Mechatronic Design of a Novel, Active Vehicle Suspension System for Passenger Cars Using a Reversible Vane Pump

Summary

The thesis presents the mechatronic design of a novel, active vehicle suspension system where four actuators are integrated directly into every lateral control arm and generate a rotary motion. A crucial role is played by the novel valveless hydraulic actuator (controlled by a displacement device) that is based on the principle of the reversible vane pump with subordinated pressure feedback.

At first there will be an overview of active and semi-active vehicle suspension systems. For this purpose a new kind of classification using consistent definitions is suggested. It is a systematic, abstract, and extensible tool for the developer when it comes to conceiving new systems.

Then the demands on the suspension system to be developed in the conception stage are detailed. A quarter-vehicle is employed for the model-based analysis. It is used for specifying the target system both in the time- and the frequency domain as well as for designing and analysing its functional structure.

The subsequent model-based design of the spring actuator makes up another central part of the thesis, with dynamical and mechatronic functions of the actuator and their impact on the overall system being defined already at an early design stage.

Due to the model-based studies and the methodical way of proceeding, it is possible to realise some constructive novelties that can be applied to reversible pumps in general. During the trial period, it is possible not only to prove the functionality but also to observe, measure, and mathematically describe some effects of an internal reset force which has so far nearly been ignored.