Development of Total Human Model for Safety version 4 Capable of Internal Organ Injury Prediction

Tsuyoshi Yasuki

Toyota Motor Corporation
1-1 Toyota-cho, Toyota, Aichi 471-8572, Japan

Abstract

Although internal organ injury in car crashes occurs at a relatively lower frequency compared to bone fracture, it tends to be ranked higher in terms of injury severity. A generalized injury risk can be assessed in car crash tests by evaluating abdominal force and viscous criterion (VC) using a crash test dummy, but the injury risk to each organ cannot be estimated with current dummies due to a lack of parts representing the internal organs. Recently, human body modeling research has been conducted introducing organ parts. It is still a challenge to simulate the impact behavior of organ parts and their injury, based on an understanding of the differences in structure and material properties among the organs.

In this study, a next generation human body FE model named Total Human Model for Safety (THUMS) version 4 has been developed to predict internal organ injury. The model represents the geometry of organ parts, their location in a living human body and their connections to surrounding tissues. The features of each organ part were taken into account in modeling, so that compressive material was assumed for hollow organs while in compressive material was applied to solid organs. Besides the major organ parts, other soft tissues such as membranes and fatty tissues were also incorporated in order to simulate relative motions among organs. The entire model was examined comparing its mechanical response to that in the literature. The study confirmed that the force-deformation response of the torso against anterior loading showed a good correlation with that of tested subjects.