Master Thesis Defense Examination

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# Thesis Title: Parametric Analysis


ABSTRACT

Restraint systems in passive safety are commonly designed for average-sized occupants, represented by the 50th percentile male dummy, often overlooking the protection needs of larger occupants. With the rising prevalence of large-size occupants, evaluating restraint system for this demographic, particularly the Hybrid III 95th percentile male dummy, is essential. This study investigates injury responses in frontal sled crash simulations using finite element modelling based on Euro NCAP protocols. A reduced vehicle model, driven by acceleration pulses from a full car crash simulation, was validated before being used to analyze key injury metrics, including Head Injury Criterion (HIC15) and chest deflection under various restraint configurations. A full-factorial Design of Experiments (DoE) was employed across 27 simulations, varying airbag deployment timing, seatbelt pretensioner timing, and load limiter force. Sensitivity analysis showed that load limiter force significantly affected HIC15 and chest deflection. The study suggests optimal configuration is when airbag deployment at 0.0130 s, load limiter force at 3500 N, and pretensioner activation at 0.0143 s which resulted in a HIC15 of 622, chest deflection of 53.27 mm, neck tension (Fz) of 2380.0 N and femur right compression of 990.0 N where all the injury metrics were within Euro NCAP safety limits. Further refinement of these parameters could enhance protection performance. This research aligns with the Euro NCAP Vision 2030 initiative and offers valuable insights into improving restraint system design for large-size occupants.



Keywords: Restraint system, Hybrid III 95th percentile male dummy, frontal crash finite element simulation, design of experiment, sensitivity analysis.


| 1 December 2025 | 9:00 am – 12:00 pm (GMT+7) | Online (Link will be provided upon registration |
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