THE MULTIBODY SYSTEM MODEL OF THE SUSPENSION MECHANISMS USED FOR THE REAR AXLE OF THE VEHICLES

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Important publications reveal a growing interest in analysis methods for "multibody systems" (MBS) that may facilitate the self-formulating algorithms. In this concept, the guiding mechanism of the rear axle is treated as a constrained, multibody, spatial mechanical system, in which body elements are connected through mechanical joints and force elements (springs, dampers, bumpers & rebound elements). The modeling of the axle guiding mechanisms is made with the following steps: defining the mechanism as multibody system; establishing the reference frames of the bodies; defining the connection matrices between the local reference frames and the global reference frame; establishing the global coordinates of the characteristic points that define the topologic model of the mechanism; defining the constraint equations; formulating the motion differential equations (using the Newton-Euler formalism); establishing the reaction forces and torques (considering the equilibrium conditions for each body); solving the algebraic and differential equations system.

The application is made for a dynamic model that corresponds to the suspension system of the rear axle, with a 2S1C guiding mechanism. In the lack of the front suspension, because in the dynamic analysis the car body is mobile, modeling a spherical joint between car body and ground ensures the equilibrium of the car body (fig. 1).

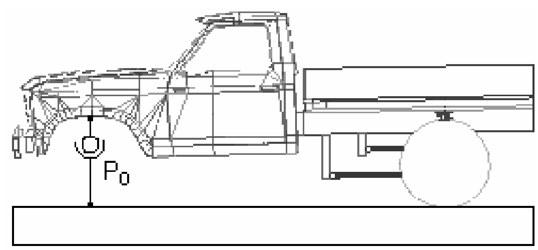

Fig. 1. Half-car model with spherical joint

The constraint & motion equations are developed considering a simplified model of the guiding mechanism, by modeling the compliant joints of the guiding arms as spherical joints. The model is analyzed in passing over bumps regime. The rear wheels are anchored on two actuators that execute vertical motion relative to ground, the motion laws applied to actuators simulating the road profile. The results shown in figure 2 correspond with the passing of the left wheel over a bump which has 80mm height, while the right wheel runs on smooth surface.

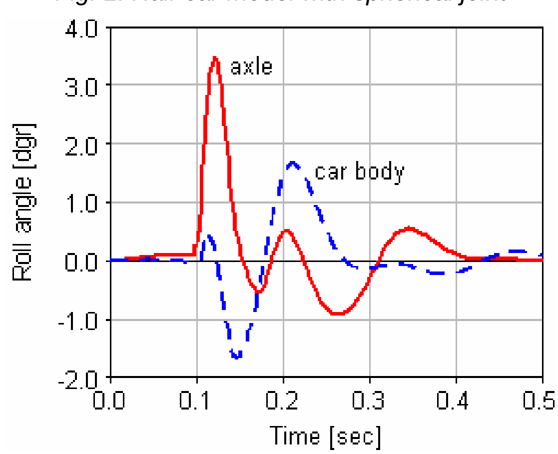

Fig. 2. Results of the dynamic analysis

REFERENCES (selection)

[1] Alexandru, C. Dynamic Analysis of the Guiding Mechanisms used for the Rear Axle of the Commercial Vehicles. International Review of Mechanical Engineering (IREME), Vol. 3 (1), 2009.
[2] Fischer, E. Standard Multibody System Software in the Vehicle Development Process. Journal of Multibody Dynamics, Vol. 221 (1), 2007, p. 13-20.
[3] Garcia de Jalón, J., Bayo, E. Kinematic and Dynamic Simulation of Multibody Systems. Springer, 1994.
[4] Schiehlen, W.O. Multibody Systems Dynamics: Roots & Perspectives. Multibody Systems Dynamics, Vol. 1 (2), 1997, p. 149-188.