ATD model vs Human model in combined frontal pre-braking and lateral impact applications

D. Jastrzebski, M. Miroslaw, T. Dziewonski

I. INTRODUCTION

Active Human numerical models allow for realistic kinematic responses to a low load pre-crash condition where an influence of muscle activity and motor control occurs and the occupant's posture differs [1] from the ATD's position prior to impact. In that sense HBM are potential tools for virtual investigation of occupant integrated safety. Good predictive capabilities of AHM in certain scenarios have been reported in the literature [2-3]. Passive Human Behavior as in PMHS shows very flexible occupant behavior prior to impact [4], while ATDs are too stiff in some cases. The current study introduces an integrated safety analyses approach of side-impact collision scenarios preceded by autonomous frontal braking of the impacted vehicle. Differences between ATD's and different human model's responses are investigated and discussed.

II. METHODS

As a first step a dedicated PRE-SCAN side impact mitigation system has been built and tested in five most relevant lateral impact scenarios: pure lateral T-bone impact, collision while joining the traffic from parking side, left turn collision, entering roundabout and lane change collision [5]. For most of the cases the developed sensor-based mitigation control system activated an autonomous braking reaction avoiding impact in most of the low- and medium-traffic tested cases. However, in simulation of a heavy traffic condition its efficiency dropped and after the braking phase a series of lateral or oblique collisions occurred. The aim of this study is to investigate the influence of combinations of low-g braking frontal pulse with high-g impact lateral pulse applied on different occupant models in order to assess the influence on overall occupant kinematics followed by investigation of restraint system effectiveness and injury patterns.

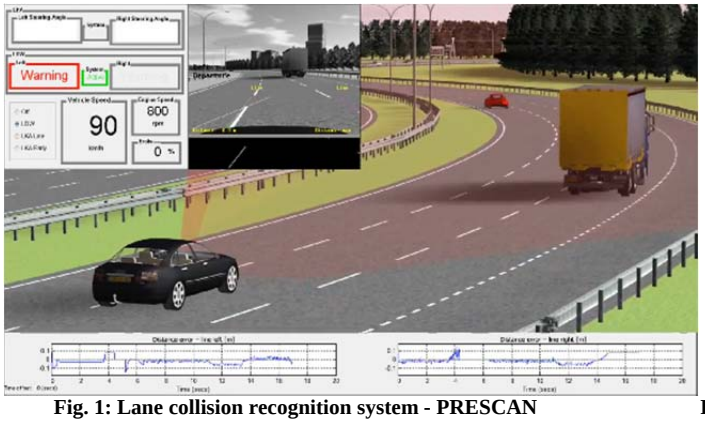

Fig. 1: Lane collision recognition system - PRESCAN

Fig. 2: T-bone collision - PRESCAN

PRESCAN and MADYMO software packages were used as a platform for integrated safety investigations. Preliminary results are based on a pure lateral T-bone impact scenario with H350 ATD and MADYMO Human models equipped with a standard 3-point belt system. Side door stiffness and its lateral penetration were based on the MADYMO Side Impact application [6]. No side protection airbags model has been applied at this stage.

III. RESULTS

Occupant kinematics during the frontal 0.6s deceleration phase differs significantly depending on the occupant model type: the ATD had hardly any noticeable reaction whereas passive human behavior showed excessive forward flexion as in PMHS. Both cases create a 'boundary' for realistic AHM response. For both cases a

standard 3-point belt system was applied. Lateral high-g impact pulse did not change the overall prediction of injury patterns (e.g. HIC changed from 72 to 213); however, a different initial position prior to high-g impulse changes the kinematics and potential contact patterns which would significantly influence passive safety system effectiveness.

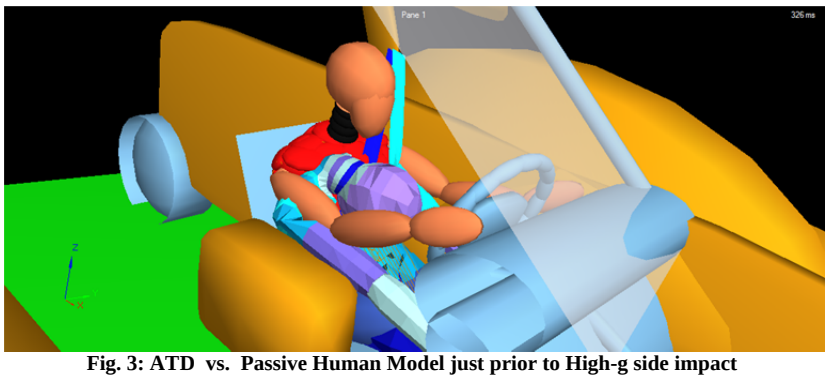

Fig. 3: ATD vs. Passive Human Model just prior to High-g side impact

IV. CONCLUSIONS / PERSPECTIVES

Current work builds a virtual platform for further complete analyses of combined frontal pre-crash braking and lateral/oblique impact. Preliminary results identify directions of further research:

- AHM application.
- Belt system effectiveness evaluation (such as standard 3-point vs. motorized [7].
- Side and/or frontal (for oblique impacts) airbag systems effectiveness.
- Recognition of pattern changes for lateral impact to assess if and how pre-crash conditions might change the standard test setups known from regulation or user's tests (like NCAP).

V. ACKNOWLEDGEMENT

The Authors thank the *TNO Automotive Safety Solutions* B.V and its Polish representative - SEARCH SC company- for the PRE-SCAN software, advice and support.

VI. REFERENCES

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