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Test & Measurement World

THE MAGAZINE FOR QUALITY IN ELECTRONICS

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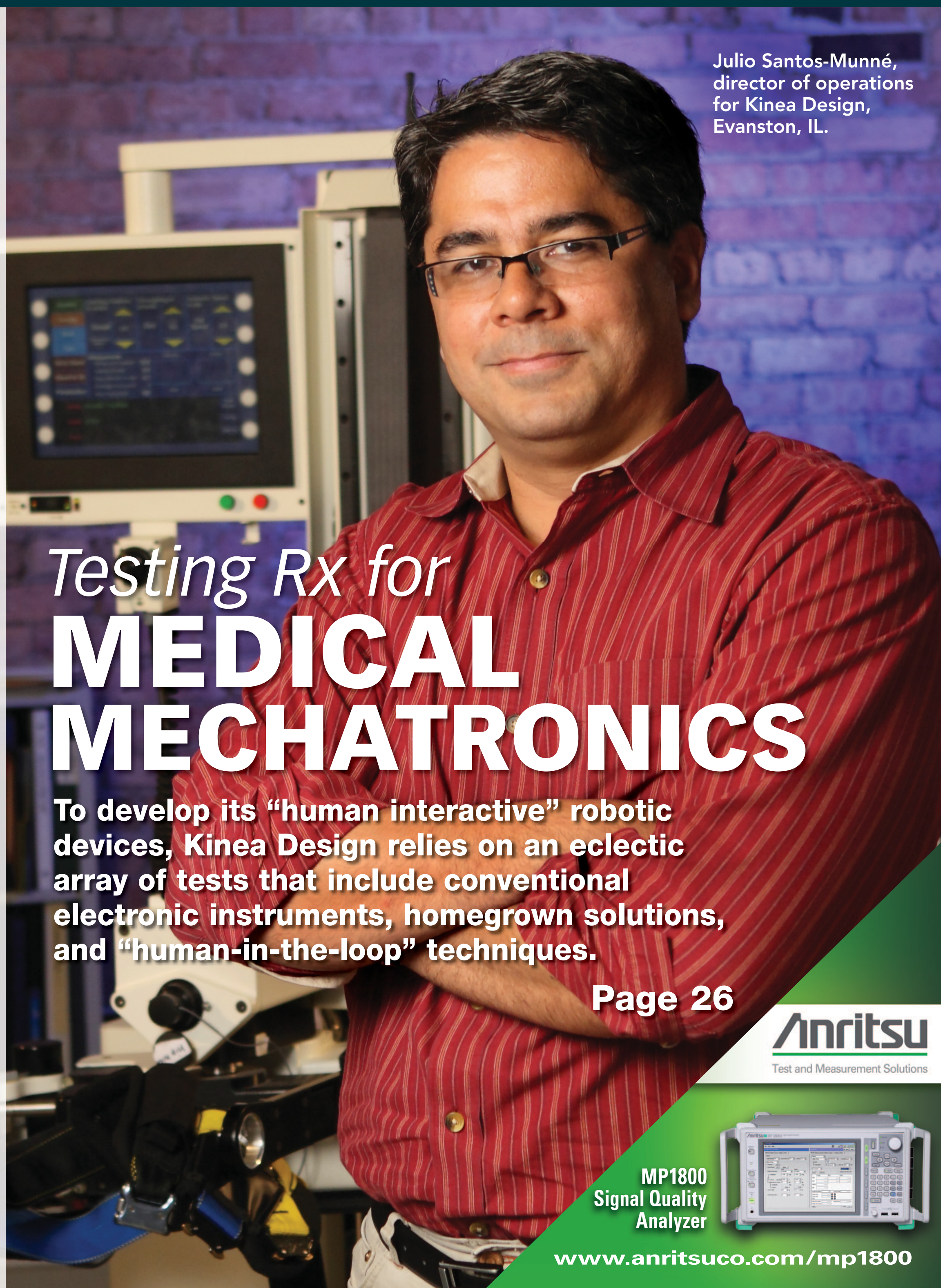

Julio Santos-Munné, director of operations for Kinea Design, Evanston, IL.

Testing Rx for MEDICAL MECHATRONICS

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Anritsu
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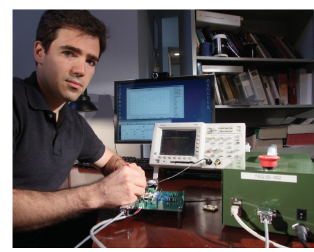

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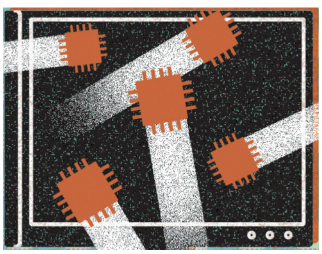

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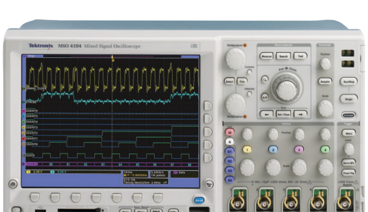

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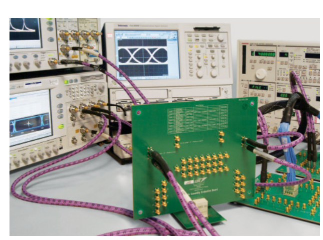

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From meat to fish

This month's cover story describes the efforts of engineers at Kinea Design, who employ mechatronics techniques as they develop products for medical applications. The company also applies its expertise to projects for industrial applications and academic research. "From meat to fish," an online companion article to the cover story, describes some of these projects, including the HookAssist device, which helps workers in meat-processing plants lift and maneuver primary cuts of meat, and a sensing scheme for possible use in autonomous underwater navigation.

www.tmworld.com/kinea_0710

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RICK NELSON
EDITOR IN CHIEF

In praise of measurement

If you want to control something, start by being able to measure it. It's good news that measuring things is becoming easier and easier. Microelectronic sensors are emerging that can measure key biological and environmental parameters.

