In-Vehicle Brake Testing

using the DaqBook®

Transportation Safety

Application Note #31

In an ongoing effort to improve transportation safety, government and private organizations study how drivers behave in emergency situations. This involves using test-and-measurement systems to collect a variety of data.

Application Summary

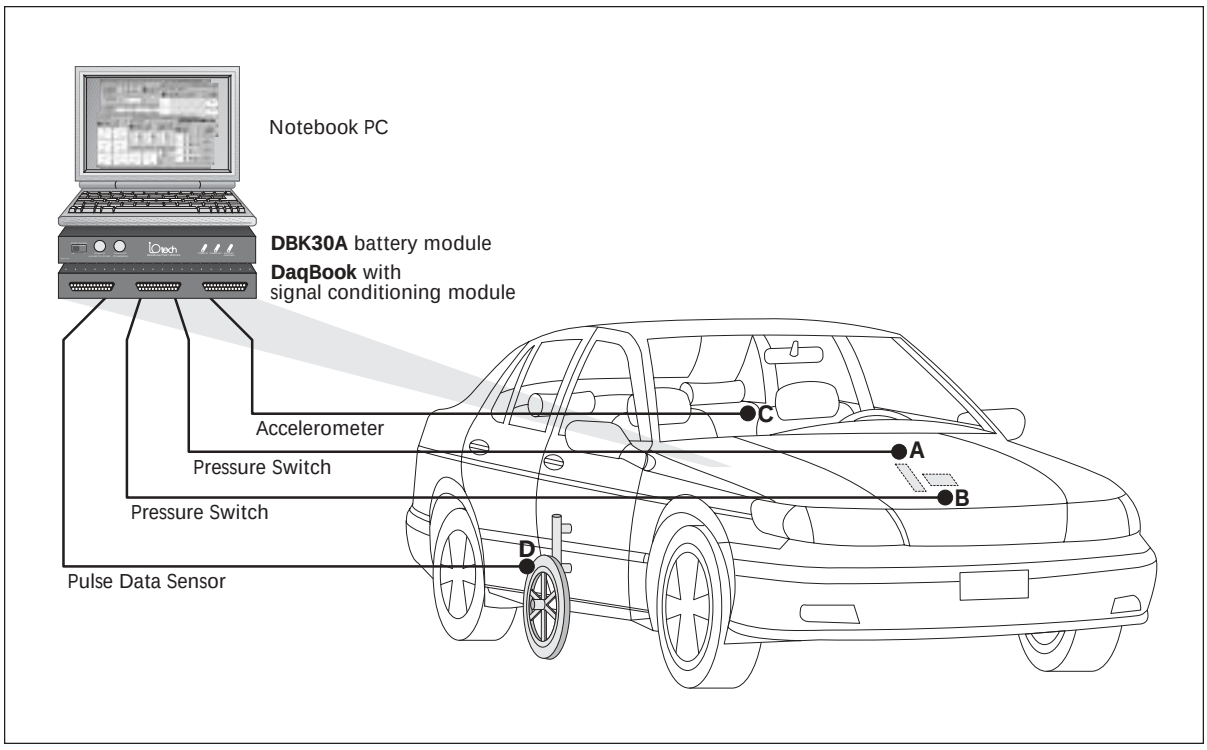
A major transportation research board funded a project to study safe stopping distances. The objective was to analyze braking behavior when drivers encountered unexpected objects in a variety of road conditions.

To increase test validity, engineers needed to gather data from everyday drivers in their own cars — not professional drivers in test vehicles. This imposed tough constraints on the engineers. For instance, the researchers were not permitted to drill holes or otherwise modify private-owner vehicles to install test equipment, which had to be properly installed in less than 30 minutes. These limitations also prohibited the use of bulky stand-alone strip-chart recorders and large groups of test-and-measurement instruments.

IOtech's Solution

The research team selected IOtech's DaqBook®, a portable data acquisition system. Connected to a notebook PC, the system provided the performance and accuracy required for the project. The DaqBook system's extensive line of expansion and signal conditioning options made it ideal for capturing various types of measurements. And the system's compact size — the same form factor as a typical notebook PC — gave the researchers the mobility that they needed.

