Vehicle Systems Dynamics(2007), vol. 45, no. 2, pp. 133–148.

Experimental modeling of controlled suspension vehicles from onboard sensors

MARIO MILANESE[*], CARLO NOVARA[*] and ANDREA FORTINA[**]

[*]Dipartimento di Automatica e Informatica, Politecnico di Torino
[**]FIAT Auto S.p.A.

Abstract - In this article, identification of vertical dynamics of vehicles with controlled suspensions is considered. Identification is performed from experimental data measured on a four-poster bench test of a segment C car, equipped with a CDC-Skyhook dampers control system. The measurements are obtained from the onboard accelerometers needed by the control system. A nonlinear model in regression form is identified, having the road profile and damper control currents as inputs and chassis accelerations as outputs. The model is identified by means of a set membership structured identification method, which takes advantage of physical information on the structure of the system, decomposing the system into three subsystems: one represents the chassis and engine and the other two represent the overall behavior of front and rear suspensions, wheels and tires. This decomposition allows us to avoid the complexity accuracy problems derived from the high dimension of required regression space. Indeed, the overall high-dimensional identification problem is reduced to the identification of lower dimensional subsystems and to the estimation of their interactions. An iterative scheme is used for solving the decomposed identification problem. As the chassis pitch is small for the usual road profiles, the chassis-engine block is considered linear and standard linear methods are used for its identification. The other two subsystems are the main sources of nonlinearities in the system, mainly due to the significant nonlinearities of controlled dampers and of tires. Owing to the complexity/accuracy problems of a physical modeling of these subsystems, an input–output approach is taken. In particular, a nonlinear set membership method that does not require the search of the functional form of involved nonlinearities is used for the identification of these subsystems. The iterative algorithm converged in two iterations to a model providing a quite satisfactory simulation accuracy for all the considered road profiles and CDC-Skyhook settings.