Speaking May 25 at the International Microwave Symposium, Greg Peters, VP and GM of the component test division of Agilent Technologies, cited the geometric growth in edge devices—that is, devices that touch the real world. Edge devices, he said, account for billions of dollars in sales and serve applications including security, health, and environmental monitoring.

The government must recognize the importance of accurate measurements.

Edge devices enable what might be called "the Internet of Things," which, writing in the May 27 issue of *EDN*, technical editor Margery Conner described as "… the networked interconnection of objects—from the sophisticated to the mundane—through identifiers such as sensors, RFID tags, and IP addresses." She continued, "Sensors form the edge of the electronics ecosystem, in which the physical world interacts with computers, providing a richer array of data than is available from keyboards and mouse inputs. Currently, someone at a keyboard has input most of the information on the Internet. We are at an inflection point, however, at which more Internet data originates through sensors than keyboards."

A host of low-power, low-cost sensors must emerge to drive through this inflection point, and the many that are available now will soon be joined by others. Quantities like pressure and acceleration have long been amenable to measurement by microelectronic sensors. And last month, IMEC added a sense of smell to the capabilities of microelectronics devices with the debut of its electronic nose. Speaking June 7 at the IMEC Technology Forum at IMEC affiliate Holst Centre in Eindhoven, the Netherlands, Mercedes Crego-Calama, principal researcher at Holst Centre/IMEC and program director for the Holst Centre's HUMAN++ program, described the e-nose as a MEMS bridge that acquires extra mass in the presence of volatile chemical vapors, changing its piezoelectric characteristics.

Conner writing in *EDN* estimated that with infrastructure and personal-device sensors combined, manufacturers will develop and deploy what amounts to about 1000 sensors per person over the next 10 years. That's a lot of welcome measurement power.

Unfortunately, there is one area in which measurement has not been given its due, and that's with regard to the oil gushing into the Gulf of Mexico. The *New York Times* on May 13 quoted Kent Wells, a BP senior VP, as saying, "There's just no way to measure it." The US government was little better, putting out a woefully low estimate of 5000 barrels per day. The *Times* noted that Ian R. MacDonald, an oceanographer at Florida State University, had made his own rough calculations suggesting that the leak could "easily be four or five times" the government estimate. He added, "The government has a responsibility to get good numbers. If it's beyond their technical capability, the whole world is ready to help them."

Let's hope the government hears that message. T&MW

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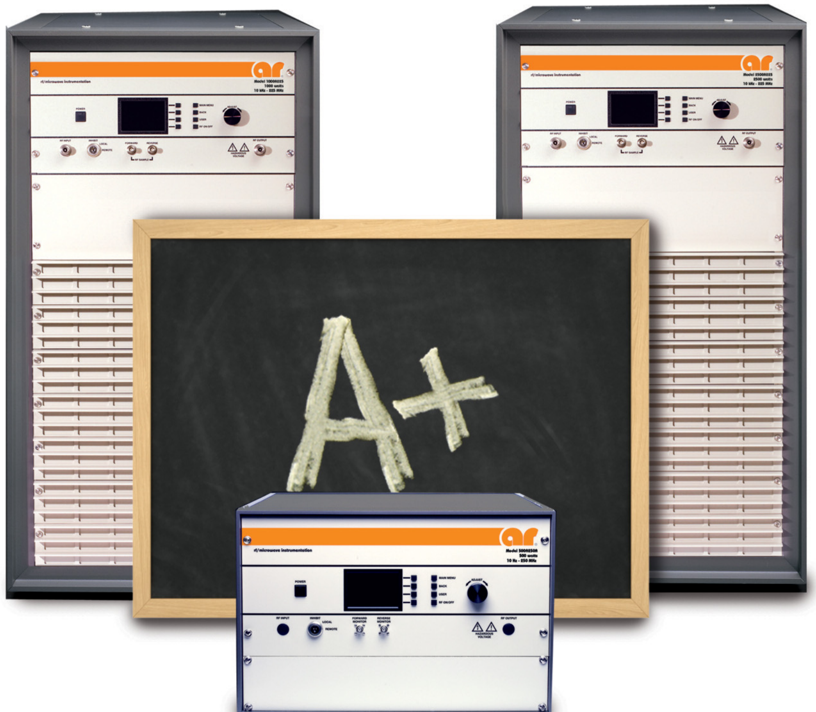

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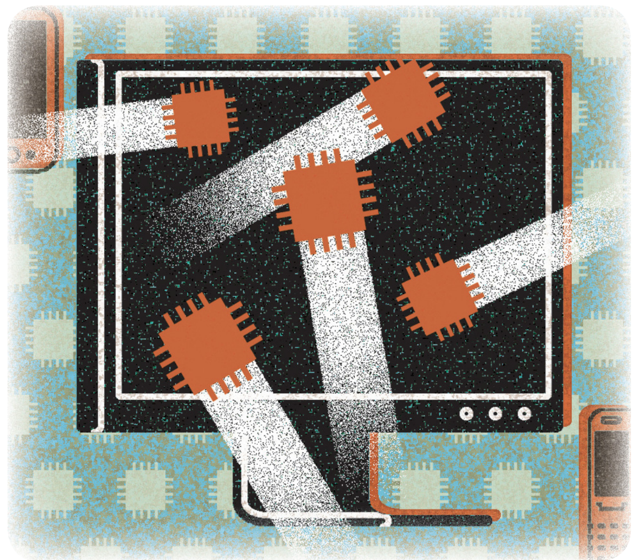
[An exclusive interview with a test engineer]

From back end to front end

Daniel Chow is a signal-integrity engineer at NVIDIA (Santa Clara, CA), a maker of GPUs (graphics processing units) found in desktop, laptop, and tablet computers; cellphones and other consumer devices; and supercomputers. Prior to NVIDIA, Chow worked at FPGA-maker Altera and was featured in "The philosophy of jitter" in the June 2009 issue of *T&MW* (www.tmworld.com/2009_06). Senior technical editor Martin Rowe spoke with Chow by telephone.



