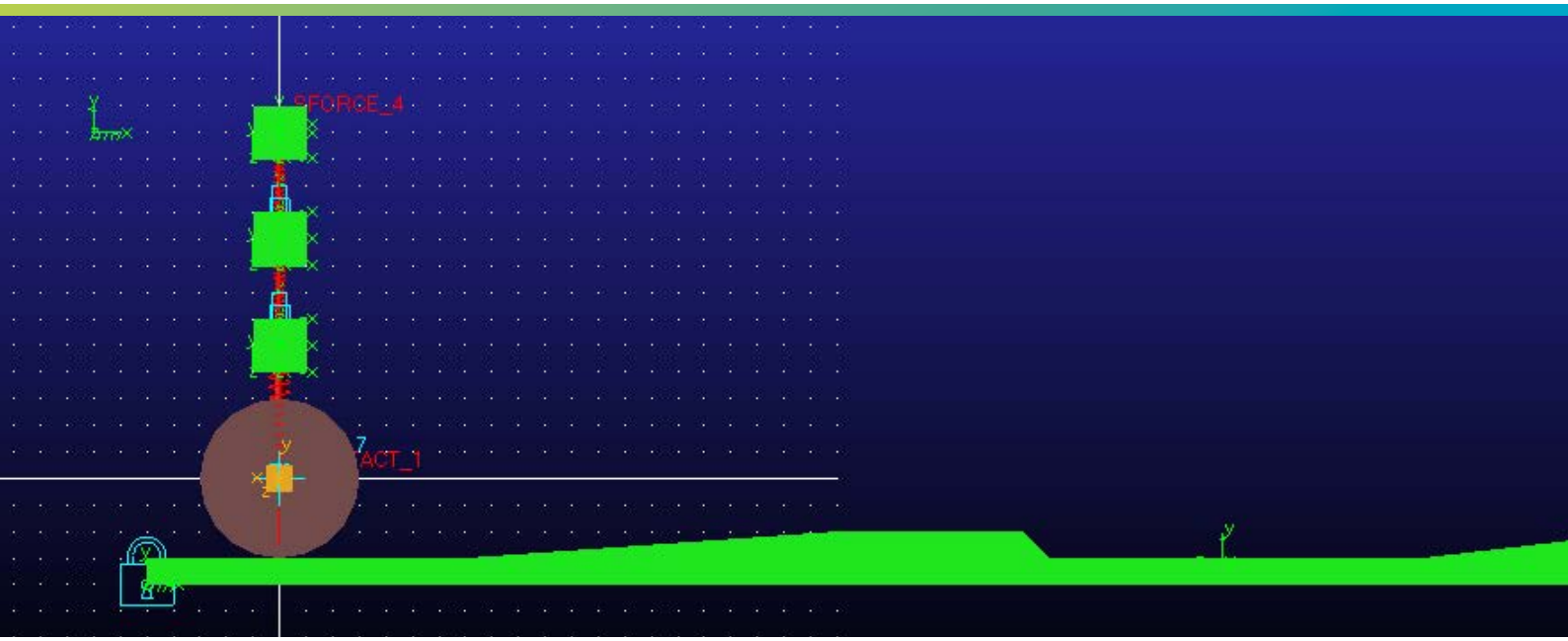
HEXAGON | MSC Software

Case study

Vellore Institute of Technology

Virtual prototyping of Magneto-Rheological (MR) damper by comparing realistic motion behavior using Adams



To study the vibration of a Semi-Active Seat Suspension System using a Magneto-Rheological (MR) fluid damper

In automotive design, the seat plays an important an important role in ensuring passenger comfort, especially in the case of long-distance drives. Most OEMs today focus on static comfort of seats, while paying limited attention towards dynamic comfort. This project by the students of VIT helped shed some more light on importance of dynamic comfort.

Using simulation tools from Adams, the students designed a model to scrutinize the performance of a semi-active seat suspension system using a PID controller and a newly designed magneto-rheological fluid damper. The software helped the students to test their model seamlessly and cost effectively on real time basis, using virtual prototyping and virtual testing, before physical prototyping and testing.

