a variety of realistic probable precrash loading conditions.

Although none of these volunteer studies have provided information on muscle activity for volunteers traveling in a regular car and subjected to maneuvers like lane changes, they have provided some understanding of the occupant kinematics and the activity of a select few muscles when the volunteers were exposed to lateral loading in a laboratory environment. Recently, [3] supplied volunteers riding in a standard automobile subjected to lane changes and lane changes with braking maneuvers with data on passengers' heads and T1 displacements, boundary conditions including seat belt forces and position, as well as vehicle dynamics. Evasive maneuver testing determines a vehicle's capacity to avoid unexpected impediments. The Moose test has been carrying it out since the 1970s. In 1997, a Swedish automotive magazine and television program flipped a Mercedes-Benz A-Class, prompting the test's naming. The test simulates situations like a reversing car or a child rushing onto the road. The goal of the current study is to illustrate, utilizing the occupants' four body part motion during moose trajectory autonomous vehicle movements.

2. Methodology

The University of West Bohemia's Ethical Review Board gave their approval to the use of human volunteers. To put it concisely, the test method for each participant involved first collecting anthropometric data. Furthermore, the experimental vehicle was equipped with Qualisys system facilities. Each predetermined anthropometry participant was equipped with clusters of reflective markers (Fig. 1), which will be fastened using fixation tape and whose movement will be monitored by the Qualisys system. An accelerometer was used to simultaneously detect and synchronize the vehicle's movement.

The experimental vehicle was driven somehow to be as close as possible to the red line passes among the path signs, see Fig. 2. The vehicle is accelerated from a stationary position until reaches to a specified speed. Then the throttle is released and the car is driven for 10 meteres. Afterwards the car speed is measured. The experiment's speed was done at 30 and 50 km/h to prevent any skidding or turning. The experiment was conducted with two cases with

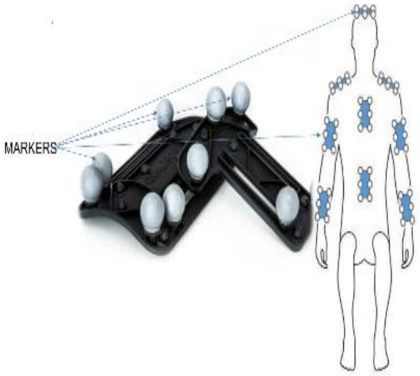

Fig. 1. Markers set-up

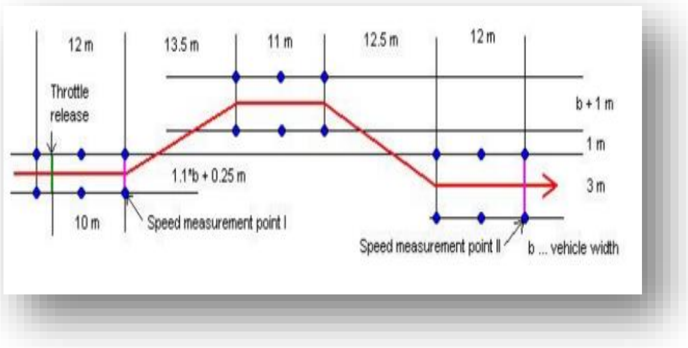

Fig. 2. Experimental vehicle trajectory

and without pedals. For the case which was done with pedals means that the accelartor pedal was not released and without pedals the accelerator pedal was released.

3. Result

The generated trajectories after being post-processed in Python to get the body parts (head, shoulder and chest) trajectories are depicted in Figs. 3 and 4 in coronal plane (-*yz*). The trajectory's beginning is shown by the marker. The motion domain of the various body parts is analysed at two distinct speeds (30 km/h and 50 km/h) which are then compared and investigated. As indicated in Table 1, data is collected focused on shoulder, chest, and head. The body height and weight of passenger 4 meet the criteria for 50 percentile HBM. Fig. 5 depicts a bar graph that compares passengers with and without pedals. The first half of the bar graph displays the comparison of passenger 4 with passenger 2, while the second half shows the comparison of traveler 4 with passenger 5.

The same applies for the opposite bar chart, which shows chest data as well as the right and left shoulders.

