Study of the Behavior of Dummy Hybrid III Upper Extremities

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Summary:

On simulation and real frontal crash test, in many cases a contact between arms and the dashboard can be observed (figure 1). Those contacts lead to important flows of forces on several parts of the dummy. By consequence, those contacts are suspected to influence the results of the evaluation of the restraint system. This study tries to quantify the mentioned influence.

The accurate influence of the interaction of the upper extremities in real crash tests is hard to investigate because of a lack of measurement possibilities. Therefore a simplified testing device was designed to investigate the effects of arm contacts. Furthermore, the comparability of simulation and real dummies becomes analysed. This is necessary because the validation of a simulation dummy comprehends lots of test configurations to assure its realistic behavior apart from the upper extremities.

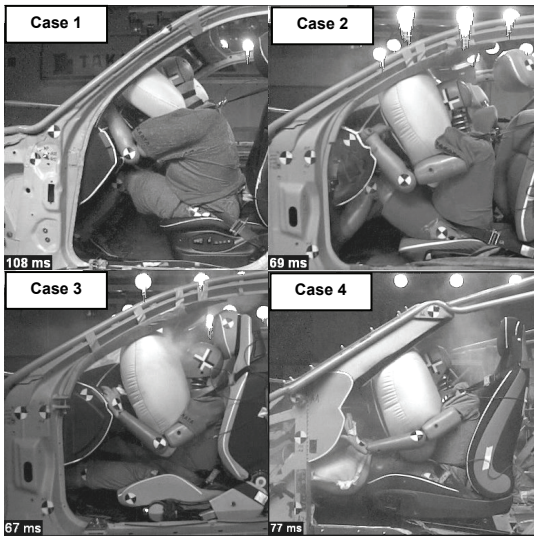

Figure 1: contact scenarios, the upper extremities have a large influence on overall dummy movement

The testing device showing in figure 2 is free from environmental influences and allows to investigate the effects of the contacts between the upper extremities and the vehicle interior in reality and simulation.

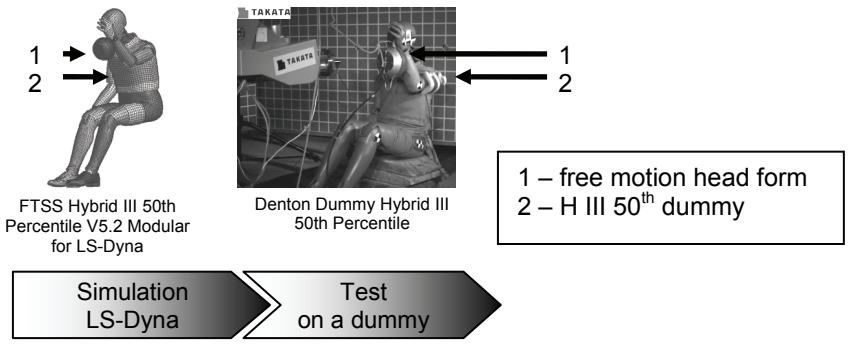

Figure 2: Free motion headform testing device

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The test configurations are derived from real crash scenarios as shown exemplary in figure 3.

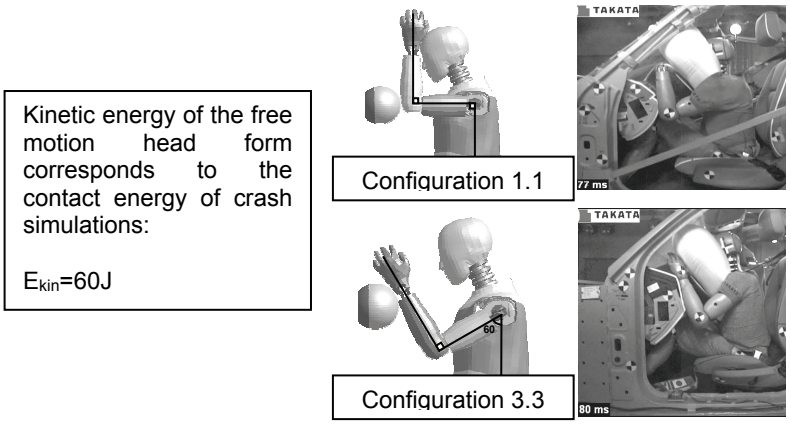

Figure 3: exemplary test configurations

Depending on the test configuration, the effects of the arm contact as well as the quality validation results are distributed on a wide range (figure 4).

