CAMPBELL SCIENTIFIC UPDATE

Winter 2008 Volume 19, Issue 1

A Major Step Forward in Vibrating-Wire Technology

New AVW200 Improves Noise Immunity

Here at Campbell Scientific, we are excited about our most recent measurement advance—a new interface module that promises to significantly improve vibrating-wire measurements. Vibrating-wire technology is used in many sensors, including strain gauges, pressure transducers, piezometers, tiltmeters, crack meters, and load cells. These sensors benefit a wide variety of structural, hydrological, and geotechnical applications because of their stability, accuracy, and durability.

While vibrating-wire sensors have their benefits, they suffer from one major problem—external noise. Because measuring these sensors involves low-level, audio-band signals, external electromagnetic noise can interfere and make it difficult to determine the resonant frequency of the sensor. If the external noise is bad enough, it can render data useless. The new AVW200 interface module applies a new method for measuring the sensor's frequency. The traditional method uses a time-domain approach. The natural or resonant frequency at which the wire is oscillating is determined by exciting the wire with an AC excitation, stopping the excitation, and then measuring time between response pulses.

In addition to refining the AC excitation, the new method featured in the AVW200 takes advantage of a built-in spectrum analyzer that uses spectral interpolation instead of the traditional pulse-timing approach. It samples the returned signal, performs an FFT (fast Fourier transform) to discriminate between spectral components, and then identifies and measures the resonant frequency of the sensor. This means that even in noisy environments the sensor's resonant frequency can be identified and accurately measured.

Along with improved noise immunity, the new method provides other important benefits. It provides much better measurement resolution (improving from 0.01 Hz to 0.001 Hz) as well as diagnostic information about the measured frequency. This diagnostic information includes the signal-to-noise ratio, amplitude of the dominant frequency, and an optional spectrum showing all of the frequency components.

The AVW200 can be used via SDI-12, RS-232, or PakBus network protocol.

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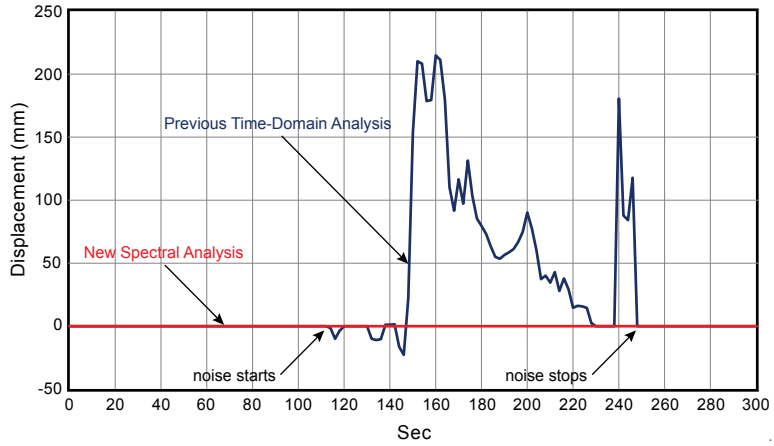
Improved Noise Immunity Using Spectral Analysis



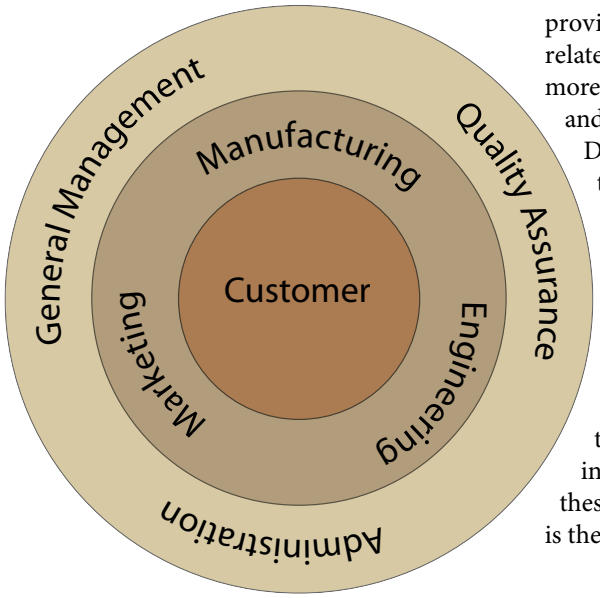
◄ New spectral analysis provides significantly improved noise immunity over the older time-domain analysis method. The noise source (in this case an electric motor) introduced 200 mm of displacement error with the old method, while the new method's error was less than 0.02 mm.