DANIEL GUIDERA

Q: How do test and measurement differ for FPGAs and GPUs?

A: Altera's FPGAs are designed into back-end systems such as switches and routers. They have long lifetimes, as much as 10 years. An FPGA's architecture may carry over from one product design to another. Thus, I've had to learn in detail how they work.

NVIDIA's GPUs are front-end devices often designed into consumer products. A GPU architecture may be in production for just two to three years. I usually spend time validating a new design for signal integrity, power integrity, and crosstalk—system-level effects that are challenging to verify through simulation.

Q: How do you perform measurements on FPGAs as opposed to GPUs?

A: You can program an FPGA to create specific conditions and tests. All you need is a power supply, a programming port, and connections to measure signals. For example, you can program an FPGA to perform a loopback test on a high-speed serial port and you can measure jitter under controlled conditions such as PRBS (pseudorandom bit sequence) patterns. You can't do that with GPUs. They operate as part of a larger system where they run live traffic only.

Q: How do you evaluate signal and power integrity?

A: It's much more difficult. My primary concern is how a device interoperates within a system. Sometimes, I can set up test points at a device's ports to measure signals at the device. A GPU's test and measurement emphasis is in interoperability, where an FPGA's emphasis is performance, because you don't know how customers use FPGAs.

Q: If you're testing with live traffic, can you get repeatability in your measurements?

A: Live traffic is, over a period of time, essentially random, and random conditions become Gaussian. Deterministic jitter begins to fade when you don't have a repeating pattern the way you can when using defined patterns. I have to use statistical methods such as the central limit theorem to model the various jitter components.

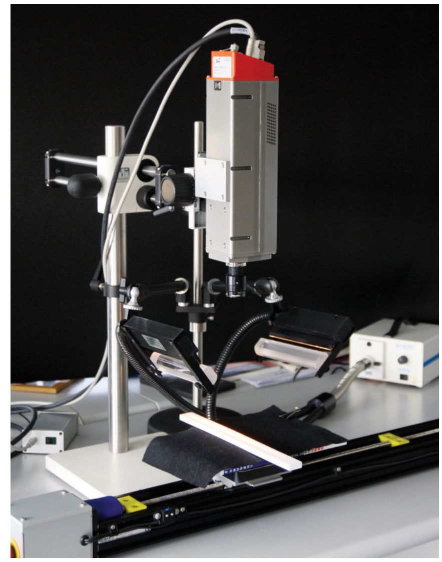
The problem with testing with live traffic is the number of bits involved. A typical 1280x1024 image with 24 bits of color per pixel contains more bits than an oscilloscope can analyze. Even if you repeatedly send an identical image through the processor, effectively making it motionless, an oscilloscope will have difficulty processing such a long pattern, and you can't characterize it. Bit-error-rate testers have less stringent limits on pattern length, but they have difficulty with very long, arbitrary (non-PRBS) patterns.

Q: What, then, do you do?

A: We look at jitter on a macro scale. We have to look at jitter as no longer purely random nor deterministic. Even random jitter is not truly random because power supplies are heavily filtered, so they remove some of the jitter. We're working on analysis techniques for these signals, and we hope to produce conference papers on the topic soon. T&MW

Every other month, we publish an interview with an electronics engineer who has test, measurement, or inspection responsibilities. If you would like to participate in a future column, contact Martin Rowe at martin.rowe@cancom.com. To read past "Test voices" columns, go to www.tmworld.com/testvoices.

IMEC touts machine-vision platform



IMEC—a European research center based in Belgium—has embarked on a machine-vision program called NVision that leverages IMEC's technologies and capabilities. Speaking at the IMEC Technology Forum (June 7–8, Leuven, Belgium), Johan De Geyter, department director for digital components at IMEC, said NVision will have applications in compact stereocams, one-chip smart cameras, high-speed cameras, and light-field imaging. Initial NVision applications, he said, will center on volumetric displays, tumor scanners, high-speed food scanners, and endoscopic smart pills.

De Geyter delved into the topic of HSI (hyperspectral imaging), and he presented as an example a melanoma pen, which IMEC is developing with a partner company. The handheld device employs controlled light, calibration, and sensing algorithms running on an embedded processor that performs hyperspectral analysis to provide go/no-go diagnosis of skin cancers. The pen will incorporate an IMEC HSI module.

De Geyter described HSI as a combination of spectroscopy and imaging that improves machine vision by making use of the spectral information of the material being analyzed. The technique, he said, can serve medical, chemical, food and feed, pharmaceutical, and automotive applications. He added that a commercial system based on the IMEC approach could cost less than $60,000 and operate at better than 8000 lines/s, in contrast to the $80,000 price tag and 180-lines/s capability of a traditional system. www.imec.be.

Atrenta announces SpyGlass-Physical

Atrenta at the Design Automation Conference (June 13–18, Anaheim, CA) announced the availability of its new SpyGlass-Physical product. This addition to the SpyGlass family enables engineers to achieve faster design closure by modeling physical implementation effects at the RTL (register transfer level) stage of the design.

