INTERNATIONAL JOURNAL OF INFORMATION TECHNOLOGIES, ENGINEERING AND MANAGEMENT SCIENCE

Specialized simulator oriented towards road traffic cargo vehicles

Ing. Daniel Beňadik, Ing. Pavol Kudela, PhD.

University Science Park, University of Žilina, Slovak Republic
{daniel.benadik, pavol.kudela}@uvp.uniza.sk

Abstract

This article is focused on USP UNIZA technological equipment. Treating the specialized simulator oriented towards road traffic cargo vehicles, suitable for research with full featured output in frame of examination of loaded material conduct as well as recreation periods of the user in given critical driving conditions. Simulation is a powerful tool for analysis, design and operation of complicated systems. Simulation provides ideal mechanism for research examination, unable to implement, too expensive or dangerous in real world, including the cognitive or physical abilities consideration, acquired knowledge concerning the drivers´ behavior, vehicles construction testing in virtual testing road and the drivers´ training.

Keywords: simulator, ride, driving conditions.

Introduction

Cargo simulator can be defined as a device, which simulates the cargo vehicle ride. Mathematic model in a computer creates the vehicle itself, as well as the environment where it is in motion. Simulation is reflected thanks to the graphic interface in real time at the reflection equipment, which is usually a screen being the main simulator output. It is usually complemented with acoustic effects. Outputs are primarily aimed at optical and auditory sense of a human being, because that is how he acquires the largest amount of information about the events around him. By means of this feedback, the user is able to control the vehicle simulator whilst driving. Moreover, kinetic and tactile senses can provide a driver with necessary information, not sufficiently acquired by optical and auditory sense. However, the information delayed. [1].

Figure 3 –Cargo Vehicle Simulator [5]

Drivers´ simulators are used in research devices for several purposes:

- Drivers´ training.
- Drivers´ preparation for unpredictable circumstances.
- Detection of driver´s reactions.
- Driver´s reaction analysis.
- Reaction treatment and analysis from tested subjects under specific conditions.

With growing use of various information systems in vehicle, such as, satellite, navigation systems, cell

phones, DVD players and e-mail systems, simulators play the role by providing safety and effectiveness of such equipment. Simulators are also used in psychometric testing, drivers´ behavior mapping and driving regime analysis for the vehicle development without any remote control.

Specialized Types of Simulators

From the point of view of the position changing and the user´s orientation towards the ground, we can divide simulators to:

- Stationary.
- Non-stationary.

Stationary simulator belongs to the simplest concerning reality approach, price and construction. It is mostly used for fun. We can also find them in driving schools, being used for beginners training. Stationary simulator does not provide efficient change of position and orientation of the user towards the ground. It does not contain kinetic mechanism that would simulate kinetic senses affecting the user by driving.

Non-stationary simulator represents a higher degree in frame of approaching the reality. Making the user move, it tries to realistically simulate the motion effect whilst driving. It is achieved due to non-stationary construction, which enables the seat movement, or more precisely the whole frame in several axes [1].

There are various kinds of ride simulators, from simulators used for example in Slovak driving schools to simulators built at important universities abroad, such as, NADS. The most important types of NADS simulators are:

NADS-1 It is a simulator with the greatest kinetic base freedom in the world. Unique characteristics and abilities of kinetic system differ from other existing simulators. This enables NADS-1 to reproduce the movement precisely for permanent acceleration and applying the breaks, motion through multi climb lane and interactions with various road surfaces. Realistic reproductions of these combined maneuvers are neither possible on simulators with solid base nor on simulators with limited side movement. NADS-1 movements are correlated with other sense impulses and provide thus the highest fidelity of real experience from the drive in simulated environment.

NADS-2
The NADS-2 is a version of NADS-1 and differs from it by having a fixed base with limited front side field of sight. This simulator is equipped with HD graphics, provided with projectors with ability of spotlight elucidation simulation by oncoming vehicles. Also the changeable cabins are used like for NADS-1.