Campbell Scientific Capabilities

Paul Campbell, President

Nearly all of our customer newsletters have focused attention on products offered by the company. To complement your understanding of our products, I would like to highlight some additional background information about the underlying capabilities of Campbell Scientific. In this edition, we will highlight our Engineering Department that spends its time developing new products and improving the existing ones. Since a related article (see page 3) describes in more detail the personnel, resources, and activities of the Engineering Department, let me describe how they relate to the company as a whole and to you, our customer.

Our engineers appreciate the challenge of solving difficult technical problems, and we all appreciate the opportunity we have of working with you, our customers.



Shown here is a diagram of our company organization. We put you, our customer, at the center, and we recognize that the primary activities that deliver value to you are marketing, engineering, and manufacturing. Outside of these primary activities where there is the most interaction with customers, there are support functions to take care of things like accounting and quality assurance.

Engineering takes the responsibility for the embodiment of appropriate technology in products that meet your needs. Their work begins with product definition through contact with marketing and with customers, and with a knowledge base of appropriate technology that can reasonably be developed or is already available to solve customer problems. Once a development project is outlined, it then progresses through the process of making value decisions about design, solving specific technical problems, and finally producing the resulting documentation that allows manufacturing to build the product. They also work in support of manufacturing with process design and improvement.

With our engineering expertise including physical and environmental sensors, electronic measurement techniques, data acquisition, communications, and systems design, we are prepared to support customers with a wide range of measurement needs. Our engineers appreciate the challenge of solving difficult technical problems, and we all appreciate the opportunity we have of working with you, our customers.

AMS Awards Campbell Scientific

The American Meteorological Society (AMS) has selected Campbell Scientific for its 2008 Award for Outstanding Services to Meteorology by a Corporation. The company was chosen because of our "long-term contributions to the weather and climate enterprise by consistently providing versatile and reliable meteorological measurement and data systems vital to research and operations." Paul Campbell and Bert Tanner were presented the award on January 23rd at the awards banquet at the AMS 88th Annual Meeting in New Orleans. We are honored to receive this award and look forward to creating innovative measurement instrumentation for many years to come.

CAMPBELL SCIENTIFIC UPDATE

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Engineering at Campbell Scientific

Art Heers, Vice President of Engineering

Some companies are engineering firms that contract out their services. Others are marketing outlets that focus solely on sales and service. Still others are mainly contract manufacturers. Campbell Scientific on the other hand, is engineering, marketing, and manufacturing, all wrapped up in one. About half of us work in manufacturing, a fourth in marketing, a sixth in engineering, and the rest in supporting roles.

From our beginnings in 1974, engineering shaped the kind of company we have become. A problem existed among meteorologists on how to measure average wind over a half-mile distance, so Eric Campbell, the cofounder of Campbell Scientific and our first engineer and president, developed the CA9 anemometer. A short while later, about the time the CMOS (low-power) microprocessor was invented in the late '70s, the first smart, programmable, battery-powered measuring device that incorporated this new technology (later known as the CR21 datalogger) was developed by Eric with the help of two or three others.

Over the years, the Engineering Department has grown along with the rest of the company, consistently maintaining our roots in innovative measurement instrumentation. You can see the fruits of our labor in:

- The current line of CRBasic dataloggers
- A wide variety of weather stations
- A multitude of sensors, from the CS616 soil-water sensors to the 3-D CSAT3 sonic anemometer
- Sensor interfaces like the new, innovative AVW200 Vibrating-Wire Interface
- The myriad of communication interfaces from the COM220 phone modem to the NL115 Internet module
- PC software products that enable our customers to see the results of their field experiments

Currently, Campbell Scientific's Engineering Department has ten electrical and computer engineers, seven mechanical and manufacturing engineers, and ten software engineers, along with a small but invaluable support staff of documentation administrators, draftsmen, technicians, and interns. Unlike the current trend in other companies, virtually all of our engineering work is done in house by these personnel—including conceptualization, schematic capture, board layout, 3-D mechanical capture, early prototypes, board turns and packaging design, documentation and programming for the pick-and-place machines and the machining center, and shepherding everything through the initial manufacturing runs.

