Identification of Occupant State Parameters using a Pattern Recognition Methodology to Reduce the Risk of Injury in a Collision

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Estimations of potential injury reduction using an ideal restraint for a specific collision/occupant combination range from 42% to as high as 68%, indicating a very strong opportunity for reduction in occupant injury through adaptive or real-time restraint optimization. One major component of an adaptive restraint system (ARS) that must be developed is recognizing the characteristics and orientation of an occupant in a collision. This information is critical in an ARS so the proper restraint law can be applied for the specific occupant in order to reduce injury in a collision. The goal of this study is to identify occupant state parameters (e.g. posture) using a pattern recognition methodology. MADYMO, a multi-body dynamics solver, is used to simulate the vehicle, occupant, and crash pulse. To identify the posture of the occupant, load cells are modeled in the cushion of the seat in order to obtain a signal outputting the forces and moments created by the weight of the occupant. Using several signals generated during vehicle simulations, the curves were analyzed for significant features that distinguish the postures from one another. These features were used to develop a pattern recognition algorithm that predicts the posture of an occupant based on the probabilities that a certain set of features correspond to a specific posture. Once the optimal decision rule algorithm was found, the benefits of this knowledge were evaluated by simulating a 57km/h frontal crash collision in MADYMO. A simulation with a normal restraint system and a simulation with an optimized restraint system were run to determine how much the risk of injury was reduced by taking occupant posture into account during a collision. This paper shows that occupant parameters can be identified using a pattern recognition methodology and this knowledge can significantly reduce the probability of injury in a collision.