Explosive Ordnance Testing

using the WaveBook

Military

Application Note #20

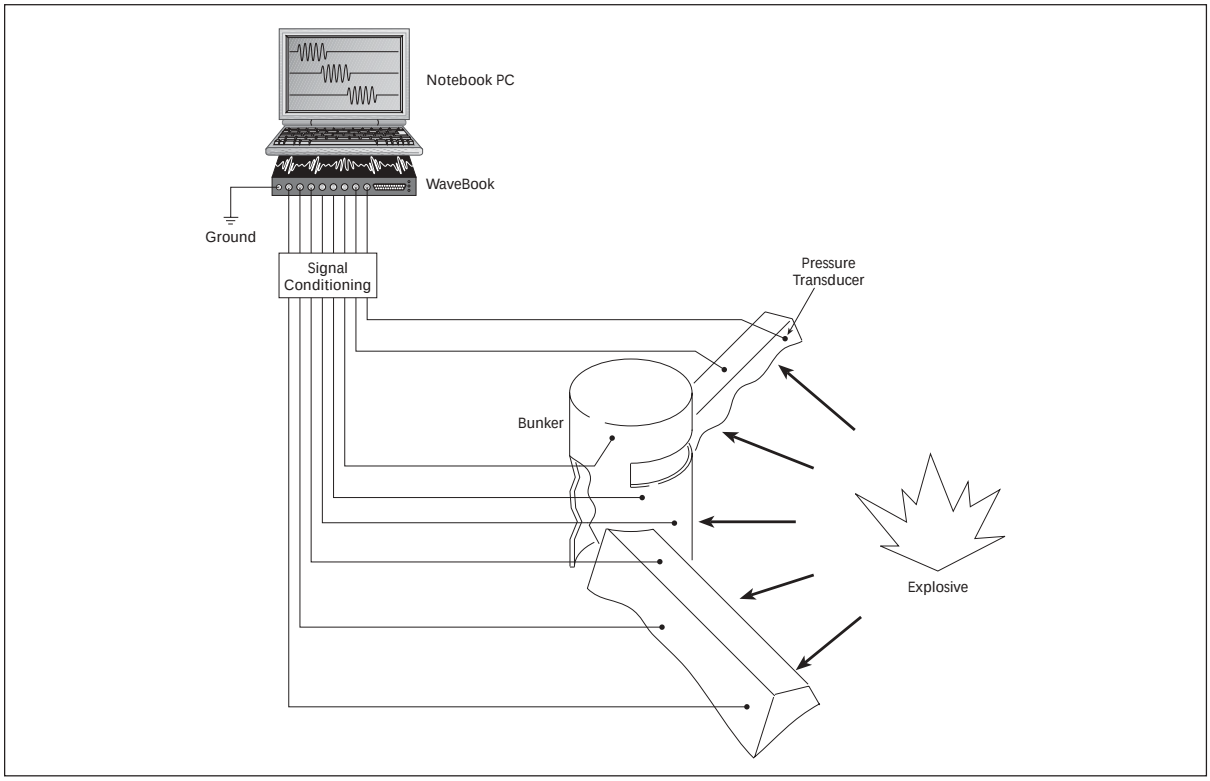
A successful military defense depends in part on the military's ability to protect its personnel in combat. One way the military accomplishes this is through the use of protective structures. To validate the effectiveness of protective structures, a large military explosive ordnance test site in Virginia uses a lightweight, high-speed, portable PC-based data acquisition system. By measuring the magnitude of pressure waves created by the detonation of explosives across various locations around a structure, the engineers at this test site are able to determine each structure's effectiveness, including its ability to deflect harmful pressure waves away from military personnel and equipment.

