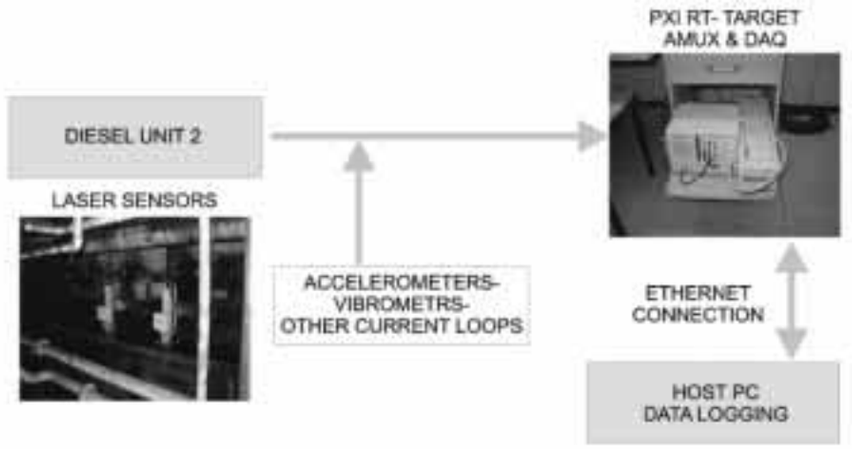
Products Used: LabVIEW™ • PXI • LabVIEW Real-Time

Using LabVIEW and PXI for an Online Mechanical Parameters Monitoring System for a Diesel Generator Unit Set

by Assist. Professor Dr I. Antoniadis,
Dr. A. Hountras and G. Glossiotis,
Rodax Corporation S.A., and
Machine Design and Control Systems Section,
Mechanical Engineering Department,
National Technical University of Athens

The Challenge: Developing an online monitoring system, combining new and existing sensors, while meeting reliability and efficiency requirements in the industrial environment of a diesel generator unit set.

The Solution: Using National Instruments PXI hardware architecture and LabVIEW Real-Time software, we integrated a reliable and modular measuring system, which performs and evaluates fast measurements in real time.



View of the Measurement System

Avoiding Machine Faults

The online automated monitoring system supervises critical conditions of a Diesel Generator Unit (DGU). With this automated monitoring system, we can avoid certain machine faults, such as rotor cracks, and transients during power changes. In addition, the system measures and archives additional mechanical parameters related to more general aspects of the machine condition or performance. We installed the DGU in a thermoelectric power station with nominal active power of 15 MW.

We efficiently integrated a flexible and reliable toolkit using National Instruments technology.

The automated monitoring system simultaneously conducts 24 measurements on the set. First, we measure vertical displacements at eight points using newly installed laser displacement sensors, banded together in two groups of four on either side of the engine. We measure the displacement of each basis tracks relative to the primary base of the engine, which is made of cement. Additionally, we combined two newly installed accelerometers for vibration measurements. The sensors measure vibrations of the engine at three points, including: the exit point of the shaft from the engine, the journal bearing between the engine and the generator, and the stator casing of the generator. We also measure relative displacements of the rotor located at the journal bearings on each side of the generator using existing machine sensors. We record all measurements in combination with the shaft rotation speed, active, and reactive power of the entire unit.

Creating a Measurement System that Acquires Records Simultaneously

The data logging and processing system consisted of a PXI chassis and appropriate modules, National Instruments LabVIEW software, and a desktop PC for the visual inspection of the system and further processing of logged data.

We collect and forward the signals from all sensors to the data logging system, using 24 4-20 mA loops. This integrated measurement system consists of several National Instruments components. We based the structure on the PXI architecture with a PXI-1002 chassis and additional components we adapted to the chassis, which include:

- PXI-8156B/333 MHz Real-Time embedded controller
- PXI 6040E DAQ board
- AMUX 64T Multiplexer

We modified these components with the adaptation of high sensitivity resistors to convert the sensors' current signals (0-20 mA or 4-20 mA) to voltage signals.

We used LabVIEW Real-Time and a desktop PC, which communicates with the PXI through Ethernet. A UPS unit provides the power supply of this PC, and the PXI power supply, ensuring the system operation remains uninterrupted. A modem installed on the host PC ensures the remote supervision of the entire system. The host PC executes basic programs of data acquisition, temporary data logging, and TCP communication.