Connected to various sensors, the system gathered data from four major sources. A pressure switch attached to the accelerator pedal let researchers know how the driver responded to braking situations, and a pressure switch attached to the brake pedal measured driver brake reaction time. Lateral and longitudinal force-balance accelerometers mounted on the floor behind the driver's seat revealed how much left and right swerving the car experienced, and pulse data from



Riding in the passenger seat, researchers used the DaqBook to gather data from brake and accelerator pedals to monitor driver behavior (A & B), a sensor behind the driver's seat to measure vehicle swerving (C), and a non-contact wheel on the passenger door to log vehicle speeds and distances traveled (D).

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the smart approach to instrumentation™

a fifth wheel installed on the passenger door helped determine vehicle speeds and distances traveled.

During a typical test, a car was fitted with the data acquisition system within the half-hour limit. Then the car owner drove the vehicle through a series of courses while a researcher sat in the passenger seat. First, the driver was instructed to drive down a road and stop the vehicle when a lamp along the road was illuminated. In a similar test, an audible signal was used to determine if there was a difference in reaction time between visual and audible stimuli.

During a second test, the researcher triggered a non-damaging cloth barrier that popped up in front of the car, requiring the driver to quickly stop. Finally, the road course was used to simulate a potential accident scenario: As the driver approached a pickup truck parked on the side of the road, a cardboard barrel was rolled off of the truck's bed and into the driver's path, causing the driver to make an abrupt stop.

Throughout testing, the data acquisition system collected a host of useful information that enabled engineers to evaluate driver braking characteristics. The results were added to a database that is being used to improve highway designs, driver education, and intelligent vehicle highway systems.

Conclusion

The DaqBook's A/D performance and programmable channel/gain sequencer make the system particularly useful for vehicle test applications that require flexibility, high channel-count and fast data collection. The system's extensive I/O and signal conditioning capabilities, combined with its low cost per channel, make it an effective alternative to larger, less-capable strip-chart recorders and groups of test-and-measurement instruments.

DaqBook/2000 Series

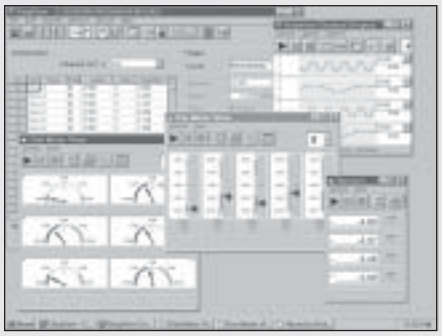
The DaqBook/2000® series of portable data acquisition devices are available with either a built-in Ethernet interface (model /2000E), or a parallel-port interface (model /2000A or /2000X). The Ethernet-based DaqBook/2000E can attach directly to the Ethernet port of a PC, or to an installed Ethernet network. The DaqBook/2000E also contains three parallel expansion ports, which can attach to an additional three parallel DaqBooks, thereby quadrupling the channel capacity of a single Ethernet link to the PC.

Features

- Analog input, frequency input, timer output, digital I/O, and analog output; all in one compact and portable enclosure
- Available with either an Ethernet PC connection, or a parallel port which can link directly to a PC parallel port, or with an interface to PCI bus, PC-Card slot, or ISA slot
- 16-bit, 200-kHz A/D converter
- Synchronous analog, digital, and frequency measurements
- 8 differential or 16 single-ended analog inputs (software selectable per channel)
- Expandable up to 256 analog input channels, while maintaining 200-kHz (5 µs per channel) scan rate
- Expandable up to 1024 analog inputs with DaqBook/2000E plus three slave parallel DaqBooks
- 512 location channel/gain FIFO, capable of scanning all channels, including expansion channels and digital/counter channels, at 5 µs per channel
- Trigger modes include analog, digital, & software, with <5 µs latency
- Virtually infinite pre-trigger buffer
- Optional four channel, 16-bit, 100-kHz analog output card installs internally
- 40 digital I/O lines scanned synchronously or asynchronously with analog inputs
- Digital I/O is expandable up to 272 lines, including isolation and relay closure options
- Four cascadable counter/pulse input channels scanned synchronously or asynchronously with analog inputs
- Two timer/pulse output channels
- Digital calibration — no potentiometers
- Multi-unit scan synchronization
- Vehicle network interface option

Signal Conditioning Options

- Signal conditioning and expansion options for thermocouples, strain gages, accelerometers, isolation, RTDs, etc.—over 40 DBK I/O expansion options in all



Software

- DaqView™ software with eZ-PostView™
- Included drivers for Visual Basic®, Delphi™ and C++ for Windows®; DASYLab®, TestPoint®, and LabVIEW®

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