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Computer simulation of the frontal collision of the articulated urban bus into the column of the traffic board portal

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There are currently many active and passive systems designed to protect passengers in modern vehicles. These systems are now developed purely on the basis of virtual approaches. The first aim of this paper is to demonstrate the process of computer reconstruction of the urban articulated 18 m long bus accident caused in January 2016 in Bratislava. Because of an acute health indisposition of a woman driver, the vehicle with passengers crashed into the column of the traffic boards portal.

Two different approaches were used and compared together. The first approach introduces an usage of software Virtual Crash used mainly by forensic experts of traffic accident branch in their simulation. Virtual Crash is based on MBS algorithms and uses rigid bodies in dynamic calculation. The second approach presents a dynamic nonlinear calculation performed in the PAM-Crash explicit system with a validated fully deformable FE vehicle model.

This model was built from about 2.5 milions elements and have over 12 milions degree of freedom. Time step of converging solution is about 1μs in this case. Similar model of 10 m long intercity bus of the same design family made by the same production technology was built in beginning 2013 and later validated by a full scale test in October 2013, Fig. 1. This experiment showed a very good agreement to computer model results and enabled the use of a computer model of 18 m long urban bus for our future computer simulations.

Fig. 1. Comparing computer simulation results with results of full scale test

The second aim of this paper is to introduce the methodology that could easily be implemented for the category of buses, where no similar methods have yet been used to assess the level of passive safety.

The paper further deals with the use of numerical simulations to assess passenger wounding in a general collision scenario that helps identify interior elements to improve passenger safety at the early stages of the design proposal to assess passenger protection with respect to human population variability. To assess the impact of population variability for defined impact scenarios, the scalable virtual model of the human body Virthuman can be used effectively. This model allows to cover passengers of various sizes (gender, age, height, weight, ...) and extends the conventional virtual evaluation of new security designs through existing standard test dummies and models based on the finite element method. The advantage of the Virthuman instrument used in the project is its computational efficiency when the MBS approach allows the use of up to 99 passengers in one model without increasing the computational time of the deformable model.

Using presented techniques, the reconstruction of traffic accidents as well as the safety risk for occupants on a vehicle board can be efficiently assesed.

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