Virtual test bench for determining loads affecting an automotive steering system

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The article solves the problem of determining maximum loads affecting an automotive steering system, at an early design stage. To solve this problem, we use computer modelling based on solving rigid body dynamics equations, implemented in a popular Siemens NxMotion software package. We describe in detail the components of our virtual test bench that includes joints, rods, steering gear, a wheel hub unit with a wheel, along with the components of the loading platform. The virtual test bench includes independent suspension elements, such as levers and joints of the linking mechanism, suspension springs and dampers, an anti-roll bar. As a result, we created a bench that models combined response of a steering system and an independent front suspension of a wheeled vehicle. A mathematical model created in the MATLAB Simulink environment and linked to the solid body model of the steering system and suspension via standard NX Motion software tools controls the test bench. The controller model implements several modes of the heaviest steering system loads. As a result of our work, we describe the procedure for building a virtual test bench, using the simulation of a steering system and an independent suspension of a 4x4 automobile as an example. Employing such a virtual test bench has several key benefits: assessing the response of a steering system combined with an independent suspension; increasing the accuracy of load calculation as compared to planar kinematic or force-based steering system parameter calculation algorithms; obtaining loads for every major component of the steering system (joints, rods, steering gear and so on); performing multiple parametric studies of the steering system and independent suspension without building expensive full-scale prototypes.

Keywords: *rigid body dynamics, load calculation, virtual test bench, automotive steering system*

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