A case in point is the making of the CR1000 datalogger. Recognition of the benefits and need for a product like this had been ruminating for a year or two in the company. Parts obsolescence of the CR10X was a mounting concern for Manufacturing. Marketing saw potential for a datalogger that matched the CR10X's ruggedness and popularity but with a few new features. The same engineers that designed the CR10X saw the benefits of using modern microprocessors and larger memory, and the potential for increased versatility and user accessibility through their new CRBasic language and PakBus network communications.

This motivated Campbell Scientific to open a project, and a team of half a dozen people got to work. Jody Swenson, our analog design specialist, improved upon Eric Campbell's original, innovative design for the CR10 that Jody had carried forward to the CR10X. Then Dave Israelsen had the idea to incorporate this and a lot more into a Campbell Scientific application-specific integrated circuit (ASIC) to save cost and space—and our first experience in designing an ASIC began.

In the meantime, Dave Madsen and I began work on the operating system. We used much of what we had learned

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The CA9 Path Averaging Laser Anemometer was the first engineering product at Campbell Scientific.

Bridge Monitoring and Testing

Many of us cross bridges every day as we travel to and from our various destinations. As long as their operating condition doesn't affect our travel, most of us probably don't give them much thought. However, the recent bridge collapse in Minnesota likely made all of us think more about the safety of the bridges we cross—and perhaps we should. Federal Highway Administration data from 2004 showed that, of the 594,101 bridges in their inventory, 77,796 were classified as being *structurally deficient*. While the classification of structurally deficient doesn't necessarily mean a bridge is unsafe, it certainly brings attention to a growing problem. With thousands of bridges nearing their life expectancy and insufficient resources to fix them all at once, bridge monitoring and testing are key to maintaining the safety of our infrastructure.

Bridge health monitoring can consist of short-term, dynamic testing or long-term, static monitoring. Short-term testing includes live-load, shaker, wind-load, strain or stress, and deflection tests. Long-term testing can include many of the same, as well as testing for tilt, rotation or movement, settlement or twist, and scour. All of these can provide engineers with valuable data about the structural integrity, load limits, life expectancy, needed repairs, and other safety concerns.

Bridge monitoring applications require rugged instrumentation, and for this reason Campbell Scientific dataloggers are often used by bridge researchers and engineers. Our dataloggers are designed for long-term, stand-alone monitoring, and to withstand extreme temperatures. They can operate without AC power or computers and feature unmatched versatility. Nearly every commercially available sensor can be used, supporting specific application requirements. Data from remote sites can be retrieved via satellite, radio, phone, cellphone, and other telemetry methods. This versatility and rugged reliability comes without sacrificing measurement quality—something for which Campbell Scientific is well known.

Our dataloggers have been used over the years to monitor many prominent bridges. Whether bridges are large or small, Campbell Scientific is committed to providing quality instrumentation and support to help maintain their safety.

If you would like to learn more about our bridge monitoring and testing solutions, call us at 435.750.9692 or visit campbellsci.com/bridge-monitoring.

Bridges Monitored with Campbell Gear

Brooklyn Bridge, NY
Bronx Whitestone Bridge, NY
Throgs Neck Bridge, NY
Verrazano Narrows Bridge, NY
William State Road Viaduct, PA
Birmingham Bridge, PA
Neville Island Bridge (I-79), PA
Ft. Duquesne Bridge, PA
Shippingport Bridge, PA
Triboro Bridge, PA
Sawmill Run Bridge, PA
SR33 Bridge over Lehigh River, PA
I-83 Ramp Bridge, PA
Smart Bridge, DE
I-65 over Kanawha River, WV
AMTRAK Susquehanna River Bridge, MD
Highway 60 bypass, IA
Saco, IA
15 Mile Creek Bridge, OR
I-5 McKenzie Bridge, OR
Willamette River Bridge, OR

For a full list, visit our Web site at campbellsci.com/bridge-monitoring.

Measurements

Strain
Vibration
Tilt
Crack size
Temperature
Wind speed and direction
Counts
Displacement
Impact
Scour
Load

Dataloggers Approved by Racing Organization

We are please to announce that the National Hot Rod Association (NHRA) has approved the CR800, CR850, and CR1000 dataloggers for use in its Sportsman categories. Founded in 1951, the NHRA is the world's largest drag racing organization and provides drag racing opportunities on all levels.