NADS MiniSim™
NADS MiniSim ™ is a portable, highly powerful simulator, assigned for research, development, clinical and training applications. This simulator is based on the most modern technology of ride simulator, which was developed during a ten yearlong research in National Advanced Driving Simulator and at Iowa University. MiniSim ™ uses technologies appearing in the most advanced simulator NADS-1, within a minor range, but also by a lower price [2].

Research Connected with Specialized Simulator

Cargo vehicle simulator uses technologies enabling driving tests for research and development employees, which in real world could be dangerous or would demand specific driving conditions. New equipment is able to simulate one of the most realistic environments in the world, offering thus drivers´ experience close to real operational conditions, allowing precise evaluation of the ride characteristics. Researchers plan to use the simulator in frame of research and development of the possibilities of the most suitable load of given material, both oversized and dangerous.

Wrong configuration of material at the back part of the trailer can cause:

- Stressed trailer drawbar.
- Kit vibration release of the back part of car axle.
- Instability of the trailer by break control.
- Higher probability of load displacement and release.

Wrong material configuration at the front part of the trailer can cause:

- Enormous load of the drawbar equipment.
- Stressed drawbar
- Front car axle release.
- Hindered car driving.
- The truck supposed to push the set with its front out of the curve.

Researchers will also deal with the possibilities of road damaging (the road administration data), increasing the transport safety, accident analysis, increased use by improper load, environmental cargo vehicle loading conditions, reaction time of cargo vehicle driver in crisis situations under various conditions.

Specialized Simulator Purchase

Vehicle simulators with implemented advanced technologies are very expensive. One of the reasons of their high prices is the requirement concerning their high quality technical treatment. Another important reason is that the vehicle simulator systems are not produced in series, but are always produced individually and implemented on the basis of the customer´s requirement. Another important reason is the requirement for space. Because of this their development is accomplished mostly in cooperation with universities, research centers or car producers. Vehicle simulators are constantly used and improved by all important car producers in the world [3]. Specialized simulator oriented towards the cargo vehicles placed at USP UNIZA has been developed on the basis of professional employees and fulfils their specific and demanding conditions.

Conclusion

With the widespread business and transit cargo transport growth, the road cargo transport represents a much more important fraction compared with the railway transport, which negatively influences the quality of environment, the road traffic density and the quality of life, mainly in urban areas. During the research treatment analysis of drivers´ behavior and reactions in critical driving conditions, the level of environmental load, use of various information systems, cell phones, the simulator is a first choice from safety's point of view. The simulator's use is also important by psychometric testing, the drivers behavior mapping and analysis of driving regimes for the no-remote-control of vehicle development.

Acknowledgements

This paper is supported by the following project: University Science Park of the University of Zilina (ITMS: 26220220184) supported by the Research&Development Operational Program funded by the European Regional Development Fund.

References

[1] KUBEŠ, F. Návrh jízdního simulátoru[online]. Available: https://www.vutbr.cz/www_base/zav_prace_soubor_verejne.php?file_id=86064

[2] The National Advanced Driving Simulator[online]. Available: https://www.nads-sc.uiowa.edu/

[3] GNAP, J., MIKUŠOVÁ M. Možnosti aplikácie simulátorov vedenia vozidiel cestnej dopravy[online]. Available: http://www.svetdopravy.sk/moznosti-aplikacie-simulatorov-vedenia-vozidiel-cestnej- dopravy/

[4] Driving simulator[online]. Available: https://en.wikipedia.org/wiki/Driving_simulator

[5] JKZ Olomouc[online]. Available: http://jkzsim.cz/cz/ridicske-trenazery/sna-211-ren/

[6] BLANA, E.A Survey of Driving Research Simulators Around the World[online]. Institute of Transport Studies, University of Leeds, 1996. Available: http://eprints.whiterose.ac.uk/2110/1/ITS170_WP481_uploadable.pdf?origin=publication_detail

[7] PIATKIEWITZ, P.Motion System Tuning of the VTI Driving Simulator IV[online]. Available: http://www.vectioneer.com/archives/636