Analysis and Design Optimization of Heavy Goods Vehicle for Pedestrian Safety - For Adult and Child Safety -

Koetsu Yamazaki [1], Faiz Redza Ramli [2]

[1] Kanazawa University, Kanazawa,Japan, yamazaki@se.kanazawa-u.ac.jp
[2] Faculty of Mechanical Engineering, Technical University of Malaysia Melaka, Malaysia, faiz@utem.edu.my

Abstract

This paper addresses the analysis and design optimization of a new passive safety concepts for Heavy Goods Vehicle (HGV) by the installation of additional component under a bumper called "lower bumper stiffener" and "an airbag" on the front panel of HGV to minimize the adult and child injuries. The HGV-to-child and HGV-to-adult collisions were simulated by the MADYMO crash analysis solver, in which the HGV collision at the speed of 25km/h against the child and adult models with several variations of working postures and facing directions were simulated. The scope of the analysis is limited to the duration of impact between the HGV and the child/adult models, so this will ignore all the post impact cases after collision. The design parameters of this concept were varied by the adoption of the Response Surface Method techniques with the use of Latin Hypercube Sampling (LHS) and the child/adult body injuries of Head Injury Criterion (*HIC*), thorax Cumulative acceleration (C_{3ms}), and peak femur loads were taken as the objective functions. Due to the diverse parameters and constraints of the initial conditions and the injury thresholds, the design problems were solved by multi-objective optimization by the Weighted Injury Criterion (*WIC*) that combined all these injuries. Based on the results of the design optimization, the potential of these child/adult pedestrian safety design concepts were discussed. Based on the two kinds of design concepts of "lower bumper stiffener" and "an airbag" on the front panel of HGV, the airbag has shown better results in reducing pedestrian injuries, especially the head injuries. The information provided for the pedestrian protection in this study could be used to assist the understanding towards designing a better HGV front bumper, particularly relating to the child pedestrian safety.

Keywords: *Heavy Goods Vehicle (HGV), Pedestrian Safety, Collision Damage Estimation, Multi-objective Optimization, MADYMO.*