Previous SpyGlass products provide information on whether a design is syntactically correct and testable; SpyGlass-Physical provides early estimates of area, power, timing, and routability for RTL designers who lack physical design expertise or tools. Existing SpyGlass users can integrate the new product into their design flow.

Ravi Varadarajan, Atrenta fellow, said the new tool does not replace a customer's favorite implementation tools but rather makes the existing tools more efficient, allowing designers to identify problems earlier in the design cycle. In addition, the time penalties involved in successive iterations using traditional tools (in which you find problems after place-and-route, for instance) limit the amount of exploration designers can do, with the result that they might settle for a sub-optimum solution. SpyGlass-Physical, Varadarajan said, alleviates that problem. www.atrenta.com.

Editors' CHOICE

Audio analyzer aims at production

Production tests on MP3 players, DVD players, and other audio products require a few basic measurements that must be made quickly. The APx515 from Audio Precision can replace the many "home-brew" test setups in use today at a cost considerably lower than the company's other audio testers. It uses the technology from the company's eight-channel audio analyzers in a unit that has two analog inputs and two analog outputs. It also has 192-kbps digital audio I/O.

Using the included software or a master .NET or LabView application, the APx515 can test an audio device in 3 s, providing measurements such as power and noise. The included software is based on the software used with the APx585 and the APx525. Test operators can control the APx515 through a keyboard, foot pedal, or bar-code scanner.

The APx515 has three software options that add functions to the unit: One option adds high-speed multitone and continuous sweep measurements; the second adds intermodulation distortion, maximum output level, dynamic range, and fast Fourier transforms; and the third adds acoustic-response measurements.

Base price: $6200. *Audio Precision, www.ap.com.*

CALENDAR

NIWeek, August 3–5, Austin, TX. *National Instruments, www.niweek.com.*

Autotestcon, September 13–16, Orlando, FL. *IEEE, www.autotestcon.com.*

EOS/ESD Symposium, October 3–8, Reno, NV. *Electrostatic Discharge Association, www.esda.org.*

International Test Conference, November 2–4, Austin, TX. *IEEE, www.itctestweek.org.*

To learn about other conferences, courses, and calls for papers, visit www.tmworld.com/events.

Editors' CHOICE

Signal-generator family reaches 70 GHz

Anritsu's MG3690C RF/microwave signal generators allow engineers to conduct tests on microwave subsystems, components, and systems in the lab; their fast 5-ms switching times also let the units maximize throughput in manufacturing applications.

The models in the MG3690C family generate signals from 0.1 Hz to 70 GHz. Individual instruments can produce baseband, IF, RF, and microwave signals to maximize equipment use and reduce cost of test. Options enable low phase-noise performance of –115 dB/Hz at 20 GHz at a 10-kHz offset.

The MG3690C instruments can generate narrow pulses down to 10 ns to emulate a variety of signals, and they can generate amplitude-leveled pulses down to 100 ns to minimize amplitude drift over time and temperature for tight test margins. The MG3690C series can generate doublet, triplet, and quadruplet pulses with independently set spacing and pulse width, enabling the signal generators to emulate a wide range of radar returns.

Models are available with top frequencies of 10, 20, 31.8, 40, 50, and 70 GHz. All models offer a 0.1-Hz start frequency option.

Base price: $17,800. *Anritsu, www.us.anritsu.com.*

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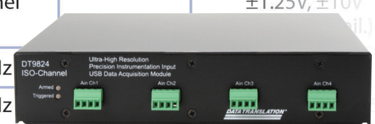
Product Selection Chart

			Analog Input Features			
	Model	**Summary**	**# of Channels**	**Throughput**	**Resolution**	**Input Range**
High Res.	DT9824	**ISO-Channel™**, High Stability, High Accuracy, Fully Isolated USB Data Acquisition Module	4DI	4800Hz per channel	24-bit	±312.5mV, ±625m ±1.25V, ±10V
Low Cost	DT9810	Lowest cost, 10-bit, non-isolated	8SE	25kHz		
	DT9812-2.5V	Low cost, 8 analog inputs, 12-bit, 2.5V range, non-isolated	8SE	50kHz		
	DT9812-10V DT9813-10V DT9814-10V	Low cost, up to 24 analog inputs, 12-bit, 10V range, non-isolated	8/16/24SE	50kHz	12-b	
	DT9816 DT9816-A	Low cost, simultaneous, 6 A/Ds @ up to 150kHz, 16-bit, non-isolated	6SE	50kHz/150k per chann		
	DT9853 DT9854	Low cost, up to 8 analog outputs, 16-bit, 16 digital I/O, 1 C/T, 300V isolation	–	–		
Sound & Vibration	DT9837 DT9837A DT9837B	4 IEPE (ICP) sensor inputs, tachometer, simultaneous A/Ds	4 IEPE (SE) + 1 Tacho	Up to 105.4kHz p channel		
	DT9841-VIB	8 IEPE (ICP) sensor inputs, simultaneous A/Ds with DSP, 500V isolation	8 IEPE (SE)	100kHz p channel		
Simultaneous High Speed	DT9832A	Simultaneous, 2 A/Ds @ 2.0MHz each, 500V isolation	2SE	2.0MHz per channel	16-bit	
	DT9832	Simultaneous, 4 A/Ds @ 1.25MHz each, 500V isolation	4SE	1.25MHz per channel	16-bit	10V
	DT9836	Simultaneous, up to 12 A/Ds @ 225kHz each, 500V isolation	6 or 12SE	225kHz pe chann		
High Speed	DT9834	High-speed, up to 16 analog inputs, 500kHz, 16-bit, 500V isolation	16SE/8DI	500kHz		
	DT9834-32	High-speed, up to 32 analog inputs, 500kHz, 16-bit, 500V isolation	32SE/16DI	500kHz		
Temp.	TEMPpoint	**ISO-Channel™**, Thermocouple, voltage, or RTD inputs, A/D and CJC per input, high accuracy	8-48	10Hz per channel	24-b	



