

# Rear Impact Human Body and Car Seat Models for Whiplash Injury Mitigation

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## ABSTRACT

*This study presents the development of a biofidelic 50<sup>th</sup> percentile male low speed rear impact human body model and car seat models for whiplash injury mitigation. The human body model is developed using multi-body dynamics and validated using the responses of 7 volunteers from JARI (Japanese Automobile Research Institute) sled tests, which were performed at an impact speed of 8 kph with both a rigid seat and a typical car seat, and without head restraint and seat belt. The human body model is composed of rigid bodies connected by rotational springs and dampers. First, the head and neck section of the model was developed and validated separately. The resulting head and neck model is computationally very efficient and able to produce volunteer response with a high degree of accuracy by simulating the effects of muscle contraction as a function of time. The torso model is composed of five bodies with the locations of the joints chosen by analysing the spinal vertebra and pelvis rotations of the JARI sled test volunteers. The human body model, composed of the head-neck model integrated with the torso model, is simulated and validated by using a generic multi-body car seat model developed for this research. Good correlation is obtained between the simulation results of the human body model, in a typical driving posture, and the JARI volunteer responses in both rigid seat and typical car seat sled tests. Several anti-whiplash seat designs are currently investigated by subjecting the human body model to low speed rear impacts.*