Modelling of new vehicle suspension concept with integrated electric drive

Jakub Tobolář[a] Jakob Müller[b] Alfred Pruckner[b]
[a]German Aerospace Center (DLR), Institute of Robotics and Mechatronics, Germany;
[b]BMW Group Forschung und Technik, Munich, Germany

In the last years, the electrification of the powertrain of passenger cars became one of the huge challenges for the vehicle developers. Several solutions for the mass-produced hybrid electric vehicles exist such as parallel or serial arrangement of internal combustion engine and electric drive. On the contrary, the pure electric vehicles are still designed in significantly lower series.

The presented paper introduces a new design of vehicle suspension which was developed in the joint research project of BMW Group Forschung und Technik, DLR and Schaeffler Group. In this suspension the wheel guidance and gearbox are highly integrated thus enabling to place the drive motor close to the wheel and consequently to minimise required space in the vehicle, see the overall design as shown in Figure 1. Therefore, the saved space can be utilized otherwise, e.g. for a battery or an electronics assembly.

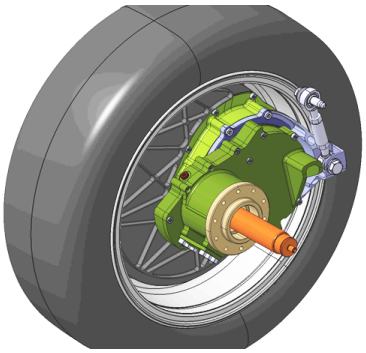

Figure 1: Overall view of the presented rear suspension (electric drive not displayed)

The paper focuses especially on different aspects of the modelling in the early design stage where the first estimations of suspension characteristics and vehicle handling were performed. This covers the coupling of multibody model of suspension with one-dimensional model of gearbox (based on the *PowerTrain* library [1] from DLR), spiral spring model or elastokinematic bushings. The created Modelica library was consequently based on the *VehicleInterfaces* standards, see [2], in order to promote easy interoperability with other automotive libraries.

Finally, the results of kinematics analysis of the suspension are discussed emphasising the support angle ε_B at braking and its dependency on the gearbox ratio.

References

[1] Schweiger Ch., Dempsey M. and Otter M.: The PowerTrain Library: New Concepts and New Fields of Application. In: Proceedings of the 4th International Modelica Conference. Hamburg–Harburg, 2005.

[2] Dempsey M., Gäfvert M., Harman P., Kral Ch., Otter M. and Treffinger P.: Coordinated automotive libraries for vehicle system modelling. In: Proceedings of the 5th International Modelica Conference. Vienna, 2006.