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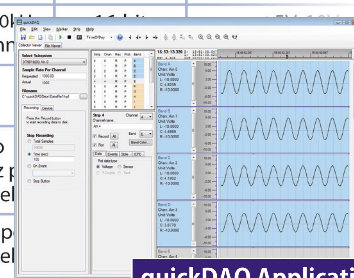
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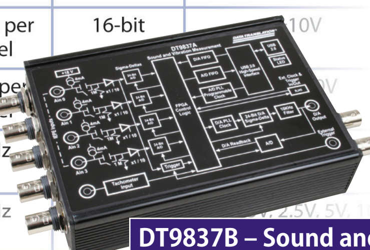

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RF vendors look for edge in recovery

> > > International Microwave Symposium, May 23–28, Anaheim, CA; IEEE, www.ims2010.org.

A bustling exhibit floor gave vendors a chance to show off their wares to attendees of the International Microwave Symposium. Greg Peters, VP and GM of the component test division of **Agilent Technologies,** said business has recovered to within 85% of its pre-recession peak in 2008. On the show floor, Agilent highlighted products such as its new portable N9923A FieldFox RF vector network analyzer, which provides 0.01-dB/°C measurement stability and offers an integrated QuickCal calibration capability. Also in a handheld format, the company demonstrated its V3500A RF power meter. Peters said such instruments can serve in edge-device applications (see p. 17).

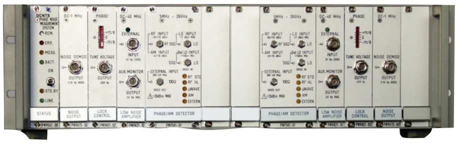
Noise Extended Technologies (Noise XT) made its first US appearance since its buyout by the employees of Aeroflex-Europtest. Guillaume de Giovanni, president of the Elancourt, France, company, said Noise XT now has a single focus on addressing customers' noise-measurement problems. On the show floor, he demonstrated the DCNTS (Dual Core Noise Test System), a two-channel phase and amplitude noise analyzer designed with a dual demodulator architecture that allows the test system to use cross-correlation to cancel its internal noise.

Jon Leitner, product manager at **Rohde & Schwarz**, and Sherry Hess, VP of marketing at AWR, described interoperation between AWR's design environment and R&S instruments. The companies have teamed up to remove the boundary between simulation and test and to support a parallel design and verification flow involving hardware-in-the-loop simulation. They also described how the AWR Connected tool in conjunction with R&S WinIQSIM2 simulation software allows RF and baseband designers to access standard-compliant signals for all modern communication technologies.

Representatives of **Giga-tronics** were on hand to discuss microwave switching systems. They recommended "test your DUT, not your system" and advised that your switch bandwidth be at least 0.35 divided by your steepest rise time. They also suggested using a star configuration, which in a four-pole format can provide six possible signal paths, instead of the common SP4T configuration, which has only four signal paths.

National Instruments demonstrated its new software for IEEE 802.11n wireless LAN testing, the NI WLAN Measurement Suite 2.0 (see p. 38). David Hall, RF product marketing manager at NI, said the suite also delivers the industry's fastest speed for error vector magnitude and spectrum-mask measurements.

Anritsu introduced its 0.1-Hz to 70-GHz MG3690C series RF/microwave signal generators (see p. 13). Bob Buxton, marketing manager in the general-purpose business unit of the company's microwave measurement division, said the generators combine best-in-class phase noise and broad frequency generation. T&MW



The DCNTS employs cross-correlation to cancel its internal noise. The resulting tests are similar to comparing the output of two systems, with similarities displayed and with differences rejected. The measurement front end includes hardware for measuring noise on two-port devices, in RF or microwave frequencies.

Courtesy of Noise XT.

Lights, vision, and software

> > > The Vision Show, May 25–27, Boston, MA; Automated Imaging Association, www.machinevisiononline.org.

If having many players is a sign of a healthy market, then the machine-vision industry is in good shape. In its five aisles of exhibits, the Vision Show in Boston had a good showing of industrial cameras. It also had frame grabbers, software, and LED lighting.

Basler exhibited its GenICam camera, which has a GigE interface with PoE (Power Over Ethernet). **Dalsa** introduced four models of its Falcon line. The High Gain series added three models: 1.4 Mpixels, 1 Mpixel, and VGA resolution. The company also introduced a 1.4-Mpixel extended-dynamic-range camera and added a graphics processing unit and multicore processing to its Sapera Essential vision software.

Microscan expanded is Nerlite line of machine-vision lighting to over 300 configurations such as ring lights and area arrays. The company added infrared, ultraviolet, blue, and white wavelengths. Microscan also upgraded its Visionscape image-processing software to include color matching and color segmentation.

National Instruments added machine vision to its CompactRIO and Single-Board RIO lines of modular automation controllers. The company also exhibited its Real-Time Embedded Vision System that supports GigE, USB, and IEEE 1394 interfaces and has 29 digital I/O lines for control. The system is also an EtherCat master. PXI Express FPGA cards with a Camera Link adapter were also on display.

