ANALYSIS OF THOR CRASH TEST RESULTS TO BETTER UNDERSTAND THE ATD BEHAVIOUR

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Research and/or Engineering Questions/Objective

In recent years, a new Frontal Impact Crash Test dummy has been developed: THOR (Test Device for Human Occupant Restraint). This Anthropomorphic Test Device (ATD) includes a vast amount of instrumentation and enhanced biofidelity compared to its predecessor, Hybrid III 50th Percentile Male. Because of this, it is being considered for both future USNCAP and Euro NCAP frontal impact testing protocols. The objective of this study is to evaluate the behaviour of this new THOR dummy in the load cases that are being considered for the new NCAP, with special attention to the ATD kinematics.

Methodology

To better understand the overall behaviour of the THOR, a series of crash test results were analysed. This process was carried out by selecting several Frontal Oblique Small Overlap tests from the NHTSA Vehicle Testing Database and evaluating the results, focusing on the dummy overall kinematics. Furthermore, additional results from crash tests performed at IDIADA were also included in this study. In particular, this analysis focused on assessing the percentage of the studied tests in which either excessive driver head rotation, unstable airbag contact or front passenger belt slipping were found.

Results

In the paper, general dummy kinematics and injury data will be presented. The analysis will focus on the THOR head, neck and thoracic responses when tested under frontal oblique and frontal compatibility load cases. This data will be presented by doing a segmentation by type of car, load case, etc. in order to evaluate in which scenarios the undesired dummy-restraint system events (excessive driver head rotation, unstable airbag contact, front passenger belt slipping, etc.) can be most frequently found.

Limitations of this study

Tests available on the NHTSA Vehicle Testing Database do not always represent the most updated test results and vehicle model performance. The authors of this paper are aware that vehicles whose development is still ongoing may include enough countermeasures to prevent some of the currently evaluated dummy performance. Moreover, many of the evaluated tests have been performed using a THOR ModKit dummy, which is not the latest version of the ATD. Because of this, future activities for this project include the analysis of future crash test work to be performed at IDIADA using THOR-M SBL-A dummy on MY2019+ vehicles.

What does the paper offer that is new in the field including in comparison to other work by the authors?

This paper includes an updated analysis of the currently available THOR frontal oblique crash test data from the NHTSA database as well as the inclusion of some full vehicle tests performed at IDIADA following European test protocols and/or European vehicles tested in Federal Conditions.

Conclusions

Recent THOR crash test data was analysed, focusing on undesired dummy kinematics and incorrect interaction between the dummy and the restraint systems. This behaviour was evaluated for future Euro NCAP and USNCAP load cases, showing the difference in performance found in both cases.