The approval of these dataloggers provides racing teams with a new approach to data acquisition. Many data acquisition packages used for making racing performance measurements come with a predefined set of sensors, which can limit the parameters that can be measured and ultimately the performance data that is available to a team. Campbell Scientific dataloggers are compatible with nearly every commercially available sensor, and are expandable using many different measurement peripherals. This open design provides the flexibility to measure whatever parameter might be of interest, resulting in more comprehensive vehicle performance data, even that elusive data that previously may have been unavailable. This flexibility, combined with our excellent technical support, will be a valuable benefit to racing teams.

We look forward to our dataloggers being approved by other racing organizations as we continue to provide innovative solutions for racing performance data acquisition.

Model AP100 CO_2/H_2O Profile System

The AP100, designed for measuring atmospheric profiles of carbon dioxide (CO_2) and water vapor (H_2O), incorporates nearly 20 years of experience designing, building, and testing custom sampling systems for atmospheric trace gases or chamber concentrations. An insulated enclosure (16 in. by 18 in.), complete with mounting hardware, houses a CR1000 datalogger and 7-Ahr battery, LI-COR Model LI-840 CO_2/H_2O Gas Analyzer, and a miniature manifold where one of the eight profile intakes or up to three zero/span gases are selected for analysis. Swagelock connections (0.25 in. OD) are provided in the enclosure bottom. An optional heater provides operation to -30°C ambient temperatures.

The flow (~0.9 slpm) and pressure (~50 kPa) in the profile intake tubing is set by an orifice plumbed directly behind the intake filter. Operating the intake tubing at reduced pressure prevents condensation (within limits) and reduces the time required for H_2O to equilibrate to a new concentration. The CO_2 and H_2O equilibrate to within 0.25% and 0.05%, respectively, of the concentration change from the previous intake for the following measurement sequence.

The entire profile (eight intakes) is sampled every 2 minutes, with each intake selected for 15 seconds. The first 8 seconds are allowed for equilibration, with measurements obtained over the last 7 seconds. These results are obtained using the AC powered pump (250 W) supplied with the system. Equilibration times have yet to be determined for lower flow rates obtained using a lower-powered 12-Vdc pump.

Case Study

Safeguarding Illinois Highways

The Illinois Department of Transportation ran tests on twelve interstate highway bridges in Illinois along Interstates 55 and 70/270 to validate methods for calculating bearing forces. The department selected typical Illinois interstate highway bridges that allowed a good range of study parameters. These bridges were instrumented on their beam webs with strain-gage rosettes to measure shear stresses caused by loads. Test data were collected by Campbell Scientific dataloggers for approximately six months at each bridge to determine loading trends.

At most of the test points, the researchers installed three triaxial strain rosettes in a vertical line on one side of the web, and also on the opposite web face on selected beams to determine the effect of torsion. For gage installation on concrete beams, individual strain gages were arranged in a three-element triaxial pattern at each rosette location.

Campbell Scientific CR5000 dataloggers were chosen for their programming, signal conditioning, remote monitoring, and reporting capabilities. Multiple CR5000 units were used for initial load tests at each bridge site since strain gages were mounted on all beams to aid calibration. Following the initial phase, one datalogger was required at each bridge site for the long-term testing.

The datalogger program was developed by Southern Illinois University Edwardsville (SIUE) using the CRBasic programming language and runtime compiler included with the CR5000. SIUE wrote in features like continuous strain-gage monitoring, computation of beam shears, periodic strain-gage zeroing, and data storage. The dataloggers' batteries were recharged by 75-W solar panels mounted to the side of the abutment.

For the initial load testing, the data were downloaded to laptop computers immediately to verify all gages were performing and to make adjustments. Long-term data acquisition typically consisted of a large file stored on a CompactFlash (CF) card at the site, then downloaded to desktop computers for extensive analysis. They conserved memory by storing data only when certain thresholds of beam shear were exceeded.

The project team was very satisfied with the performance and reliability provided by the CR5000 dataloggers and related software products.

New Product

ST350 Bridge Diagnostics Strain Transducer

The ST350 350-ohm Strain Transducer has been added to our product line in a joint effort with Bridge Diagnostics, the manufacturer. The ST350 can evaluate live-load stresses on bridges, buildings, cranes, and other civil structures. This transducer can be installed within minutes on steel, concrete, timber, and fiberglass-reinforced plastic members.

