Far Side Comparison of Hardware ATDs and Virtual ATDs to Human Body Models in a Generic Sled Environment including a Far Side Airbag

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I. INTRODUCTION

With the aim improving occupant safety in various crash impact conditions, Euro NCAP introduced the far side protection loadcase in 2020 [1]. The farside load case has also been proposed as a pilot for virtual testing, with the eventual application of Human Body Models (HBMs) [2-3]. In the scope of virtual testing for future assessments, there has been a noticeable shift towards the adoption of HBMs, which means an understanding of the nuanced differences in how these models respond to impacts and predict injuries is crucial. As seen in [4], HBMs are more flexible than Anthropomorphic Test Devices (ATDs or dummies) and experience larger excursions. To explore this further, this study investigated the influence of a far side airbag on occupant kinematics was investigated.

II. METHODS

A sedan-based sled environment, including the first seat row, a centre console, a steering column and a far side airbag, was used to perform hardware tests using the WorldSID 50% and the SID-IIs 05% ATDs. These hardware tests were then simulated and validated in a corresponding virtual environment (LS DYNA R12.2, Fig. 1, left). The final step was to perform further simulations using the THUMS v4.1 50% Male and 05% Female HBMs in the previously validated environment. These simulations were executed with and without a far side bag, which is deployed from the driver seat (Fig. 1 right, 50th percentile Male). Using the simulation data, kinematics and some injury metrics for head and chest were compared between WorldSID 50% and THUMS v4.1 50% as well as SID-IIs 05% and the v4.1 05%. In a last step, a sensitivity study was executed for the virtual ATD and HBM setups, in which different input parameters, such as sled acceleration or belt friction, were varied, identifying additional similarities or differences between these two occupant surrogates.

III. INITIAL FINDINGS

The comparison between test and simulation is shown in Fig. 1, left. In simulations, the absence of a far side airbag can be examined. A comparison of HBM and virtual ATD for the case without airbag shows that the HBM experienced 47 mm more Y excursion, as measured at the head COG, compared to the ATD (Fig. 2, left).

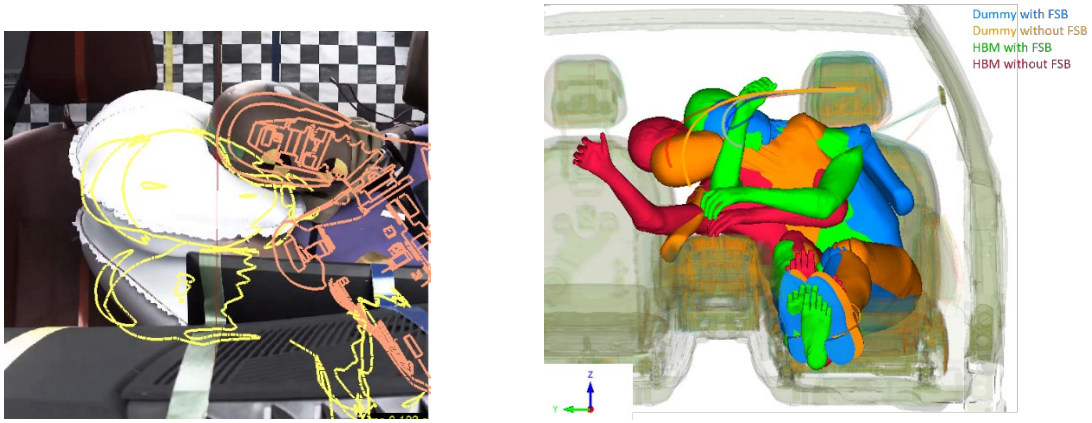

Fig. 1. Comparison between hardware test and simulation of WSID 50% (**left**).
Overlaying simulations of WSID 50% dummy and HBM THUMS v4.1 50%, with and without far side bag (**right**).

This is less than what was observed in [4]. For the case with a far side airbag the difference in Y displacements decreases to 8 mm (Fig. 2, middle).

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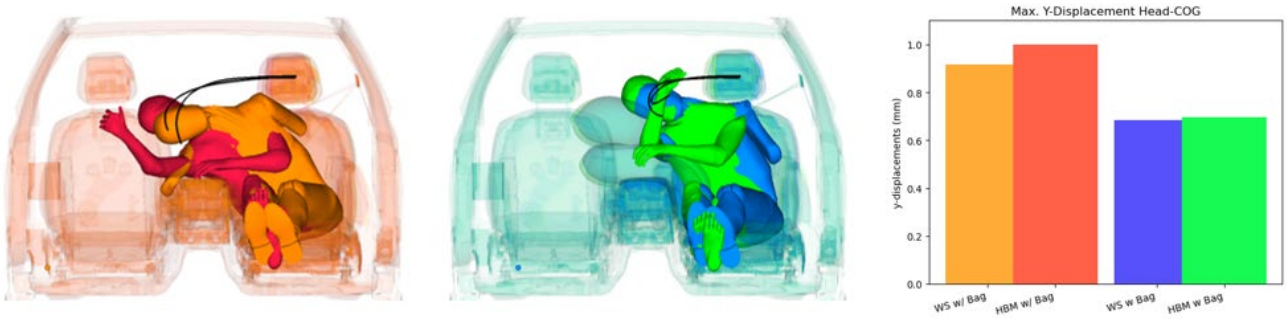

Fig. 2. Comparison between WSID 50% (orange) and THUMS v4.1 50% (red) without far side bag (**left**), Comparison between WSID 50% (blue) and THUMS v4.1 50% (green), with far side bag (**middle**), summarized with maximum y-displacements of head COG in bar chart (**right**).

IV. DISCUSSION

The far side airbag decreased the difference in head lateral displacement between the HBM and ATD by 39 mm, which corresponds to a reduction of 83% of the delta values. This suggests that contact with the airbag is effectively controlling the head excursion in a similar manner for both ATD and HBM. This implies that the WorldSID 50M is a good candidate to evaluate head excursions in far side crashes when a far side airbag is present, which was also shown in [5]. It is unclear how the injury risks differ between ATD and HBM, but according to [6] thoracic injuries, in particular, should be investigated further. One limitation is that the different occupant sizes were compared using different ATDs, 50th percentile Male THUMS vs. WorldSID and 5th percentile Female THUMS vs SID-IIs, which limits the comparability. Future work will look at more anthropometries and interior configurations.

V. REFERENCES

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