Challenge

Established in 1984, Vellore Institute of Technology is a premier educational institution in India. Having an enormous campus of youngsters in the field of research and engineering, VIT offers a broad spectrum of courses. Students from the School of Mechanical and Building Sciences (SMBS) were working on an application to control the vibration of Semi-Active Seat Suspension System using a Magneto-Rheological (MR) damper. The aim was to analyze the performance of semi-active seat suspension system using a PID controller and newly design magneto-rheological fluid damper.

Vehicle suspension can be classified into three kinds namely - passive, active, and semi-active suspension systems. The team was keen to build a semi-active seat suspension to reduce vibration transmissibility in the low frequencies, in addition to the high performance at high frequencies. To do that, fluids such as magneto-rheological (MR) and electro-rheological (ER) were used in the semi-active systems. These fluids have micron size particles of iron suspended in the oil. The particles of iron vary the stiffness of the fluid when the voltage is applied to the fluid, as the iron particles align themselves in the externally applied magnetic field.

Creating and testing the physical design of a seat suspension system can prove to be cumbersome and extremely expensive. Formulating a mathematical model of a seat suspension system presented several challenges.

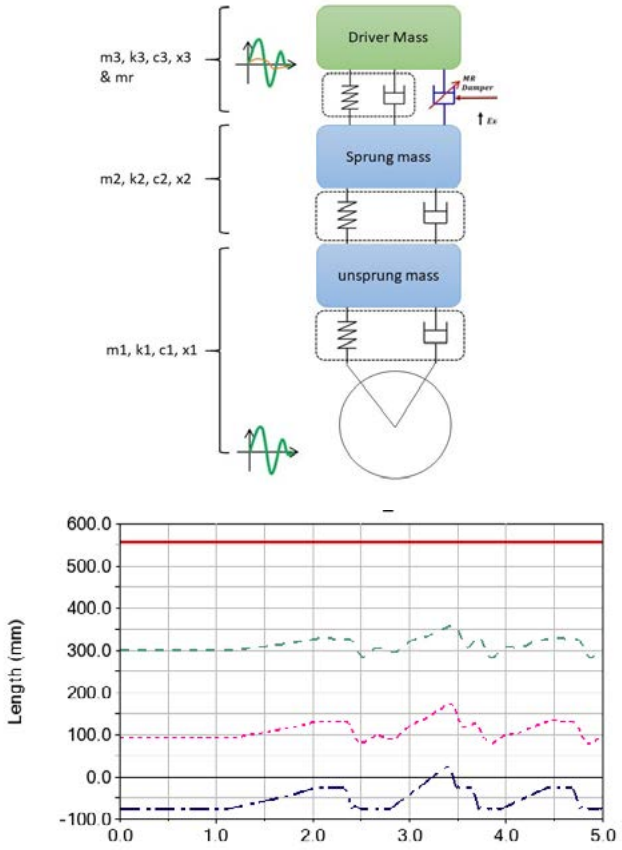


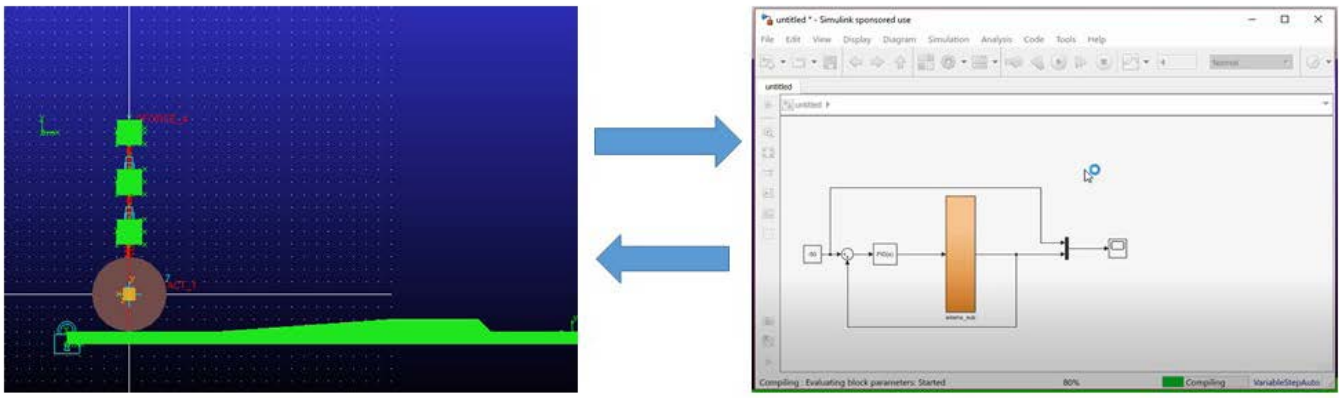
Fig: Integrated Seat and Suspension Model