Construction Research in Alaska

Campbell Scientific and Geo-Watersheds Scientific are research partners with the Cold Climate Housing Research Center (CCHRC). The CCHRC is a nonprofit research and testing organization that promotes healthy, durable, energy-efficient, affordable homes, along with building products and designs for cold climates.

Applied science and environmental data generated through cooperation among these organizations is used to help improve living conditions for Alaskans throughout the state. These same advances have potential to improve conditions in other parts of the world as well. Benefits may include better construction techniques, improved use of water resources, and integration of energy resources.

The CCHRC recently completed its new Research and Test Facility (RTF) on the campus of the University of Alaska, Fairbanks. The facility is built on an area with underlying permafrost at various depths. Permafrost is perennially frozen ground, which presents many foundation and structural design challenges. This is a major area of study at the RTF.

The RTF is instrumented with a variety of monitoring sensors under the building, in the foundations, in flooring systems, and throughout the wall and roof areas. There is also a weather and geotechnical station nearby to help improve the understanding of permafrost, foundations, and thermal control of the subsurface building envelope.

The foundation system was built to allow future leveling in case of degradation of underlying permafrost. Jacking pads under the foundations are used to adjust the concrete beams that support the building walls and lower-level floor system.

Various floor and foundation types were used in the construction of the building so that different temperature-profile sections could be monitored for thermal analysis of the building heat flow to underlying permafrost. The CCHRC network consists of ten CR1000 dataloggers stations whose input channels are expanded by AM16/32A multiplexers interfacing hundreds of thermistors, dozens of CS616 soil moisture probes, and several other types of sensors.

In addition to studying foundation systems, the CCHRC expends major effort researching building envelopes, hybrid micro-energy systems, water reuse, and green roofs at the RTF. The data collected for these projects will be used for operations, education, and research. For more information on this project, visit cchrc.org.

HFP01 Hukseflux Soil Heat Flux Plate

Hukseflux's HFP01 has replaced the HFT3 as our heat-flux plate for applications that do not require self-calibration. The HFP01 outputs a voltage signal that is proportional to heat flux. Heat-flux plates typically measure heat flux of soil as part of a larger energy-balance measurement system. In this application, two or more HFP01 sensors are buried at a depth of 8 cm, and located at least 1 m from each other.

West Texas Mesonet

The West Texas Mesonet (WTM) project was initiated by Texas Tech University in 1999 to provide free real-time weather and agricultural information for residents of the South Plains region of western Texas. The network has grown to include 51 meteorological stations (10 m tall), one radar wind profiler, one acoustic wind profiler, and one upper-air sounding system. It was recently expanded westward into New Mexico to help provide weather data for ranching and wind-power interests.

Weather information from each surface station is transmitted every five minutes back to a base station at Reese Center (12 mi west of Lubbock, Texas). Agricultural data (including soil temperature and moisture information) are transmitted every 15 minutes. All real-time data collected from the surface stations are available on the main Web page at www.mesonet.ttu.edu.

The WTM uses Campbell Scientific dataloggers, towers, enclosures, communication devices, and a wide variety of sensors. The stations measure numerous factors of wind, air temperature and humidity, sunlight, soil temperature and water content at multiple depths, precipitation, and barometric pressure.

There is no grid electricity at any station. The sites use 20- or 50-W solar panels to charge two deep-cycle gel type marine batteries. Power use is so great at several of the major radio repeater stations that they need to use two 50-W solar panels to charge three batteries. Each datalogger has a backup set of internal batteries to save data in case of a major failure in the marine batteries.

Texas Tech cooperates with the National Weather Service (NWS) by providing high quality meteorological and agricultural information to a region where the NWS would find few data sources. In return, the NWS relays WTM data to the media and surrounding community through warnings, forecasts, local storm statements, and other reports. The NWS also helps with the communication costs at many stations in the WTM domain.

The huge treasure of data from this mesonet is available for free on the Internet. It is displayed in various formats for the various users: agriculture, wind-power industry, media outlets, schools, community leaders, emergency management, and the general public. The Web site receives an average of 35,000 hits per day, and has had as many as 110,000 hits in one day, benefiting a great many users.

SDM-CD8S 8-Channel Solid-State DC Relay Controller

The SDM-CD8S, expected this spring, controls DC devices that have a moderate current load, such as solenoids, solenoid valves, DC motors, stepper motors, lights, horns, heaters, and fans. The SDM-CD8S is targeted for applications requiring only a few control ports, where a larger and high-powered relay module such as the SDM-CD16S is not necessary. The voltage range for this device is 8 to 26 Vdc. It can deliver up to 1.5 A per channel with a maximum of 6 A total for all channels.