Application Summary

Increasing the survivability of military personnel and equipment exposed to destructive power has been a challenge for the military since the inception of warfare. When an explosive detonates, it creates a wavefront or pressure wave that is denser than steel. Traveling at supersonic speed, this highly dense wavefront can cause considerable damage. To shield military assets from this destructive power, military civil engineers construct protective enclosures of earth and building materials. These protective structures redirect the destructive pressure waves away from military personnel and equipment located inside.

To validate the effectiveness of earthen protective structures, the engineers of the Virginia explosive ordnance test site build full scale models, place pressure sensors at specific locations in and around the structures, and collect data during simulated front-line combat. The engineers connect these pressure sensors to a portable PC-based digitizer and configure it for a high-speed rising analog threshold trigger via Windows-based software. This allows the digitizer to wait for the explosion's impulse before acquiring any data.

When the engineers detonate an explosive near the protective structure under test, the resulting explosion's pressure wave excites the pressure sensors. The pressure sensors' output is then amplified by a signal conditioner that passes it on to the portable digitizer as a linear analog signal. This analog signal triggers the portable digitizer, which then measures the magnitude of the pressure wave



The portable pressure wave test set-up

at each pressure sensor location for the duration of the blast. The portable digitizer's speed enables it to capture the pressure-wave explosion data. With this data, the test site engineers are able to calculate important physical parameters such as the impulse imparted to objects within the explosion.

Ultimately, this data enables the test site engineers to improve the protective structure design so that it can effectively dampen and deflect destructive pressure waves. This information also enables them to test the effectiveness of explosive ordnance currently under development against fortifications commonly used by potential enemies and is useful for helping the military attain a maximum kill ratio for each shell design.

Potential Solution

Initially, the ordnance test site engineers evaluated several A/D plug-in boards and rejected them because they could not find software that easily and quickly enabled them to collect the required data.

IOtech's Solution

The test site engineers selected the portable WaveBook™ for its included *Out-of-the-Box*™ software — WaveView™. WaveView enables the engineers to choose from a variety of trigger types and makes it easy for them to quickly set up multiple experiments without having to write special programs for each.

Conclusion

The WaveBook's high frequency acquisition, low-noise analog inputs, portability, *Out-of-the-Box*™ software, and overall versatility make it a perfect solution for this application as well as for other general-purpose data acquisition needs at the test site.

WaveBook Series

The WaveBook™ series of portable and desktop digitizers offer multi-channel waveform acquisition and analysis for portable or laboratory applications. All WaveBook models include 8 built-in channels expandable up to 72 channels of voltage, accelerometer, microphone, strain gage, thermocouple, position encoder, frequency, high voltage, and other signal types. For applications beyond 72 channels, up to four WaveBooks can be combined within one measurement system, for a total capacity of 288 channels. WaveBooks are available with either an Ethernet or parallel connection to a PC.

Features

- PC connection via Ethernet, parallel, PC-Card, or PCI card
- 1 µs/channel scanning of any combination of channels
- Expandable up to 288 high-speed channels
- SYNC connection allows multiple units to measure synchronously
- Add up to 224 lower-speed thermocouple channels
- DSP-based design provides real-time digital calibration on all channels
- Single and multichannel analog triggering with programmable level and slope
- Digital TTL-level and pattern triggering
- Pulse trigger and external clock
- Programmable pre- and post-trigger sampling rates
- Sixteen 1-MHz digital inputs
- Operable from AC line, a 10 to 30 VDC source, such as a car battery, or optional compact rechargeable battery module

Using WaveView software's spreadsheet-style interface, you can easily set up your application and begin taking data within minutes of connecting your hardware, with no programming required.

Included Software

- WaveView™ for *Out-of-the-Box*™ setup, acquisition, and real-time display:
  - Scope mode for real-time waveform display
  - Logger mode for continuous streaming to disk
- eZ-Analyst™ for real-time spectrum analysis
- Export data in third-party formats
- Includes drivers for Visual Basic®, Delphi™, C++ for Windows®; DASYLab®, and LabVIEW®
- ActiveX/COM development tools