Function Space Optimal Control Methods for Tracking Problems in Vehicle Engineering

Michael Burger (Fraunhofer ITWM Kaiserslautern)

We discuss the use of optimal control methods to derive excitation and input quantities for numerical system simulation in vehicle engineering. In particular, in the field of durability testing, it is a typical task to compute such excitation signals that reproduce certain reference quantities during simulation in an optimal way. For instance, for an axle test-rig model with axle, control quantities (e.g. actuator displacements) are searched that reproduce best given wheel forces. The considered system, i.e., test-rig and specimen, is modeled as mechanical multibody system and mathematically described as differential-algebraic equation(DAE). The resulting model equations are usually complex and highly-nonlinear. The mentioned task is formulated as a tracking optimal control problem. The unknown excitations are control inputs and one aims at minimizing the deviation between simulation outputs and given references quantities. Thus, one is faced with a nonlinear DAE optimal control problem. We present some function space methods (in time domain) to solve such a problem: classical methods from optimization applied in an appropriate function space. We present and discuss extensions of specific ODE methods to the DAE case. We discuss the applicability of such methods in connection with commercial software tools for simulation and modeling(where the availability of information about the equations is limited). Finally, we present some numerical examples.