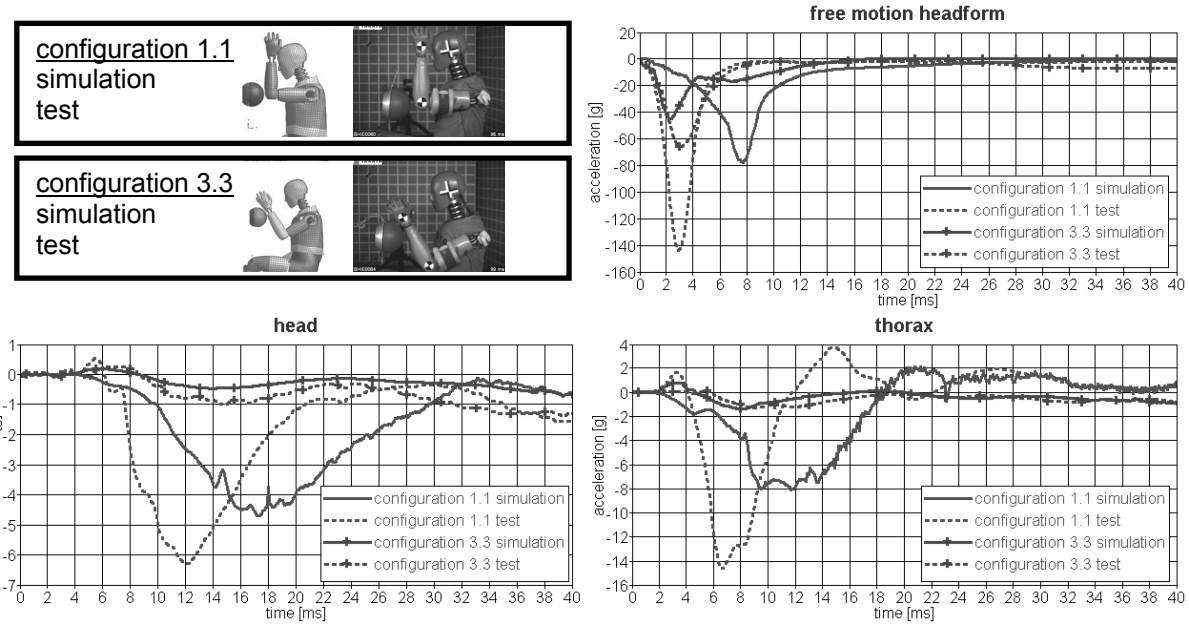

Figure 4: simulation & test results, influence of the measured values depending on the configuration

The results of the test evidence that there exists coherence between the dummy values e.g. thorax acceleration and the interaction of upper extremities with the vehicle interior. In a worst case scenario (configuration 1.1) the thorax acceleration reaches values around 14g in the real test. Otherwise, it becomes obvious that in cases where the head form impacts on stiff structures without deformable elements, such as hinges (configuration 1.1), the deformation of the foam in the simulation dummy is too pronounced. This relation is shown in figure 5. The differences in this deformation of the foam, as well as the possible distinctions in the shoulder joint lead to variations of test and simulation curves.

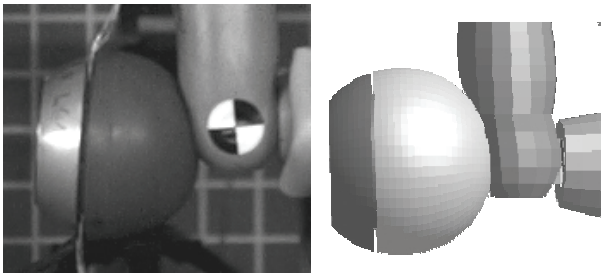

Figure 5: deformation dummy foam, simulation dummy seems to be softer than the hardware dummy

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This investigation points out that influence of the interaction of the dummy arms with the vehicle interior leads to measurable effects in the dummy values in simulation and real tests. The output of simulation and test differ from each other depending on the test configuration. For this reason, an additional validation procedure for the upper extremities is necessary.

Keywords:

upper extremities, dummy validation, arm contact

Literature:

[1] Dagonet, M.: “Dummy Hybrid III upper extremities behavior Investigation”, diploma thesis, 2009

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