Energy Efficiency Goes to Washington

The 2007 Solar Decathlon took place on the National Mall in Washington, D.C., October 12 to 20. This competition enlisted 20 teams of college and university students to design, build, and operate the most attractive, effective, and energy-efficient solar-powered houses. Each house was instrumented with sensors to evaluate how well the students met the challenge. Campbell Scientific dataloggers were chosen for a key role in the evaluation phase.

Over the previous two years before the event, each team of college students designed a solar house, knowing from the outset that it must be powered entirely by the sun. The competition demanded that their designs maintain the house within a certain temperature range, provide lighting, run appliances, charge an electric car, and much more. They then built their solar houses, learning as they went.

The 20 teams transported their buildings to Washington and assembled them on the National Mall. The judging then began, with Campbell sensors and dataloggers measuring factors such as light, temperature, and humidity. Our gear helped the judges gauge performance in contests of engineering, comfort, appliances, hot water, and lighting.

The U.S. Department of Energy holds the Solar Decathlon every two years to serve three main purposes:

- To educate the student participants about the benefits of renewable energy and energy efficiency
- To raise public awareness about renewable energy and energy efficiency and the technologies available to reduce energy use
- To help move solar energy technologies to the marketplace faster

There are many simple ways to save energy, and many relatively simple ways to generate energy from the sun. Solar energy technologies are clean, producing significantly less pollution than other options. And we can count on that energy source as long as the sun shines. Campbell Scientific was proud to provide tools to help measure our progress in energy production and use. For information, photos, and videos about this competition, visit solardecathlon.org.

NR01 Hukseflux 4-Component Net Radiation Sensor

The NR01 net radiometer is manufactured by Hukseflux for research-grade energy-balance studies. The radiometer consists of four radiation sensors—two pyranometers measure short-wave radiation and two pyrgeometers measure far-infrared radiation. One upward-facing pyranometer/pyrgeometer pair measures incoming radiation while a complementary, downward-facing pair measures reflected radiation. The NR01 also includes a resistance temperature device (RTD) to measure the internal temperature and a heater to prevent condensation.

OBS® Sensors Now Built by Campbell Scientific

For many years, Campbell Scientific has carried the OBS-3 and OBS-3+ sensors from D&A Instrument Company. These sensors monitor turbidity and suspended-sediment concentrations using optical backscatter (OBS) technology.

Campbell Scientific recently purchased D&A Instrument Company and their OBS product line. Production and business operations have been moved to our headquarters in Logan, Utah, and we are now responsible for all warranty repairs, quotes, orders, and any other business regarding D&A Instrument products.

The OBS technology works by emitting a near-infrared light into the water, then measuring the light that bounces back from the suspended particles.

We've already begun production of the OBS-3+ probe, and the OBS-3A and OBS-5+ water-quality systems. These later two systems provide data logging capability, store up to 200,000 lines of data, and include PC software for system setup and data retrieval.

Each OBS-3A has a turbidity sensor and a temperature sensor. A pressure transducer for depth measurement and a conductivity probe are available as options. The system can perform wave processing of the depth measurements using a fast Fourier transform (FFT) algorithm for wave height and period.

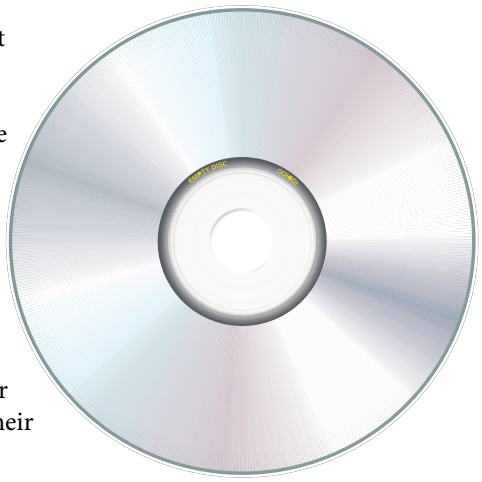
The OBS-5+ monitors high suspended-sediment concentrations and depth. Its unique optical design consists of one emitter and two detectors. This design allows the OBS-5+ to sense suspended-sediment concentrations for up to 50 g/l in mud or 200 g/l in sand. A pressure transducer is included for depth measurements.

