Industrial-Quality Control System Gives Students Real-World Experience in Advanced Process Control Technology

The Environment

The Chemical and Fuels Engineering Department at the University of Utah in Salt Lake City is one of this country's leading engineering and research facilities. Ranking among the nation's top 25 institutions in federal research funding, the university provides a relevant, practical, real-world process engineering experience for undergraduate and postgraduate students alike.

The Objectives

More than 20 laboratory experimental apparatus and pilot scale equipment in the industrial teaching laboratory utilize more than 300 Opto 22 I/O points.

As one of the nation's top universities, attracting top students both nationally and internationally, the University of Utah was challenged to keep up with the rapidly-changing state-of-the-art in the areas of process control and data acquisition. The new distributed control and data acquisition system provided by Opto 22 allows students and faculty to work with equipment that is years ahead of that found in most educational institutions and ahead of many process industries.

Specific areas of practical Opto 22-based research include:

- Nonlinear multivariable process control
- Fundamental combustion modeling
- Online process optimization
- Multiple steady-state solutions to distillation problems
- Fundamental combustion experiments
- Bioreactors
- Reaction kinetics.

Taking advantage of easy PC networking and the distributed processing capabilities of Opto 22 hardware, the Chemical and Fuels Engineering Department enables students to gain experience on the types of equipment they may encounter in industry. The wide area access of experimental data to faculty and research offices increases efficiency and staff involvement in the research. Better data leads to better research results.

Networking permits data to be used in many different areas without the tedious transferring and reentering of data. Operator interfaces in one area can monitor projects in all areas of the laboratory.

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The Results

The Opto 22 control and data acquisition system is based upon a networked distributed-control architecture. Several 32-bit processors are connected to multiple operator interface computers over ARCNET and Ethernet local area networks. Each of the 32-bit Mistic processors connects to several I/O units. The intelligent I/O units perform many of the high-speed system functions, including the latching of momentary events, counting and frequency measurement of digital events, analog engineering units conversion, and PID loop control.

By distributing the processing among many devices, the Opto 22 system maintains a high level of performance that is relatively independent of overall system size and complexity. This is especially important in a research environment where various experimental processes may be going on simultaneously with other continuous process control projects.

Networking makes all of the data available everywhere in the facility. Instructors and laboratory assistants in office areas have immediate access to all process data. Processes can be monitored and modified, assuming appropriate security access, from any location.

"The software interface is very robust and cannot be crashed by inexperienced users," said Dr. Terry Ring, department chairman.

Kiethley Metrabyte and IOtech data acquisition equipment were previously in use in the Process Laboratory. Opto 22 equipment added the ability to network data and user interfaces to faculty and research offices. "The Opto 22 equipment also more closely models Process Control equipment that the graduates may encounter in industry. The Opto 22 interface is much more robust than any laboratory-oriented software package," added Dr. Ring.

The ability to more closely model industry equipment and process control problems for teaching and research proposes is of great value. "Our students will gain experience that is more relevant to their careers."

The system is programmed using a multitasking flowchart-based language developed by Opto 22. The language, called OptoControl, is part of Opto 22's FactoryFloor software suite which includes OptoDisplay, a versatile human-machine interface, and OptoServer, a network connection tool which allows access to real-time data from any location on a local area network.

"Our student programmer was very proficient within several days. He was an expert within several weeks of working with the Opto 22 software," said Dr. Ring. "The visual programming interface is essentially self-documenting. It is relatively easy for another programmer to follow the work of the initial programmer and make modifications as necessary. The structure is very robust and automatically checks for block compatibility."

The four-story distillation tower has 40 I/O points and seven regulator loops, including several cascade controllers. The entire system can operate from either one or two main controllers. Eight PCs are networked throughout the lab to act as user MMIs.

The current department mandate is to hook every experimental apparatus and pilot plant to the Opto 22 Distributed Control System (DCS).

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