Influence of Pre-crash Bracing on Impact Energy Distribution in a Car Occupant

Dipan Bose[1], Costin D. Untaroiu[1], Jeff R. Crandall[1]

[1]University of Virginia

ABSTRACT

Objective: *The current study is aimed at evaluating the effect of active muscle on the dynamics of the pre-impact bracing car occupant using numerical simulations. The objective of the study includes identifying the sensitivity of occupant injury metrics to the level of pre-impact bracing action.*

Problem Outline: *Bracing or pre-impact muscle tensing, one of the key reflexive actions adopted frequently by car occupants, significantly affects the dynamics and injury mechanisms during crash loading. However, the evaluation of muscle effects is beyond the scope of cadaveric and mechanical surrogate tests. Therefore, numerical techniques are necessary to compensate for the lack of musculoskeletal data for developing occupant safety devices.*

Methodology: *The study involves developing a numerical musculoskeletal human model with accurate geometric and material properties. Simplifications to joint details and rigid body definitions of body segments non-significant to occupant response will be employed to reduce simulation time. The occupant model will be subjected to realistic crash pulses to represent collision speeds ranging from 10kmph to 50kmph. Subsequent variation will be done to the level of muscle activation in lower extremity and upper extremity region. For each simulation run, body segment energy and injury metrics such as chest deflection, tibial loads, head acceleration will be evaluated.*

Included Data: *The data-set provided in this study will include variation of parameters such as internal energy of the lower extremity, pelvis, upper torso and head, to loading conditions expressed as a function of different collision pulses and level of pre-impact bracing.*

Summary of Results and Conclusions: *It is expected that the level of muscle activation is a significant parameter affecting the lower injury and chest injury metrics for a given characteristic collision. Such quantification of the role of active muscle effects will help in developing restraint and safety devices optimally designed for overall population.*