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SIMPACK News

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The Jaguar XK

The Use of SIMPACK on the All New Jaguar XK

1. THE VIRTUAL JAGUAR XK

1.1 THE MODEL

The model consists of a fully flexible trimmed body reduced within NASTRAN. The output points of the body model consist of all of the suspension and major subsystem connection points, salient measurement points and general graphic display points. The frequency range of the body model is up to 100 Hz. The front and rear sub frames are also modelled flexibly in a similar fashion. The suspension components are modelled rigidly with all of the elastomeric entities and contact points considered.

The power unit and driveline are also modelled rigidly again with all of the compliance considered. The exhaust however is modelled flexibly and hung using the relevant stiffness from the body to the power unit. The hydramounts used throughout the vehicle are considered with user written subroutines that match the dynamic and non-linear behaviour of the mounts within the model to the data taken from real measured components.
The tyre elements are simulated using the SWIFT durability tyre.

1.2 THE GENERAL LOAD CASES FOR THE MODEL CONSIST OF THE FOLLOWING

1.2.1 CONSTANT VELOCITY SINE SWEEP
Constant velocity sine sweep is used as a correlation tool and for early elastomeric mount tuning.

1.2.2 IMPACT HARSHNESS

Impact harshness is a single event vibration analysis for the vehicle.

1.2.3 SMOOTH, MEDIUM AND ROUGH ROAD

Spencer Salter,
Jaguar and Land Rover

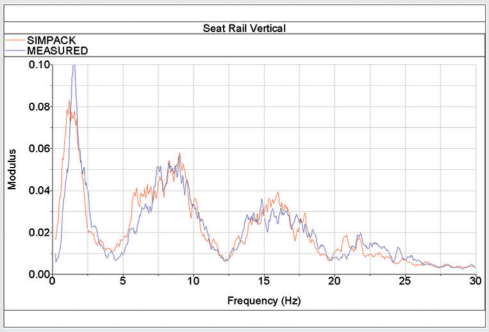

Fig. 1 Typical Correlation

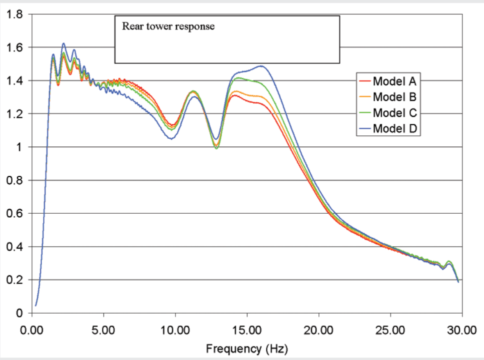

Fig 2.1 Rear Tower Response

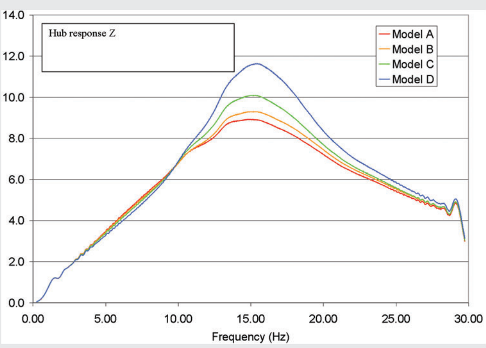

Fig. 2.2 Rear Hub Response

Smooth, medium and rough roads are solved in the time domain at various vehicle speeds. These are matched to the development activities carried out during the later phases of vehicle tuning.

1.2.4 STEERING SHIMMY AND BRAKE DISC

Steering shimmy and brake disc thickness variation are also modelled using the SIMPACK model.

1.2.5 SYSTEM LOADS AND DISPLACEMENTS

The model is also used for specific load and subsystem displacement generation to aid the packaging of the design.

2. THE OBJECTIVES

During the early stages of the design the model is used to specify the elastomeric and hydramount properties so that the sub system targets, and ultimately the vehicle level targets, are met. This is a complex task matching stiffness to the mass and inertia of un-sprung and sub-sprung systems within the vehicle. The model naturally evolves throughout the design process as more accurate physical property data become available. The model is therefore constantly in use to track the vibration levels against the required targets throughout the design of the vehicle. In the later stages of vehicle development, the model can also be used to direct, guide and solve specific ride and vibration issues that can be uncovered during the later development stages of a vehicle.

3. CORRELATION

The model is correlated at the earliest opportunity. This normally involves additional body models describing the donor simulator vehicles. Once the required level of correlation is achieved the model is used extensively in parametric studies for system tuning and optimisation. Fig.1 shows a typical level of correlation between the XK model and vehicle for a medium road input.

4. OPTIMISATION

Fig 2.1 and 2.2 show one of the studies for analytically tuning the damper top mounts. By using the model in this manner the top mount stiffness and damping can be tuned to strike the compromise between hub control and comfort. Using a flexible body structure, the top mount can be more accurately matched to the opposing structural stiffness and body modal properties. This is particularly important for the convertible derivative.
The power unit mount optimisation was also carried out within the model, tracking subtle differences between power unit mount designs for robustness and sensitivity. This required additional subroutines to be created in order to model the subtle amplitude dependant elements within the physical hydramount.

5. SUMMARY

By using the SIMPACK model, inexpensive vehicle tuning can be carried out with confidence analytically. The resulting optimised parameters within the model can be read directly across to the vehicle development activities. This model and others constructed in a similar manner prove invaluable in solving specific ride and vibration issues.