Bachelor thesis

The analysis of driver safety during rear-end crashes

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Automation and Robotics – Biomechanics and Biorobotics
Academic year 2019/2020

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1. Introduction

The main aim of the thesis is to analyze how the safety of drivers during rear impacts has changed over the years and how it translates into the number of fatalities and injured passengers.

For this purpose, statistical data on car accidents was collected. Crash tests conducted by the NHTSA were used to assess the safety of drivers during rear-end collisions. The data from tests was used to determine the injury criteria, and thus to assess the level of protection of individual body parts. Based on the results of tests, the following injury criteria were calculated: Head Injury Criterion (HIC15 and HIC36), Nij, Nkm, NIC, LNL, Viscous Criterion, Compression Criterion, Combined Thoracic Index, 3 ms criterion for the head and chest.

2. Results

The statistical data on car accidents shows that the number of fatalities and injured passengers per 100,000 inhabitants is falling in both Europe and the United States. In the USA the downward trend is also visible per 100 million miles travelled.

The analysis included 67 rear-end crash tests from 1995-2005. The measurement data was filtered using a Butterworth filter. All tests used in the analysis had the following characteristics:
- 180 degree impact angle
- collision simulation using a movable barrier
- impact speed 46-48 km/ h
- 50-percentile male dummy- Hybrid III

The analysis showed a significant decrease in the value of head and cervical spine injury criteria during rear-end collisions, which corresponds to a decrease in the number of deaths and injuries per 100 million miles travelled in the USA. When it comes to the thoracic injury criteria, they worsened. However, the values obtained are very low, which suggests that there is no high risk of chest injury during rear-end collisions. The greatest improvement in driver safety during rear-end collisions was seen in the protection of the cervical spine.
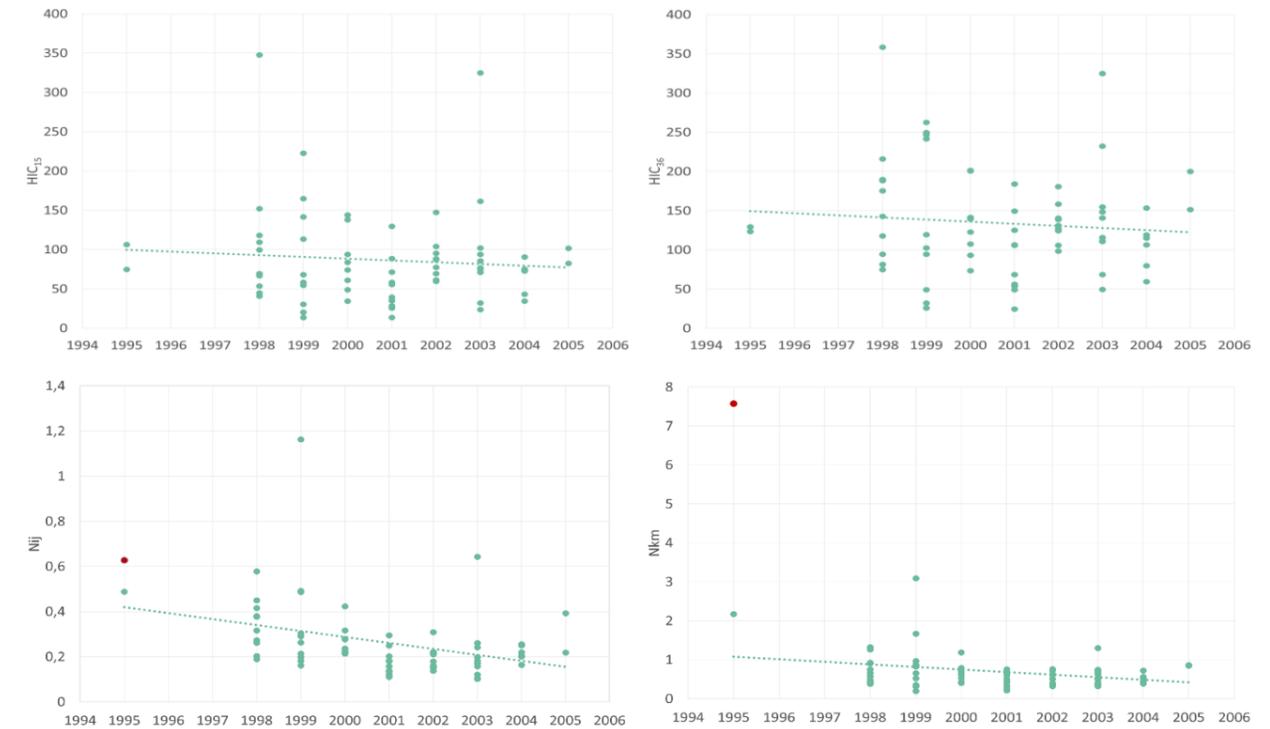

Figure: Injury criteria values (HIC15, HIC36, Nij, Nkm) for the dummy on the driver's seat in rear collisions
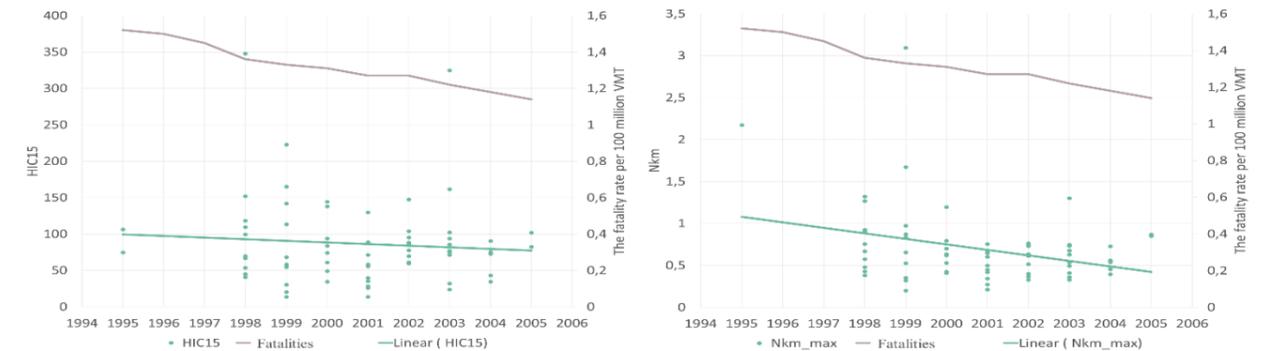

Figure: Comparison between the number of fatalities and injury criteria values(HIC15, Nkm) in 1995-2005

3. Conclusions

- The values of the head and cervical spine injury criteria have dropped during rear-end collisions in 1995-2005.
- The chest injury criteria has increased in 1995-2005, but they are still very low. There is a really low risk of chest injury during rear-end collisions.
- There is a high correlation between the values of injury criteria of the cervical spine and the number of fatalities and injured passengers.
- The type of vehicle frame has a significant impact on the magnitude of the loads that affect passengers during rear-end collisions. This is mainly due to the lack of crumple zone in pickups.