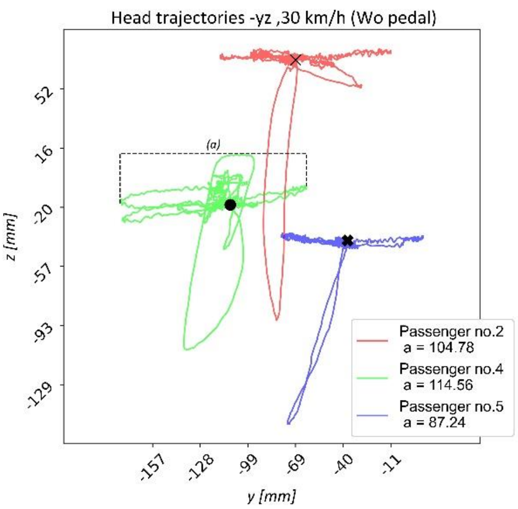

Fig. 3. Comparing the head trajectory range of passenger 2, 4 and 5 at 30 km/h

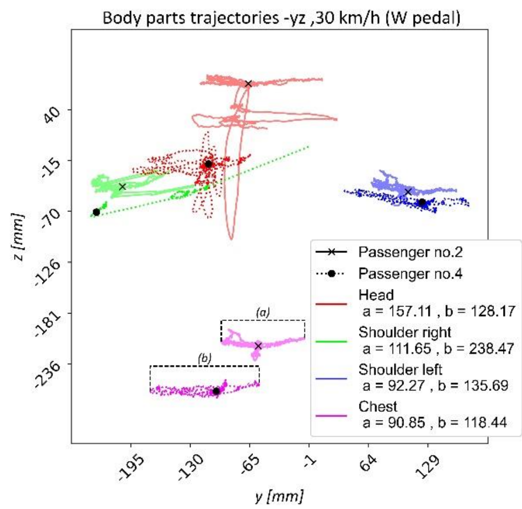

Fig. 4. Comparing the body (head, shoulders and chest) trajectories range of the passengers 2, 4 and 5 at 50 km/h

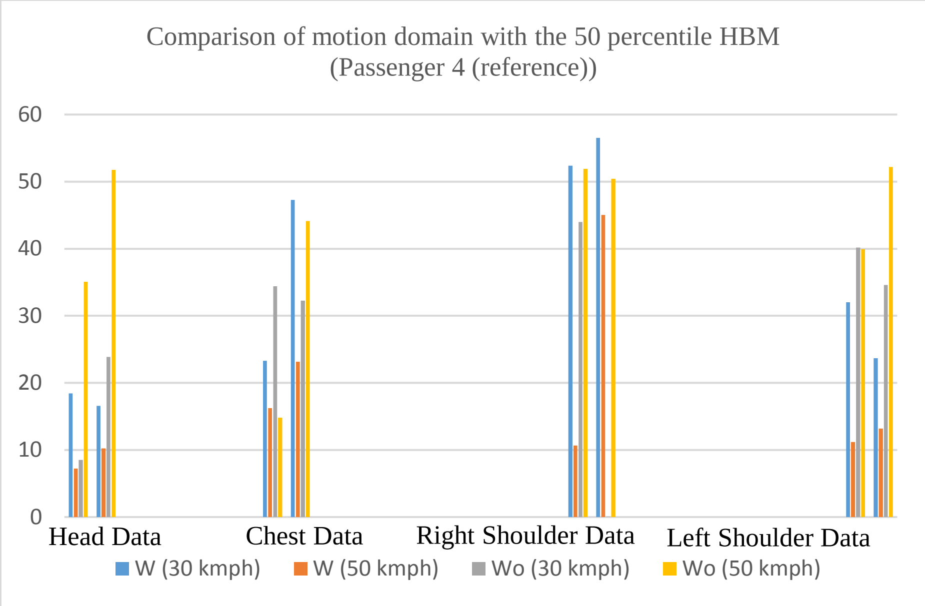

Fig. 5. Comparision of the passenger with the refernce passenger of head, chest and shoulder

Table 1. Body part motion domain

HEAD DATA

	30 kmph	30 kmph	50 kmph	50 kmph
Passengers	With Pedal (WP)	Without Pedal (WoP)	With Pedal (WP)	Without Pedal (WoP)
Passenger 2	157.11	104.78	253.92	211.8
Passenger 4	128.17	114.56	235.54	326.26
Passenger 5	106.95	87.24	211.47	157.4

CHEST DATA

	30 kmph	30 kmph	50 kmph	50 kmph
Passengers	With Pedal (WP)	Without Pedal (WoP)	With Pedal (WP)	Without Pedal (WoP)
Passenger 2	90.85	63.4	205.36	164.69
Passenger 4	118.44	96.64	172.03	193.29
Passenger 5	62.44	65.46	132.2	107.96

RIGHT SHOULDER DATA

	30 kmph	30 kmph	50 kmp	50 kmph
Passengers	With Pedal (WP)	Without Pedal (WoP)	With Pedal (WP)	Without Pedal (WoP)
Passenger 2	111.65	73.1	216.43	112.75
Passenger 4	234.47	130.55	242.28	234.46
Passenger 5	101.96	130.51	133.19	116.29

LEFT SHOULDER DATA

	30 kmph	30 kmph	50 kmph	50 kmph
Passengers	With Pedal (WP)	Without Pedal (WoP)	With Pedal (WP)	Without Pedal (WoP)
Passenger 2	92.27	69.19	233.64	164.69
Passenger 4	135.69	115.62	207.52	274.24
Passenger 5	103.58	75.64	180.19	131.19

4. Conclusion

We conducted a research to evaluate the kinematics of passengers during a vehicle motion. One female and two males of different anthropometry participated in the study after the ethics committee approval. They sit as passengers on the frontal seat and were instrumented by Qualisys markers to be monitored during the maneuver. Several measurements at the speeds of 30 km/h and 50 km/h were performed. The study analyses and compares the motion capture data as a base for validating an active human body model.

Acknowledgement

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