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Prototype Wheelchair Testing

using the DaqBook®

Medical

Application Note #88

Application Summary

Electric wheelchairs manufactured and marketed in the US are subject to a number of rigorous testing requirements and safety standards, even though they are self-regulated and self-certified. The safety standards used for wheelchairs and medical-type scooters conform to ANSI/RESNA* standards, which harmonize with Canadian and ISO equivalents. This lets both consumers and manufacturers in the US and Canada import and export these products across borders without restrictions.

The standards define test procedures, numerous parameters, and documents that are needed to ensure the occupants' safety and method of reporting the findings to RESNA. Some of the parameters include static stability, dimensions, strength, flammability, and coefficient of friction. Yet other parameters include energy consumption, climatic tests, power and control systems, and speed, to name a few. The standards state that every parameter shall be monitored and measured over a specified time, ambient temperature, and other environmental conditions. The method of data collection should be fast, accurate, and reliable. Moreover, with such large amounts of data to be collected, the data acquisition system should be automatic.

Although Electric Mobility uses stationery fatigue-cycling machines to test mechanical parts for durability with a variety of sensors that can detect catastrophic failures, it also measures mechanical dynamic variables on working prototypes such as acceleration, speed, distance, and rollback, as well as electrical variables including motor/controller temperature, current, and voltage.

Potential Solution

One manufacturer, Electric Mobility, Inc, Sewell, New Jersey, has been designing and building electric wheelchairs and scooters for disabled persons for many years and has been instrumental in implementing the ANSI/RESNA standards since the 1990s. Brian Rafter, Quality Test Engineer at Electric Mobility, is responsible for testing prototypes to ensure conformity to functions, specifications, and standards. He cycle tests all components, fatigue tests the mechanical components, and generally runs through the entire performance test.

Until recently, Rafter used individual instruments to measure voltage, current, temperature, speed, and acceleration or deceleration and recorded the values manually. As more data were required and certain critical measurements had to be recorded simultaneously, Rafter had to find a better, more automated way of data collection.

IOtech's Solution

Rafter selected the IOtech DaqBook® and a few signal conditioning modules to replace the cumbersome methods that were being used. Technicians and engineers were manually recording voltage and current readings from digital voltmeters into notebooks. This method is totally inadequate when certain readings had to be correlated in time, particularly motor current and voltage with temperature measurements. The DaqBook lets Rafter record and store up to 8 dynamic input channels directly and up to 256 channels with DBK™ expansion modules.

Engineers at Electric Mobility use 3D computer-aided design software to design and develop prototypes quickly. Rafter's main function is to test and cycle the prototype and all its components in order to validate the product according to design specifications. When something does not measure up or fails outright, he modifies the part to ensure that it does in fact meet specifications. In the rare event of multiple failures, he must determine the sequence of the failed parts, that is, find out which part failed first, and so forth. Since the wheelchairs or scooters are fully instrumented with strain gages, thermocouples, and current probes, the DaqBook records the instant that the part failed and the response of all the sensors immediately before, during, and after the occurrence. This data lets Rafter pinpoint the single failure mode or the sequence of multiple failures.

* American National Standards Institute/Rehabilitation Engineering and Assistive Technology Society of North America

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The prototypes can be quite complex for such relatively simple-looking machines. For example, Rafter has about ten different modules that he uses in several configurations and combinations. Some modules are targeted exclusively for bench testing certain components, while others are configured for totally mobile measurements built upon the DBK30™ rechargeable battery/excitation module. In a totally portable or mobile system, Rafter measures the temperature of the controller unit and electric motor with thermocouples feeding 14-channel DBK84™ modules. He also employs DBK8™ modules to measure motor current, DBK8 (high-voltage input) modules to measure motor voltage, and DBK7™, 4-channel frequency-input modules to measure encoder outputs for real-time speed, distance traveled, and rollback. Also, accelerometers measure forces during acceleration and deceleration with DBK4™, 2-channel dynamic signal input modules.

In addition to the DaqBook, Rafter uses two IOtech DaqBoard/2000s to supplement the tests. The DaqBoards™ are each capable of 16 analog inputs and 40 digital I/O, which let Rafter perform fatigue tests automatically. Strategically placed sensors and switches can detect failed parts during fatigue cycling and automatically shut down the test when a failure occurs.

For data analysis, Rafter uses software supplied by IOtech and third parties. The open architecture of the system gives him the flexibility to select the software he is most familiar with or best suits the application. For example, he often uses the Excel spread sheet software to calculate and average data much more accurately and display the test results for reports.

Conclusion

Electric Mobility, Inc, Sewell, New Jersey, a manufacturer of wheelchairs and scooters for people with disabilities, currently use several IOtech DaqBooks in its prototyping lab for verifying that new product concepts meet specifications. These DaqBooks, along with several DaqBoards, collect data during bench-top fatigue testing as well as during actual operational tests. The systems are totally automatic, and collect data on numerous channels simultaneously to let researchers precisely determine the root failure and track or identify the sequence of multiple failures.

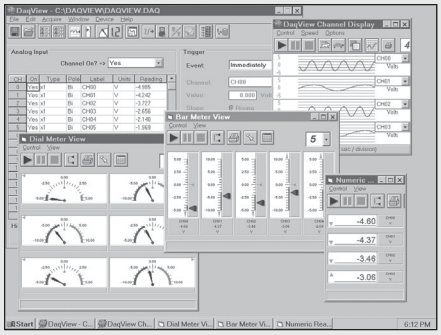
DaqBook/2000 Series

The DaqBook/2000® series of portable data acquisition devices can synchronously measure analog inputs, frequency inputs, and digital inputs. The 16-bit/200-kHz DaqBooks come equipped with built-in signal I/O capability, which can be further expanded and enhanced with over 40 DBK series expansion and signal conditioning options.

The DaqBook/2000 series includes a built-in 10/100BaseT Ethernet interface capable of transferring acquired data back to the PC at the full 200 Kreading/s measurement rate of the DaqBook. Multiple DaqBooks can be attached to a single PC via an Ethernet hub or switch, and are capable of being synchronized and of transferring data continuously at full speed into the PC. Up to 10 DaqBooks can be transferring 200 Kreading/s back to a PC concurrently, with no loss in data.

Features

- Analog input, analog output, frequency input, timer output, and digital I/O; all in one compact and portable enclosure
- Built-in Ethernet connection provides continuous streaming to the PC with no data loss
- 16-bit, 200-kHz A/D converter
- Operates from -30˚ to +70˚C
- Powerable from 10 to 30 VDC, or with included AC adapter
- Synchronous analog, digital, and frequency measurements
- Trigger modes include analog, digital, frequency, and software
- Virtually infinite pre-trigger buffer
- 4 channels of 16-bit, 100-kHz analog output (models /2001 and /2020)
- DaqBook/2020 offers convenient front panel connectors for thermocouple, voltage and frequency measurements all in one box
- DaqBooks attach to over 40 DBK signal conditioning options to assemble a low-cost system, customized to your particular application



DaqView™ graphical data acquisition and display software is included with all DaqBook systems

Signal Conditioning Options

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

Software

- DaqView™ software included for effortless data logging
- Includes support for Visual Basic®, C/C++, ActiveX/COM, LabVIEW®, MATLAB®, and DASYLab®

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