Honda Applies Breakthrough in Durability Engineering

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In the previous issue of LMS News, we introduced the concept of the virtual test rig and its use in load prediction. The idea was groundbreaking: the forces acting at any point on any component of a new vehicle type can be synthesized using virtual system simulations com-bined with measurements taken on corresponding vehicle. The practice is of course more challenging. Being successful and productive with such a virtual durability design process not only requires having FEM and multibody model technologies: application know-how and innovativesoftware tools are needed in order to get these numerical models correlated with reality.

For many years, LMS had all the technology and software tools necessary to create a virtual test rig. LMS TecWare could pre-process load sequences and synthesize customer-correlated load scenarios, as well as post-process MBS generated responses. LMS DADS was proven to have the high frequency inte-gration accuracy required for the multi-body modeling of virtual test rigs. It also had a unique and very efficient direct dynamics calculation integrated with LMS FALANCS. Last, but not least, LMS Time Waveform Replication (TWR) software could perform the “virtual drive file generation” to drive the virtual test rigs. All that was needed was to work in collaboration with experienced durability engineers to make the virtual test rig possible and practical.

One such example was at HONDA, where LMS technologies, tools and services have made it possible to deliver the integrated virtual test rig as part of their day-to-day development process for durability optimization.

HONDA Accord: suspension loads prediction

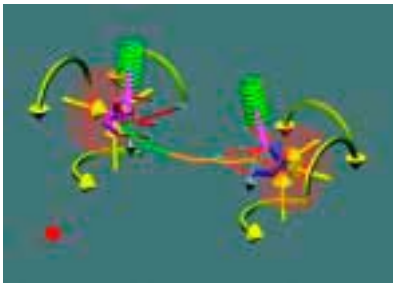
Honda’s goal was to be able to perform durability optimization entirely at the virtual prototype stage and to use physical prototyping only for final sign-off. This would allow a faster, cheaper, and more flexible design process compared to the traditional process in which, for example, suspension design validation can only start when the body-in-white is finished and loading conditions on the suspension cannot be changed anymore.

The LMS task was to derive MBS modeling guidelines that would enable a trade-off between the calculation speed and accuracy of the predicted durability loads. Both test rig (constrained simulation) and test track (unconstrained simulation) experiments needed to be considered and simulated for different road conditions, including rough road simulation and a curb strike. LMS developed different suspension models in DADS with different levels of complexity (quarter and half axle, with and without torsion bar) and optimized suspension stiffness and damping characteristics to get optimal correspondence with meas-ured response data. For this purpose data acquisition on both the test rig and the test track (including wheel force transducers) were performed.

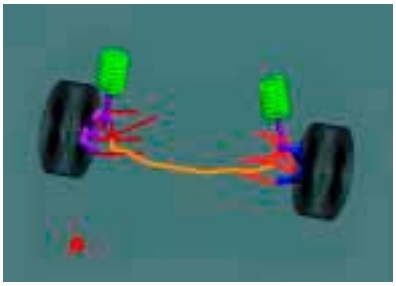
An excellent correlation between model and measurements was achieved, again making use of LMS TecWare for fatigue relevant comparison and automatic reporting. For the test track simulation of the half car model (rear suspension only), a special algorithm was implemented to derive body motion from acceleration and gyroscopic measurements and apply this to the MBS virtual test rig model by means of an iteration process. A very important advantage of this technique is that front and rear suspension can be optimized for durability independently of each other while still considering the car body motion required for accurate unconstrained loads prediction.

Conclusion

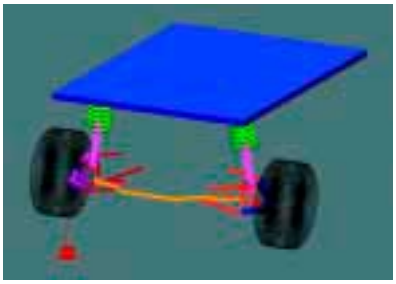
The above case history has shown that the LMS approach to Loads Prediction using a virtual test rig closely matches with reality. We would like to thank Honda for their cooperation in developing the technology - and for permission to publish the results. Together with complete Digital Test Track (including LMS advanced Tire models suited for accurate durability and ride comfort simulations) these tools are available today as Loads Prediction capabilities and services for full vehicles. ■



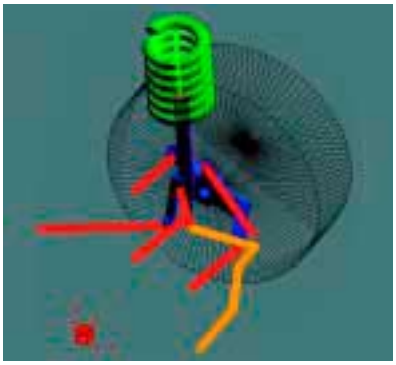
LMS DADS multibody model with applied test-based spindle loads of multi-link rear suspension



Virtual Test Rig: LMS DADS multi-body model of multi-link rear suspension simulating physical testing on suspension test rig



Unconstrained vehicle simulation: LMS DADS multi-body model of multi-link rear suspension simulating driving on durability test track



Half-axle LMS DADS multi-body model of rear suspension

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