Campbell Scientific will carry on the tradition of high-quality craftsmanship that D&A established. We will continue to seek product advancements, at times consulting with John Downing, the former president of D&A. To find current information about the OBS product line or learn more about Campbell Scientific, please visit campbellsci.com/obs.

Product Manuals Distributed via CD

Beginning on March 1, 2008, our policy for sending out product manuals will change. We are moving away from paper-based manuals to PDF versions on CD. The PDF versions of the manuals have the benefit of being searchable and will help us reduce paper consumption. One CD will be shipped with each order. Additional copies can be ordered at no charge by specifying "ResourceCD" and indicating the desired quantity with your order.

If you prefer paper copies of the manuals, you can still get them, but you need to let us know. Please visit campbellsci.com/paper-manuals to indicate your preference for paper manuals. (You only need to visit the site if you want to receive paper manuals.) You can also specify that you would like to receive paper manuals at the time of order. There will be no cost associated with paper manuals when ordered together with their products. A charge will be associated with paper manuals ordered separately from their products. You can always find the latest versions of our manuals on our Web site at campbellsci.com/manuals.



New Software for High-speed Data Collection

Our RTDAQ (Real-Time Data Acquisition) software will soon replace PC9000 as the flagship product for industrial and other high-speed data collection applications. RTDAQ retains key PC9000 functionality and features, such as a variety of windows for monitoring data in near real time and support for our CR5000 and CR9000X dataloggers. Improvements over PC9000 include:

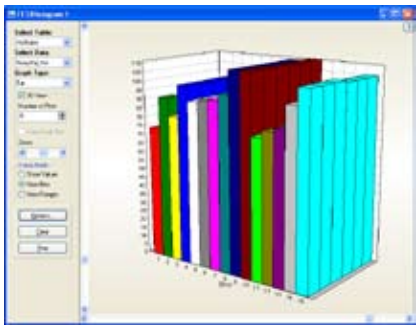
- Ease of use
- A look and feel similar to LoggerNet and PC400
- Inclusion of the EZSetup Wizard, Short Cut, RTMC, and PakBus Graph utilities
- Support for our newer CRBasic dataloggers (CR800, CR850, CR1000, and CR3000).

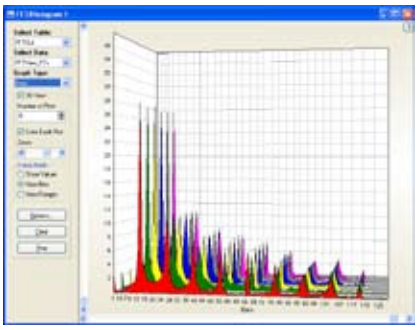
Programming tools provided by RTDAQ are Short Cut, an updated version of PC9000's program generators, and the CRBasic Program Editor. These programming tools support the new FieldCal instruction that enables real-time, nonintrusive calibration of sensors in the field.

RTDAQ supports manual data collection over a single telecommunication medium; scheduled data collection is not supported. Compatible communication technologies include direct connect, short-haul modems, telephone modems, TAPI, TCP/IP, narrow-band VHF/UHF radios, spread-spectrum radios, and multidrop modems. Real-time data may be monitored using Fast Graph, Histogram Viewer, FFT Viewer, Table Monitor, and X-Y Plotter.

For viewing historical data, RTDAQ includes an enhanced version of the View application. Known as ViewPro, this program allows extensive display of multiple selections of data, as well as viewing of specialized data storage such as fast Fourier transforms (FFTs) and histograms.

RTDAQ represents a significant milestone in bringing ease of use, needed datalogger support, and configurable data monitoring to Campbell Scientific's industrial customers.





Engineering, Continued from page 3

from the CR10X and the CR9000, while trying to keep up with the new ideas for instructions and functionality that came in. In parallel, Rex Bodrero and Evan Campbell were designing the packaging and working with the machine shop for early prototypes. Finally, all through the course of this hardware design, Jon Trauntvein and several other software engineers were creating what would become LoggerNet, the software that could communicate with the modern dataloggers and display the information measured and logged.

