

Finite Element Modeling of a Lower Limb Based on the East Asian Body Characteristics for Pedestrian Protection

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Abstract : Current vehicle safety standards and human body injury criteria were established based on the biomechanical response of Euro-American human body, without considering the difference in the body anthropometry and injury characteristics among different races, particularly the East Asian people with smaller body size. Absence of such race specific design considerations will negatively influence the protective performance of safety products for these populations, and weaken the accuracy of injury thresholds derived. To resolve these issues, in this study, we aim to develop a race specific finite element model to simulate the impact response of the lower extremity of a 50th percentile East Asian (Chinese) male. The model was built based on medical images for the leg of an average size Chinese male and slightly adjusted based on the statistical data. The model includes detailed anatomic features and is able to simulate the muscle active force. Thirteen biomechanical tests available in the literature were used to validate its biofidelity. Using the validated model, a pedestrian-car impact accident taking place in China was re-constructed computationally. The results show that the newly developed lower leg model has a good performance in predicting dynamic response and tibia fracture pattern. An additional comparison on the fracture tolerance of the East Asian and Euro-American lower limb suggests that the current injury criterion underestimates the degree of injury of East Asian human body.

Keywords : lower limb, East Asian body characteristics, traffic accident reconstruction, finite element analysis, injury tolerance

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