Solution

The team was keen to address this issue through the use of simulation. The students used MSC Software's Adams multibody dynamics simulation solution to explore, build, and test designs virtually. The mathematical model was simulated in Adams using a graphical programming Environment and governing equations.

The suspension system was subjected to two crucial road excitations (called random input). The mathematical model of the quarter semi-active suspension system was made in the simulation block using the governing equations. The schematic diagram below describes the model of seat multiple-degrees-of-freedom-Furthermore, the students found they could achieve the required effect by applying a controller. To this end, they used a Proportional-Integral-Derivative (PID) controller that helped in controlling the error between the damping force and the force from the road. In addition to that, an MR damper fluid was used in the semi-active systems to reduce vibrations.

Adams and its comprehensive library of components, joints, and forces meant that the students were able to graphically model mechanical systems, without the need for students to write complex equations of motion



Simulation using Adams View

Key highlights:

Product: Adams

Industry: Automotive

Benefits:

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for mechanical design. They could, in turn, simulate the design with full-motion behavior within the graphical programming environment, visualize the results using animations, and plot using Adams Post processing.

The figure details the students' approach to investigating adaptive suspension under control, using a controller and damper. Velocity and acceleration can be calculated only at vertical displacement.

These variables show the automobile's performance indicators and the parameters which could be improved using simulation.

Benefits

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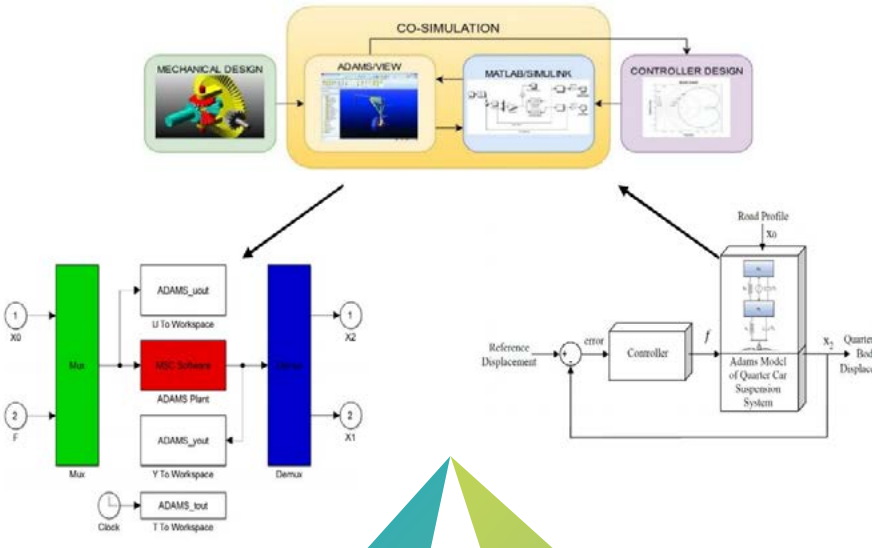

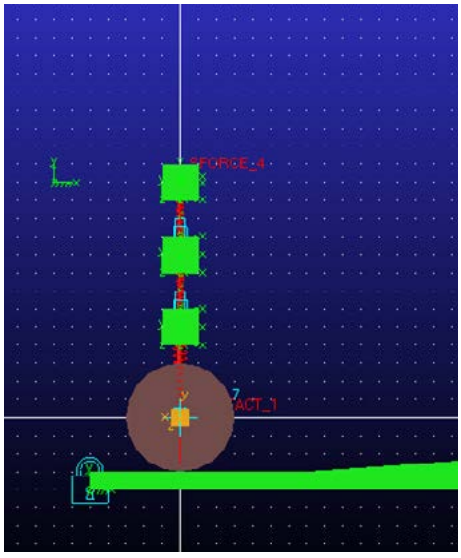

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