At Campbell Scientific, Engineering and Marketing have always been very close. As engineers, we spend much of our time studying the laws of physics and the workings of modern technology so that we can design measurement systems that benefit our customers. Much of our time is spent figuring out problems and working up designs with paper, pencil, computers, lab benches, soldering irons, calculators, data books, and our thinking caps. But a key to our success at designing the *right* products is our understanding of the problems that match our specific capabilities. So we are communicating with Manufacturing personnel that will build what we design, and especially with Marketing and our customers so that the product ends up being a real service to someone.

This process of defining the product of the future is not just a simple question of, "Tell me, you in Marketing, what to build." In the beginning, no one told Eric, "I need a datalogger." The word didn't even exist back then. But when we as engineers dig deep into what our customers are up against, and when at the same time we really love applying the latest technology, then solution can meet problem, embodied in the products we develop. It's win-win all the way around. That is what engineering is all about at Campbell Scientific.

Have Any Feedback?

We are always interested in hearing your ideas and suggestions. Our Web site has a variety of resources that provide you with an opportunity to give us your input.

General Feedback—If would like to tell us about a positive or negative experience with Campbell Scientific, comment on the newsletter, or share other suggestions, this page provides a simple feedback form. campbellsci.com/feedback

Quick Polls—These polls offer a one-click mechanism of giving us your opinion on a variety of topics. We ask a question, you click the answer that you agree with, and the results are immediately updated. campbellsci.com/polls

Case Studies—Visit this page if you would like us to consider your project for one of our case studies, or if you would like to share some photos. We often include these on our Web site and in our newsletters. campbellsci.com/submit-case-study

Ask a Question—If you have a support question regarding products you've already purchased, a question about products you are thinking of purchasing, or a question on any other topic, this page is for you. campbellsci.com/questions

AVW200, Continued from page 1

Its low power consumption and rugged design match the durability and long-term stability of vibrating-wire sensors. Wireless versions are also available, allowing for remote deployment separate from the datalogger.

We expect the AVW200 to build on our reputation for providing quality measurement products for both research and day-to-day applications. For more information, please visit campbellsci.com/vibrating-wire.

Wireless versions (AVW206, AVW211, AVW216) allow deployment separate from the datalogger.

NL120 Network Link

The new NL120, a 10base-T Ethernet interface, connects directly to the 40-pin peripheral port on a CR1000 or CR3000 datalogger. It is the smallest Ethernet interface available. Ethernet interfaces allow our dataloggers to communicate over a local area network or a dedicated Internet connection via TCP/IP. The NL120 will be available this spring.

AM16/32B Relay Multiplexer

The AM16/32B has replaced the AM16/32A. The AM16/32B supports two clocking modes. Mode A works like the AM16/32A and sequentially advances through each channel. Mode B uses a relay address to go directly to a specific channel—reducing power consumption and wear on the relay switches.

Campbell Scientific Calendar

January

20-24	American Meteorological Society	New Orleans, LA
22-24	DistribuTECH	Tampa, FL
28-31	Alaska AWRA Conference	Juneau, AK
30-31	Wine & Grape Symposium	Sacramento, CA
31-02	Golf Industry Show	Orlando, FL

February

05-07	Fish Farming	Greenville, MS
09-12	Aquaculture America	Lake Buena Vista, FL
12-14	World Ag Expo	Tulare, CA
26-29	Rural Water of Utah	St. George, UT

March

20-21	Accelerated Bridge Construction	Baltimore, MD

April

14-18	Western Snow Conference	Hood River, OR

May

06-09	Alert User Group	Palm Springs, CA
18-22	Monitoring Conference NWQMC	Atlantic City, NJ
20-22	Pacific Northwest Snowfighters	Kennewick, WA
29-01	1/4 Scale Tractor Pull	Peoria, IL

June

01-04	WindPower	Houston, TX
02-04	International Bridge Conference	Pittsburgh, PA
08-11	WEDA XXVIII & TUMU 39	St. Louis, MO
23-27	USGS-CHIDER	Knoxville, TN
24-26	A&WMA	Portland, OR
29-02	ASABE	Providence, RI

July

14-18	HydroVision	Sacramento, CA
20-23	Precision Agriculture	Denver, CO
25-27	Recirculating Aquaculture	Roanoke, VA

August

04-07	StormCon	Orlando, FL
03-08	Ecological Society of America	Milwaukee, WI

Visit our Web site for training class schedules and additional listings.

CAMPBELL® SCIENTIFIC, INC.
WHEN MEASUREMENTS MATTER

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