

Simulink Model of a Suspension System:

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System Design:

To design the suspension system, a 1/4th model was used as one of the four wheels of the car to simplify the model to a mass-damper system. The output y1 shows how the wheel balances itself within a target settling time of 2 seconds for the model.

The test conditions are provided through 'W' input. To simplify and observe system behaviour, a simple step signal can also be provided through this input. Other outputs of the Suspension subsystem are used only for the closed loop control purpose.

The other input 'U' is used to tell the model that we want to stabilize the wheel/car to a '0' position. This also can be varied for different purposes.

The system parameters are as follows.

(m1) body mass	2500 kg
(m2) suspension mass	320 kg
(k1) spring constant of suspension system	80,000 N/m
(k2) spring constant of wheel and tire	500,000 N/m
(b1) damping constant of suspension system	350 N.s/m
(b2) damping constant of wheel and tire	15,020 N.s/m

Callbacks:

Callback is used in the subsystem to import the system parameters as variables for different operations in the model.

Data Inspector:

Data inspector is used to log the input test conditions and output y1 which shows how the model stabilizes itself.

The data inspector can be particularly used to observe the system performance with respect to dips and rises and have a comparative study by altering the test conditions.

Solver Selection Strategy:

ODE-45 solver is used as the model does not have any high order ODEs and is non-stiff. Also fairly high enough accuracy was provided by the ODE-45 solver in the simulations so it was chosen.

Signal Builder:

Signal builder was used to generate different test conditions to observe system performance.

A positive y value signal shows rise in the road. Test condition 1 shows sudden but constant rise while test condition 3 showed slow but increasing rise.

A negative y value signal shows dip in the road. Test condition 2 and 4 are similar to 1 and 3, only difference being they simulate dip instead of rise.

Test condition 5 is a mix which shows increasing rise at first and then a slope of dip till the end.

These test conditions can be varied to target the model for a particular road condition.

As observed, the model stabilizes very fast and has 0 steady state error under all conditions.