Identification of a nonlinear spring and damper characteristics of a motorcycle suspension using test ride data

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During test rides of motorcycles modifications are made to the suspension. In order to quantify this changes, the nonlinear spring and damper characteristics must be determined. However, it is not always possible to perform measurements of the suspension on a test bench. Hence, a parameter identification after a test run, formulated as an optimization task, seems to be an auspicious approach. For this purpose, a cost function is defined, which is minimized by considering the dynamics of the system. The strength of the contribution is the efficient gradient computation using the adjoint variable approach. In order to approximate the nonlinear spring and damper characteristic cubic splines are used. The values of the spline functions at specified grid points are adjusted such that the deviation between simulation and measurement is minimal. As an example we consider the rear suspension of a KTM motorcycle with given measured data from a test ride. The nonlinear spring and damper characteristics are described by cubic splines with nine parameters to identify in total. After a number of iterations, the cost function cannot be further reduced, and the optimal set of parameters leads to acceptable accordance of the measured and simulated displacements in the chosen time interval.