Every minute, we acquire records from all 24 channels simultaneously. For each data record, we chose a sampling frequency of 20 Hz. This works perfectly by accounting for the excitation source of the signals measured, which is the shaft rotation speed of the engine. The shaft rotation speed never exceeds the value of 130 RPM (~ 2.167 Hz), and we assigned the number of samples per channel at 1,024. Therefore, the system accomplishes a 5.12 second acquisition period for all 24 channels.

We also store the specified data in files every 15 minutes by creating a new file,

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which we name with a timestamp indicating the first minute of acquisition. The host PC enables us to transfer the saved data from the hard disk of the PXI to its hard disk for further data processing. National Instruments Internet Toolkit makes this possible. Before we execute an FTP process for certain periods, we copy the files from the PXI to the host PC. We can later erase these files from the hard disk of the PXI to save volume. We designed three major programs that are executed on the host PC.

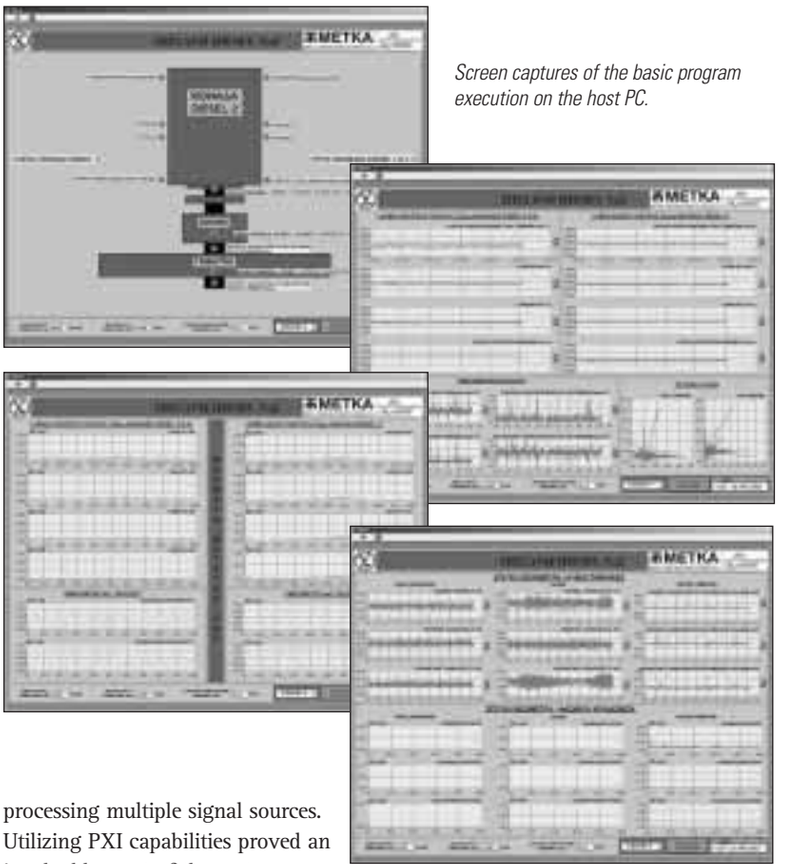
TCP - This TCP program visually inspects acquired data online. It uses a TCP connection to communicate with the program executing on PXI, and consists of four screens. The first three screens contain graphs of the waveforms of the signals, their amplitude spectrums, and two orbit graphs. In the fourth screen, a simplified diagram illustrates locations of adapted sensors on the engine.

Historical - This historical program allows us to present historical data, which we save on hard disk.

Trending - This trending program illustrates measurement trends from the signals.

Results

We efficiently integrated a flexible and reliable toolkit using National Instruments technology. We significantly reduced cost and time by efficiently collecting, logging, and further processing multiple signal sources. Utilizing PXI capabilities proved an invaluable asset of the system. ■



Screen captures of the basic program execution on the host PC.

For more information, contact
Dr. I. Antoniadis,
National Technical University of Athens
Control Systems Section
Tel: +30 210 772 1524,
Fax: +30 210 772 1525,
E-Mail: antogian@central.ntua.gr,
or Dr. A. Hountras,
Rodax Corporation SA
Tel: +30 210 523 5404,
Fax: +30 210 523 4093