Optimal forces for the deceleration of the ES-2 dummy

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Abstract

The purpose of this project is to improve the development process of vehicle safety systems by introducing a new analytic approach. Today the development of vehicle safety systems, especially the airbag design process, requires many iteration loops via simulations and experiments. In this process parameters are changed and after each change a new simulation is conducted and the injury values are evaluated. We have a different, two folded approach. First we calculate the optimal forces to decelerate a dummy or human body. In a second step these optimal forces can be used to design vehicle safety systems. This may still require some small parameter variations through iteration loops, but should advance the performance and decrease the development time.

This project focuses on side impacts. To calculate the optimal forces a generic side impact setup is designed. The ES-2 dummy is positioned on a Heidelberg-type seat and has an initial lateral velocity of 12 m/s. Steel plates are positioned next to characteristic body regions of the dummy in order to decelerate the dummy. This setup is based on the experimental setup of [CavanaughEtAl90].

In the simulation experiment a controller calculates the optimal force for each plate to decelerate the dummy as swift as possible without exceeding the critical injury values. To design such a controller a modellidentification is necessary. As critical injury values, we use the injury values that are used to achieve a five star rating in the EURO NCAP. The simulation yields the optimal forces to decelerate the dummy without exceeding the critical injury values. To implement the controller, the user loading subroutine is used. Based on the current injury vales, this function calculates the current forces necessary to decelerate the dummy. The model is simulated on the High Performance Computing Center(HPC) cluster of SimTech. For the evaluation of the results the binout data is imported via a Matalb Converter to Matlab and automatically the energy appield to the most relevant regions is calculated.

References

[CavanaughEtAl90] Cavanaugh, J.M.; Waliko, T.J.; Malhotra, A.; Zhu, Y.; King, A.I.: Biomechanical Respone and Injury Tolerance of the Thorax in Twelve Sled Side Impacts. SAE Technical Paper, 1990.