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Belt Fit Simulation For A Safety Belt System Design

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ABSTRACT

A safety belt system plays an important role to support a skeleton of torso during traffic accidents. Most of the research efforts on a safety belt system have been made for crash simulation by only considering a dynamic human model so far. However, belt routing analysis usually known as comfort level estimation is also an important factor in safety belt design, considering that serious injuries of abdominal region result from the infiltration of belt into a neck or a chest. Thus safety belt evaluation using kinematic human models is also needed.[1,2]

In this study kinematic human model and dynamic human model have been employed to simulate belt routing for comfort estimate and crash analysis for safety estimate. The eBTD^{TM}, a program to design safety belt routing system employing a kinematic human model, can estimate a safety belt routing corresponding to the input data of h-point, dummy posture and so on.[1] However it cannot be used for a crash simulation. On the other hand the MADYMO^{TM}, a program to perform crash simulation employing a dynamic human model, is usually used to estimate the injuries such as HIC and chest deflection.[3]

In practice computer simulation using both softwares simultaneously under the same conditions has many problems because each program uses its own dummy model and different data format for a safety belt. In order to solve this problem, belt fit simulation method in using MADYMO^{TM} has been suggested in this study, which enables a belt routing and crash analysis in the same program. The proposed belt fit simulation model is composed of a buckle, a D-ring, belt segments and a FE belt webbing. The simulation model can estimate the safety belt routing corresponding to a location of anchor points because this simulation model was designed to make belt segments pass the anchor points of safety belt system.[3,4] The belt fit simulation is accomplished by pulling backward belt segments that are connected both end nodes of a shoulder belt and a lap

belt. To validate the proposed simulation method, the routing outputs by eBTD^{TM} have been compared with those by the proposed simulation and consistent results have been obtained. With the proposed process both comfort and safety analysis can be performed under the same conditions continuously, and thus the safety belt design parameters such as the location of anchor points, dummy posture and etc. can be evaluated.[5] In conclusion, this process can be employed easily in the early stage of safety belt system design.

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