Analysis of Cyclist Kinematics in Car Impacts considering different Vehicle Fronts, Collision Speeds, Body Heights and Impact Constellations

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ABSTRACT

In order to analyse the kinematics of cyclists in car accidents a wide range of impact constellations has been simulated using the MADYMO multi-body solver. The study comprises six real passenger car fronts, all representing different vehicle classes, named Compact, Sedan, Van, Sports Car, SUV and OneBox [1]. Four cyclist heights are considered, a 6 year old child, a 5 %-female and a 50 % as well as a 95 %-male. Each cyclist model consists of a size-specific bicycle model and the corresponding MADYMO Ellipsoid Pedestrian Model placed on top.

Parameter studies carried out in advance reveal that the pedal position has a decisive effect on the cyclist kinematics. Therefore four different pedal positions have been defined with the leg facing the vehicle backward, forward, up and down. Three representative impact scenarios have been derived from an accident analysis, including two perpendicular constellations with a lateral impact of the cyclist in the central and outboard area of the car front (crossing scenarios) as well as one oblique scenario.

While for the oblique scenario a constant vehicle speed of 25 kph is defined, this parameter is varied for the crossing scenarios. Here the simulations are conducted with vehicle speeds of 40, 35, 30 and 20 kph. The speed of the cyclists is not varied and amounts always to 15 kph.

The simulation models and parameters have been validated by reconstruction of a real accident taken from the GIDAS database. The impact positions of hip and head as well as the final position of the cyclist could be reproduced with satisfying accuracy.

The simulation results reveal an increased head impact area, which can reach until the roof leading edge and in case of sports cars even beyond. Furthermore, the study shows high values for head impact speed as well as angle. Even the average values for the head impact speed usually lie above the collision speed.

Keywords: cyclist kinematics, simulation, front shape, collision speed, pedal position, bicycle & cyclist sizes.

REFERENCES

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