Newnex demonstrated a product that extends the length of cabling between cameras and frame grabbers. The S800 converts IEEE 1394b to CAT5/5e/6 Ethernet cable, extending the reach to 100 m. T&MW

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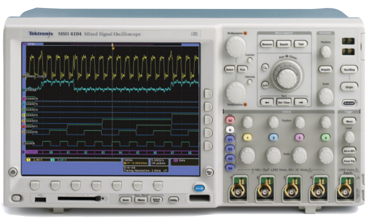
Embedded and edge devices offer test opportunities

Two classes of applications are offering design-and-test challenges, even though they don't necessarily require the highest bandwidths, data rates, and memory depth. Those applications include embedded systems and edge devices, with the latter category including devices ranging from sensors to cellphones—ones, according to Greg Peters, VP and GM of the component test division of Agilent Technologies, that touch the real world, not servers confined to a back room. Peters, speaking at the International Microwave Symposium (IMS) on May 25, said he expects the number of such devices to grow geometrically.



Mixed-signal oscilloscopes such as the Tektronix MSO4000 have become workhorses of embedded-system design and test. Courtesy of Tektronix.

The Embedded Systems Conference (ESC) Silicon Valley held in April provided test companies an opportunity to present their offerings for the embedded-systems market. Tektronix highlighted its mixed-signal oscilloscopes and presented the results of a time-and-motion study it sponsored; the study indicated that engineers searching for runts and glitches when debugging designs performed typical debug tasks 53% faster when using Tektronix scopes, such as the MSO4000 mixed-signal oscilloscope (**figure**), compared with competitors' versions.

LeCroy product marketing manager Dan Monopoli described the types of instruments and capabilities embedded-system designers are looking for. LeCroy customers can be divided into two camps, he said—those attending ESC, and those attending DesignCon. At ESC, customers look for instruments that can handle decoding for I2C and SPI signals. In contrast, DesignCon attendees are looking for high-bandwidth scopes that can help investigate signal-integrity issues on high-speed buses like PCI Express Gen 3. Products that LeCroy introduced at ESC included the ArbStudio AWG (arbitrary waveform generators) and LogicStudio 16 logic analyzer.

Agilent's Peters, speaking at IMS, cited a bifurcation of the electronic food chain with respect to test-equipment purchases: For some applications, ultra high performance is required, while for others, price/performance is key. Embedded applications would seem to fall in the latter category, but as Peters pointed out, dealing with real-world edge devices requires accurate modeling of nonlinear behavior, using, for example, Agilent's X-parameter technology.

Joel Woodward, a senior product manager at Agilent with responsibilities for marketing to the embedded design community, said, "A lot of times we think of embedded as a lagging industry, but embedded has wholeheartedly embraced the adoption of high-speed serial links." He said that if you purchase a modern FPGA, you essentially get high-speed serial I/O for free. "The wonderful thing about the computer industry is it will drive the price of advanced technology way, way, way down, so it becomes feasible for embedded teams to implement them [high-speed links] in their designs."

The good news for instrument makers is that prospective customers will increasingly need to make measurements on the high-performance signals that relatively low-cost parts can handle. T&MW

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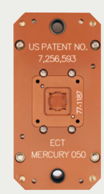
Minimizing load-board damage



In a study titled "Spring Probe PCB Pad Wear Analysis" presented at the 2010 BiTS Workshop (March 7–10, Phoenix, AZ), Valts Treibergs and Chris Cuda of Multitest's ECT Interface Product Division analyzed the effects of spring probes on load-board pads in an effort to extend the life of $10,000-and-up load boards. Their controlled study of spring-probe geometries found that the radius-flat-tip PCB-side geometry displaced the least amount of surface gold plating on load-board pads of 0.5-mm pitch and larger. www.multitest.com

X-Series to test low-power GPS devices

LTX-Credence announced that U-blox, a fabless semiconductor provider of embedded positioning and wireless communication devices, has selected the X-Series as its next-generation RF test platform. U-blox plans to use the X-Series as its principal engineering and production test platform for all wireless communication ICs. www.ltxc.com, www.u-blox.com.

VarioTAP adds non-JTAG interfaces

Goepel Electronic has enhanced its VarioTAP emulation technology for the support of non-JTAG debug interfaces. The new features enable coverage of the various proprietary debug architectures of different chip manufacturers without requiring processor specific pods. The first interface to be supported is the so-called BDM (background debug mode) interface for Freescale processors. www.goepel.com.

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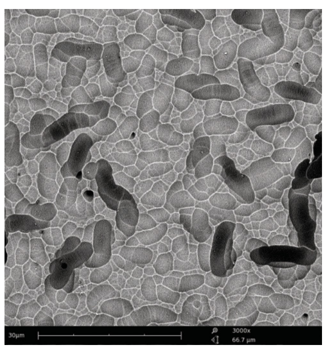
Desktop SEMs produce fast images

The push to reduce the size of inspection systems for increased portability and flexibility has led to the development of desktop machines based on technologies such as AOI (automated optical inspection) and AXI (automated x-ray inspection) as well as on SEMs (scanning electron microscopes). Many of these smaller systems are used for offline, rather than inline, inspection tasks. In SEMs, electrons image a sample to distinguish characteristics on a much smaller scale than is possible with optical microscope techniques. Since this process must occur in a vacuum, most desktop SEM applications are by necessity restricted to offline inspection, said Phenom-World's Jack McFarland, GM for North America.

Desktop SEM systems are designed primarily for rapid imaging, said McFarland. For example, the moving parts in MEMS need to be inspected quickly at around 5000X magnification. Desktop SEM systems produce high-quality images that are comparable to those from large SEM systems, but they do so much faster and for one-tenth to one-twentieth of the cost.

For example, the Phenom desktop SEM can load and image a sample in under 30 s. "It can image at magnifications up to 24,000X, but usually you're looking for magnification between [the point] where optical runs out of steam at about 1000X, up to about 5000X," McFarland said. "You do lose some flexibility for dealing with difficult samples, but 80% of the time the desktop meets your needs." He explained that in the other 20% of cases, a desktop SEM is ineffective "usually due to the need for much higher magnifications, larger samples, wet samples, or where elemental analysis is required."



