HEWLETT® PACKARD

Vehicle Body Testing

Application Note 1270-5

Applications
Automobiles
Trucks and Vans
Off-road Vehicles
Railroad Cars

Departments
Research and Development
Engineering Test
Quality Assurance

Description

All land based vehicles are subjected to stresses when driven over a variety of terrains. To design better bodies and suspension systems, R&D departments test vehicles under a wide variety of road conditions. The testing involves the acquisition of data on torque, fatigue and stress in three dimensions. Manufacturers are striving for improved insulation (acoustic and thermal), suspension systems, frame design and the materials used in vehicle bodies.

Problem

To eliminate the need to run a vehicle on a test track and subject both the measurement instruments and the vehicle non controllable influences of weather, a laboratory simulation of the test track is needed. To develop a simulation a test vehicle is driven over the track. Measurements are made on the body, suspension, tires, bumpers, axles, steering column and engine mounts to find the effects of three-dimensional forces acting on the vehicle during the test drive. Then the measurements can be converted to inputs for motion simulators that test the effectiveness of new vehicle designs and materials in a laboratory eliminating the need to go to a test track each time.

Solution

A Hewlett-Packard VXI Data Acquisition System can perform the measurements required for vehicle body testing. Strain, temperature, acceleration, vibration and noise can be measured, stored, and analyzed by the system. The results of the test can show the highest stress points and the amount of fatigue experienced by various parts of the vehicle. Noise and vibration sources can be identified and performance under destructive conditions can be monitored. The accuracy and repeatability of a data acquisition system ensures collection of meaningful data leading to more reliable vehicle bodies and suspension systems.

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Implementation

Vibration

Motion detectors are transducers that measure displacement, velocity, or acceleration. They typically output a voltage proportional to movement. Measuring the voltage over time and then calculating a Fast Fourier Transform can show the frequency components of resonant vibrations.

Instrumentation: High-Speed DVM, FET Multiplexer

Strain

Both static and dynamic strain measurements are used to measure stress at various points on the body of the vehicle or in the suspension system. By accelerating the test, an hour of stresses can equal 30 to 40 hours of normal vehicle operation. A data acquisition system can interface directly with strain gage bridges and greatly simplify the data gathering process.

Instrumentation: Integrating DVM, Strain-Gage Multiplexer, High-Speed DVM, Dynamic Strain-Gage Multiplexer

Temperature

Temperature is a key factor in determining the stress and fatigue on joints in the suspension system. Temperature can also be used to determine the best materials for the suspension system and vehicle body. Thermal insulation requirements can be determined by measuring the inside and outside temperature of the vehicle and calculating the heat loss.

Instrumentation: Integrating DVM, Relay Multiplexer with Thermocouple Compensation

Noise

Microphones in the passenger compartment of a vehicle measure the noise generated by the engine, tires, transmission, suspension system and body. Acoustical considerations will affect the amount of insulation or type of material used in body construction.

Instrumentation: High-Speed DVM, Digitizing Oscilloscope

Road Simulation

The entire operation of running a vehicle on a test track can be simulated in the lab using high-speed analog outputs tied to corresponding high-speed hydraulic actuators. Simulation can mimic actual road test conditions or be a condensed version in which one hour of testing equals 30 to 40 hours of actual road testing.

Instrumentation: High-Speed D/A Converter

Crash Testing

Safety is major concern for on-the-road vehicles. Crash testing is performed on new bumpers, body frames, and on suspension systems. Strain gages and displacement transducers are typically used for gathering this type of data. For crash testing, high-speed measurements are essential.

Instrumentation: High-Speed DVM, FET Multiplexer, Dynamic Strain Gage Multiplexer

Key System Features

Data Storage
Data Scaling
Temperature Linearization
Strain Gage Linearization

Typical System Configuration

Data Acquisition System	Qty
13 Slot Mainframe	1
Integrating DVM	1
Relay Multiplexer Channels	20-60
High-Speed DVM	1-3
FET Multiplexer Channels	8-60
Dynamic Strain Gage Multiplexer Channels	10-30
High-Speed D/A Channels	4-16

Computer/Software

PC Embedded Controller
Keyboard, Monitor and Mouse
Disc Drive, Printer, Plotter
Software - DOS, Windows and HP VEE

Other Equipment

Dynamic Signal Analyzer
Digitizing Oscilloscope

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