

Vehicle ride motion analysis: virtual modeling and real testing.

The research topic focuses the attention on the study of vehicle response to vertical motion. The study aims to deeply understand which are the parameters that mostly affect the car dynamic behaviour during its vertical motion and how they do it, so that it is possible to optimize the car setup according to its class and target.

The goals of this research are different, but all of them meet in a complete evaluation of vehicle ride motion parameters, as discussed above. First of all, I think that the building of a complete virtual model is a good base to face the problem and come in contact with lots of variables and quantities that describe ride motion; secondly, it is necessary to perform real tests and develop a specific procedure to validate the virtual model and, as consequence, obtain a characterization of the vehicle. A complete description of ride motion together with a global evaluation of vehicle dynamics will be the final result.

As described above, the methodology conceived to reach the target is divided into different steps. The first step regards the building of a complete virtual model using a dedicated software like CarSim or ADAMS, in which it is possible to model every car subsystem, like the weight distribution, the suspension geometry and curves, powertrain and drivetrain, and so on. With a complete virtual model, it is possible to run some preliminary tests in order to deeply understand every aspect of vehicle behavior and how to change and improve it. The advantage of having a virtual model is that it is possible to perform lots of simulations, with a reduction of time and costs if compared to real testing procedures. But, to have significant results, it is necessary to validate the model: in fact, the second step regards testing on a real vehicle. During this phase, I think the best way to analyze the vertical motion and validate the model is to put the vehicle studied on a four poster rig, with which it is possible to run lots of procedure to simulate different inputs for vehicle tires and masses. Study and develop a specific procedure, made by a series of detailed tests, are also necessary in order to obtain actual data and results. In addition, to complete vehicle characterization, it is possible to change some vehicle parameters (e.g. spring stiffness, shock absorbers damping, suspension angles, weight distribution) in order to have a wide range of data, useful for the vehicle dynamics optimization.

The results expected from this research are: a consolidated procedure to perform real ride testing on a vehicle, including data acquisition system and instrumentations; the validation of previous virtual model, so that this can be used to perform lots of other simulations without involving the use of real cars; a series of data from which I can understand the effect of particular car subsystem on vehicle behavior and setup (e.g. suspension stiffness, chassis stiffness, damping values, weight distribution), so that it is also possible to develop a sensitivity analysis.