In crystalline silicon PV (photovoltaic) solar cells, desktop SEMs can reveal variances in the mono- or multicrystalline structure, which affect cell quality, as well as over-etching, which can cause capacity loss.
Courtesy of Phenom-World.

But by focusing on the most prevalent uses and giving up a little flexibility, customers can gain a machine that fills the majority of their needs and is much simpler to operate than a typical large SEM. Although a few desktop SEMs are placed on the factory floor, they are used mostly in research and failure analysis labs where there's not a lot of space, and where they can be moved around easily.

In wafer inspection, desktop SEMs can only look at pieces of wafers due to the sample chamber's small size, usually 1 to 2 in. in diameter, said McFarland. "For PCBs, you'd probably do a cross-section and look for a noncontinuous layer, for example, where there could be a short," he said.

Only some technologies in desktop SEMs will likely contribute to even smaller footprints in the future, but their capabilities will continue to improve, said McFarland. "For example, the navigation camera at the front end of the Phenom will get a lot better and smaller, so we may end up with a combination optical/SEM inspection device," he said. Vacuum technologies are improving but the mechanics and electronics involved will only shrink slightly in the near future. "Most likely, we will keep the Phenom at the same footprint while we increase its software capabilities and make it even faster, rather than trying to add capabilities from the big SEMs." T&MW

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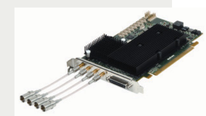
Capture board supports HD, SD video

The Orion HD video-capture board from Matrox Imaging supports standard and high-definition video inputs and outputs including 1080p/60. It captures data from two independent digital or analog HD video sources, even in different formats, and can output them on the desktop or a separate monitor. The board can also switch between signals of different types on each path. www.matrox.com.



Vision software gains color-matching tools

Microscan's 4.1 release of its Visionscape software adds color-matching and color-segmentation tools to the package, which provides a graphical programming environment for use on PCs and smart cameras. The vision software also allows the creation of user interfaces through VB.net and C#, and it supports GigE cameras. www.microscan.com.

Software adds processing support

Dalsa has added two platforms to its Sapera Essential vision software, which bundles image acquisition and control with image-processing tools. Sapera Nitrous lets the functions in Essential leverage the acceleration provided by graphics processing units and multicore processors. Sapera Architect Plus provides an environment for prototyping and modeling imaging tools to speed algorithm development. www.dalsa.com/mv.

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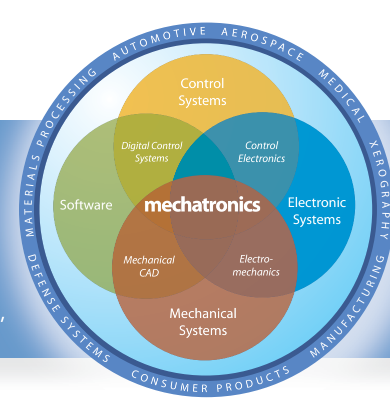

Complexity demands a new engineering mindset

Engineering education is a great example of a complex system that must be transformed.

Kevin C. Craig, PhD, is the Robert C. Greenheck chair in engineering design and a professor of mechanical engineering, College of Engineering, Marquette University.

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Mechatronic system design involves integration. From the very start of the design process, engineers combine a physical system with sensors, actuators, computer control, and human interfaces to give the system some intelligence and decision-making capability.

At its very heart, system complexity is synonymous with power. This power can be good or bad. If the complexity in any system is not tamed, the consequences can be devastating. We have witnessed some of the consequences of untamed complexity in the Chernobyl nuclear plant accident in 1986, the recent world financial meltdown, and now the oil spill in the Gulf of Mexico. All are examples of systems of unimaginable complexity—intended or not—that were left unmanaged without common-sense, human-centered checks and balances, resulting in catastrophes of immense scope.

In a complex system, learning how all the pieces—constant and variable—interact gives a depth of understanding that averts catastrophe. That is what is meant by human-centered design: understanding the interfaces among technology, people, communities, governments, and nature. Understanding the interfaces is what makes complexity manageable.

There are two main impediments to engineering education reform.

All complex systems have, as a foundation, fundamental principles that cannot be ignored. Yet, complex systems also need flexibility from the engineering perspective so the problems that will inevitably arise can be addressed. Clearly, the typical discipline-specific engineer is not well-equipped to manage such complexity; not even an engineer with multidisciplinary engineering breadth can do an effective job.

Complexity demands an engineering skill set with technology depth and also nontechnical breadth—specifically, human-centered design expertise capable of managing complexity. This concept received wide acceptance at the IBM/IEEE Conference on Transforming Engineering Education, held April 6–9 in Dublin. Jim Spohrer, director of IBM University Programs, saw human-centered design expertise as essential to IBM's focus on service activities worldwide, because every product has a service associated with it. The questions that arose at this conference were: "Why are these engineers not being created?" and "How do we ensure that they will be?"

The urgent problems society faces are multidisciplinary in nature, complex, and ever-changing. Engineering graduates need to be able to adapt and apply technology that is human-centered, desirable, feasible, viable, sustainable, usable, and manageable. Incoming students need to experience a culture change. They need to transform from the world of memorizing, test-taking, and focusing on grades, to the world of critical-thinking problem solving, turning easily accessible information into insight and understanding, and taking responsibility to become an engineer.

So, if we all know what should happen in engineering education, why is it not happening?

