

Spectrophotometer Hardware and Software Upgrade

Industrial Research Limited: Measurement Standards Laboratory

The Challenge

Provide the Photometry & Radiometry Laboratory of Industrial Research Limited with a best-in-class solution for future research by replacing a DOS PC based system originally started in the 1970s with an industrial strength automation and control system solution.



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The Solution

Increase the system automation, expandability and resolution using a combination of National Instruments LabVIEW and PXI products with a SICK Absolute Encoder.

Introduction

The Photometry & Radiometry Laboratory at Industrial Research Ltd. is the New Zealand Measurement Standards Laboratory for light measurement. One of the pieces of equipment used in the laboratory is the Spectrophotometer (Figure 1), which is used for research and as the reference for light-measuring instruments nationwide.

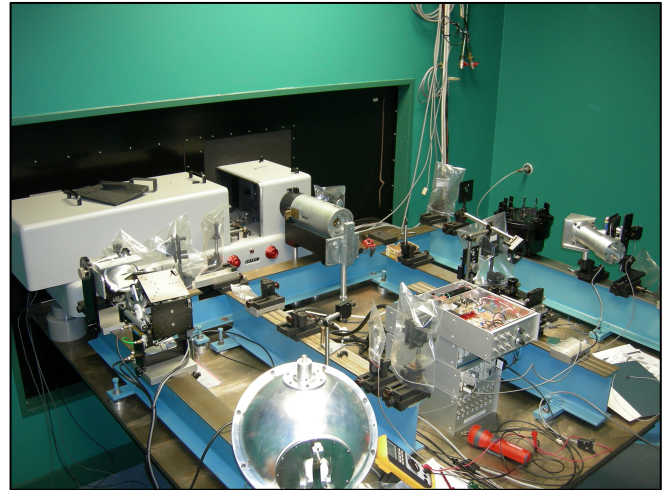


Figure 1: Spectrophotometer

Since its installation more than a decade ago, the Spectrophotometer was beginning to become restricted in its capabilities. The obsolete PC technology was no longer available, which created a high potential risk situation for the laboratory should they experience technical problems. In addition, the Photometry & Radiometry Laboratory sought to maximise efficiency by improving the level of automation for the Spectrophotometer.

To address these restrictions, IRL required a hardware and software upgrade, and brought in Nightside Test Design to perform the initial phases of the project.

Technical Background

The Spectrophotometer is split between three rooms: the Control Room, the Light Source Room and the Light Detection Room.

The Spectrophotometer measurements use a light source focused on the diffraction grating. The grating splits the light into its component parts which are then measured by various detectors. The equipment of the Spectrophotometer comprises:

- A Wavelength Control Unit (WCU)
- Mechanics for changing physical samples
- Mechanics for selecting detectors



Figure 2: Control System

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The WCU uses a stepper motor connected to a worm drive to move the diffraction grating through an angular range to select a wavelength component of the light source and direct it to different detectors and samples under test. The existing system provided some automation of the Spectrophotometer; however, the control system needed upgrading to gain efficiencies and resolution improvements.

Technical Solution

Nightside created an Automated Control System based around National Instruments PXI product range and included Motion control, Digital I/O, CAN and GPIB interfaces. Where practical the existing GPIB instrumentation was re-used.

Antoine Bittar, a Project Leader in the Measurement Standards Laboratory of New Zealand, confirmed: "Once we decided on the upgrade we looked for a single company to provide a complete solution. Given the quantity of parts that have to be controlled and moved, and the number of instruments that need to be read, we have to make sure that the system is smoothly integrated."

A SICK Absolute Encoder was used to close the motor control loop via CAN providing feedback on the position of the diffraction grating. An absolute encoder was selected as it can recover from power loss without loss of position. The high accuracy encoder provides 8192 revolutions at 8192 counts per revolution. The completed control system has allowed the Photometry & Radiometry Laboratory to improve wavelength measurement resolution by a factor of two, from +/-0.0024 nanometers to +/-0.0012 nanometers.

The Control System Software was written using LabVIEW and has been designed such that it provides Industrial Research the ability to extend its capabilities in the future. Some of the extensions that are planned include automating the transfer of light sources and the addition of other tests.

Results

The Spectrophotometer upgrade provided the Photometry & Radiometry Laboratory with its anticipated benefits as well as additional efficiencies.

The solution deployed by Nightside is at the cutting edge of current technology, removing any risk of obsolescence or unavailable parts and service. In fact, the system was developed specifically for ease of expansion and upgrades.

This advanced system has also allowed the Photometry & Radiometry Laboratory to significantly improve the resolution of the WCU. Finally, the increased level of automation has minimised the amount of manual intervention and setup time required during a test run.

"Nightside was really the only company capable of meeting our specifications," said Bittar. "The project involved an enormous effort to understand our specific requirements, and Nightside has delivered beautifully. We look forward to working with them on an ongoing basis."

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