Optimization of the Handling and Ride Behaviour of a Bus

Walter J. Paucar Casas*, André V. B. da Silva*, Eduardo D. Savi*, Leandro Pavan†

* Universidade Federal do Rio Grande do Sul, Departamento de Engenharia Mecânica
Rua Sarmento Leite 425, Porto Alegre - RS, CEP 90050-170, Brasil
walter.paucar.casas@ufrgs.br, andre_brizio@hotmail.com, eduardo.savi@ufrgs.br

† Marcopolo S.A.
Av. Rio Branco 4889, Caxias do Sul, RS, CEP 95060-650, Brasil
pavan@marcopolo.com.br

ABSTRACT

There is need to develop theoretical-experimental models that allow us to be fully able to better assess and conclude on the dynamic behavior of the bus when driving on different tracks and performing different types of maneuvers..

The objective of the work is to evaluate and optimize simultaneously the lateral and vertical dynamic behavior of a bus modeled as a multibody system.

The methodology used in this work is divided into two parts. The first part consists in programming a multibody bus model that can be used for optimization purposes concerning the lateral dynamics behavior via mathematical programming; the development of a double lane change maneuver, adapted from the combination of the standard ISO 3888-1:1999 involving double lane change for passengers cars and the standard ISO 14791:2000(E) involving only single lane changes for commercial vehicles, in the absence of specific standards; and finally the validation of results through experimental tests and computational simulations. The second part consists of programming a multibody bus model for optimization purposes concerning the vertical dynamics behavior via mathematical programming, in this case subject to a track of class E according to the classification of the standard ISO 8608 (1995).

The results of the programming of the lateral maneuvers of the bus model were validated experimentally and then compared by simulations of the maneuvers in a virtual model implemented in commercial multibody software. The achieved results showed correlation, enabling the optimization of the lumped parameters of the suspension of the multibody bus model through the genetic algorithm technique.

The implemented objective function consists of the penalized composition of the RMS value of the roll angle of lateral maneuver regarding the handling; and parameters associated with riding like the RMS value of the vertical acceleration, the maximum suspension working space, and the maximum deflection of the tire in order to ensure continuous adherence on the track. The obtained results of the suspension lumped parameters achieved a negotiation of the conflicting goals.

REFERENCES

[1] J. Kim, "Analysis of handling performance based on simplified lateral vehicle dynamics", *International Journal of Automotive Technology*, **9**(6):687-693 (2008).

[2] J. Wu, Q. Wang, X. Wei and H. Tang, "Studies on improving vehicle handling and lane keeping performance of closed-loop driver-vehicle system with integrated chassis control", *Mathematics and Computers in Simulation*, **80**(12):2297-2308 (2010).

[3] M.J. Thoresson, P.E. Uys, P.S. Els and J.A. Snyman, "Efficient optimization of a vehicle suspension system using a gradient-based approximation method: Mathematical modeling", *Mathematical and Computer Modeling*, **50**(9-10):1421-1436 (2009).

[4] S. Hasagasioglu, K. Kilicaslan, K., O. Atabay and A. Güney, "Vehicle dynamics analysis of a heavy-duty commercial vehicle by using multibody simulation methods", *The International Journal of Advanced Manufacturing Technology*, **60**(5-8):825-839 (2011).