High-Energy Shaker Monitoring

using the WavePort/PE™

Industrial Vibration

Application Note #50

Application Summary

General Kinematics Inc, Barrington, Ill., designs and builds large moving-mass vibrating process equipment for transporting, cooling, separating, fluidizing, and grinding using shaking loads weighing several tons. Industrial applications include foundries, food processors, mining equipment, coal and garbage handlers, recyclers, and the petrochemical, wood, and ash regeneration industries. The equipment generates displacements and accelerations that are capable of shaking sand from huge castings and feeding railroad-car size loads of coal and lumber across conveyors at a specific rate. As might be expected, vibratory equipment can induce a small portion of the high-energy load forces back through its own structural support members. These resonant frequencies with relatively small amplitudes can produce some vibration within the structure's steel members, foundations, control panels, and office buildings.

The frequencies and displacements are distributed over the structural machine members often in complex patterns and can vibrate in characteristic phase relationships that either add together to increase resonance and the chance of failure, or cancel to reduce the resonance. "As many as eight different members or machines vibrating at once can produce excessively high destructive internal forces and audible noise," says Bob Huffer, Field Service Manager, "and we have to minimize or avoid the frequencies and forces both during the machine design phase as well as after the machines are installed in the field."

Potential Solution

Unwanted forces and frequencies generated in vibrating equipment are most typically a result of weak support structures, insufficient foundations, poor soil conditions under the foundation, city water mains, or just random resonances. "Many people either don't understand or overlook the effect of frequency versus force when a vibration issue arises until they do the vibration analysis. It is difficult to imagine that a pure frequency or natural frequency can create massive amounts of movement within structures, foundations, and so forth, with extremely little input force applied," explains Huffer. Therefore, designing methods to provide sufficient structural damping while maintaining the rigidity necessary to sustain the shock and vibration are a challenge to GKC engineers. In order to help them determine the machine geometry as well as the balancing and damping means, the initial design undergoes 3D modeling and the machine runs real-time testing with multiple-channel data acquisition equipment. Originally, General Kinematics used a pair of two-channel, real-time analyzers. But serious drawbacks of the equipment, which includes a limited number of input

The General Kinematics Un-coaler is an example of a vibrating machine connected to the WavePort/PE™ for analysis. It is an enclosed feeder for reclaiming bulk material. The unit discharges material vertically to the conveyor below, making the loading operation central and symmetrical. The IOtech WavePort/PE connects to accelerometers on eight of the machine members to monitor and record high-energy vibration wave shapes and displacements that are often phase related. DASYLab® software is used to record and analyze the waveforms for post-acquisition processing.

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channels and no means for recording the critical FFT waveform data for post processing prompted them to find another system.

IOtech's Solution

General Kinematics subsequently selected an IOtech data acquisition system called WavePort/PE™ that combines a WaveBook/516™ with a WBK14™ input module providing eight channels of dynamic signal conditioning (with provisions for an optional eight more channels) to collect the critical data. The IOtech WavePort is not I/O limited. It comes with an FFT module for frequency analysis and easy-to-use DASYLab® software connected to a General Kinematics-supplied notebook computer.

The WavePort is a rugged package containing a WaveBook/516 specifically designed for harsh environments or when the unit is transported frequently between several locations as done by Huffer and his team for field service assignments. The case is made of ABS plastic with a space available for mounting a notebook PC. The WaveBook/516 portion of the WavePort comes with single and multiple-channel analog triggers that are set with programmable level and slope. It also includes drivers for DASYLab® as well as Visual Basic®, Delphi™, C++ for Windows®, and LabVIEW®.

The WBK14 module contains eight dynamic analog input ports that handle General Kinematics' accelerometers strategically located throughout the vibrating machine, while another eight input channels monitor temperatures, various voltages, and other analog devices. The accelerometers are typically combinations of single-axis and triaxial configurations with outputs of 100 mV/g. All accelerometers are frequently calibrated to maintain accuracy, and the Wavebook calibration is checked annually to ensure compliance with General Kinematics' high standards for product quality.

The DASYLab® software that comes with the system contains drivers for those who prefer to do the programming themselves. They simply connect icons by clicking and dragging to interactively develop custom test and analysis applications for PC-based data acquisition systems. Huffer's goal is, in fact, to use the DASYLab® as a basis to write his own custom run-time software package. Users also create custom graphical user interfaces (GUI) that include analog meters, chart recorders, bar graphs, digital meters, and others. General Kinematics' analyses include real-time observation of frequency versus displacement and phase correlation. The modules can handle math, statistics, and data reduction, and let General Kinematics perform a complete real-time signal analysis.

Conclusion

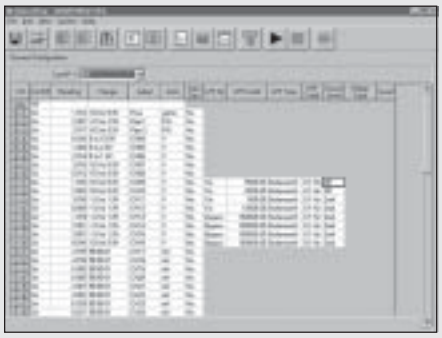
The WavePort's sufficient number of inputs and ability to record accelerometer waveforms for postprocessing let General Kinematics more quickly and efficiently analyze the structural design and integrity of its vibration machinery.

WavePort/PE & WaveBook/516

The WavePort™ series of products are designed for applications where the system may be exposed to harsh environmental conditions, or where it is often transported from one location to the other. WavePorts are packaged in a high-impact plastic ABS package, and are comprised of WaveBook™ and WBK/DBK Series options inside.

WavePort/PE Features

- Ruggedized packaging for transportable and field applications
- Based on WaveBook/516™ architecture
- Available with several different channel and signal conditioning configurations
- Convenient BNC signal connections
- Internal UPS (Uninterruptible Power Supply)



WaveView™ graphical data acquisition and display software is included with all WaveBook systems. 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

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