As I see it, there are two main impediments to engineering education reform. First, the silo structure in a typical engineering college does not foster reform. Engineering departments typically don't collaborate or interact in a multidisciplinary way and fail to realize that doing so would enhance, not diminish, what they do. Second, there is a failure of faculty to get out of their comfort zone, become involved in real-world problem solving, and respond to the challenges of teaching multidisciplinary engineering problem solving in a discovery learning mode, as opposed to a lecture mode.

Knowledge needs to be unbundled and rebundled in engineering education to give it balance between theory and practice and relevance to the solution of the multidisciplinary problems society faces. Engineering education done in this manner can mitigate catastrophe! T&MW


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Keithley upgrades RF vector signal analyzer, introduces upconverter
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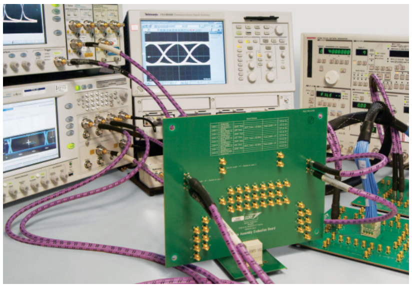
RF/MICROWAVE TEST

Gore study contrasts VNAs and TDRs

W.L. Gore has released the results of a study in which its engineers compared the measurement uncertainty of VNAs (vector network analyzers) and TDRs (time-domain reflectometers)—two instruments able to analyze time or frequency domain data to accelerate product-development cycles. The goal of the study was to determine whether the instruments possess similar levels of measurement precision.

Using a variety of cable assemblies with a range of insertion loss and VSWR (voltage standing-wave ratio) characteristics, the engineers initially tested six cable assemblies in controlled conditions on each instrument. Next, they evaluated the instruments' measurement uncertainty in the best-case scenario with the highest-performing assembly. Then, to ensure TDR/VNA test parity, they evaluated the VNA using both one-port s_{11} reflection and the more traditional two-port s_{21} transmission method.



A recent study compared the measurement uncertainty of VNAs and TDRs.
Courtesy of W.L. Gore.

Among the study's findings: "In both the TDR and VNA, instrument-related measurement uncertainty was found to be dependent upon the device under test's VSWR and insertion loss. The median measurement uncertainty for the VNA was found to be an order of magnitude below that of the TDR…." In addition, "TDR instrument-related uncertainty accounted for 61 percent of the total measurement uncertainty. VNA instrument-related uncertainty made up 22 percent of the total uncertainty."

Said Paul Pino, the company's North American product engineer for test and measurement, "Because precision is crucial in this industry, understanding the accuracy of an instrument is essential. Although our study indicated that one platform operated with significantly lower measurement uncertainty than the other, the important learning from this study is that both instruments are formidable tools, with each having its own strengths and weaknesses."

You can download the complete 18-page study at gore.com/measurement.

Rick Nelson, Editor in Chief

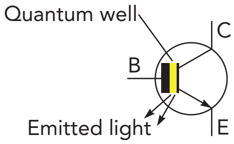
FIBER-OPTICS TEST

Transistor laser could change communications

Since their inception in 1947, transistors have been three-terminal devices with electrical inputs and electrical outputs. Researchers at the University of Illinois at Urbana-Champaign have changed that. A team headed by professors Milton Feng and Nick Holonyak, Jr., has developed a transistor that emits light—enough to send data over fiber-optic links and across silicon wafers.

Typical transistors emit a small number of photons, but not enough to be useful. The transistor laser adds a quantum well in the transistor's base structure, the P region of an NPN transistor. Tests have shown that the quantum well boosts optical signal intensity as much as 40 times.

The researchers fabricated and characterized several hundred transistor lasers. From their results, they developed circuit models of the device's performance. Tests involved using a photodetector to receive the optical signal, from which the researchers measured three-port S-parameters (s_{11}, s_{12}, s_{21}, s_{22}, s_{31}, and s_{32}) with an Agilent Technologies N5230 parametric network analyzer. (The s_{13}, s_{23}, and s_{33} parameters were not used.) The DC and S-parameter measurements let the researchers obtain values for the device's *I-V* and *L-I* characteristics as well as resistance, capacitance, and inductance of the device's junctions (Ref. 1).They also measured eye diagrams at data rates up to 13 Gbps with an Agilent 86100A sampling oscilloscope using a 2^7 pseudo-random bit sequence data stream. From the models, the researchers have demonstrated the performance of the transistor lasers at data rates up to 40 Gbps.



The three-port transistor laser emits photons from its base that are strong enough for use as data-communications signals.

At first glance, the transistor laser appears to defy Kirchhoff's current law, which states that the charge that enters a node must exit it (charge conservation). In a typical transistor, $I_{EMITTER} = I_{BASE} + I_{COLLECTOR}$, but with the transistor laser, the equation needs an additional term for energy conservation, I_{STIM}, which represents an additional base-charging current for photon continuity and energy conservation.

Martin Rowe, Senior Technical Editor

REFERENCE

1. Then, H.W., et al., "Microwave circuit model of the three-port transistor laser," *Journal of Applied Physics*, May 10, 2010. American Institute of Physics, jap.aip.org.

Find vibrations in defective rotating parts

Data-acquisition systems need signal conditioning to prevent unwanted signals from masking important data.

By Jim Axelson, Bauer Controls

Identifying gear, shaft, or bearing quality problems in rotating systems such as automobile transmissions typically requires laser vibrometers, microphones, or accelerometers. During a test, these sensors produce analog signals that can represent defects as the mechanical system rotates. Each rotating part transfers energy, or vibrates, at a frequency associated with its rotating speed and its physical characteristics. The number of teeth, number of vanes on a pump, bearing dimensions, and gear-set design all contribute to the vibration characteristics of the rotating component.

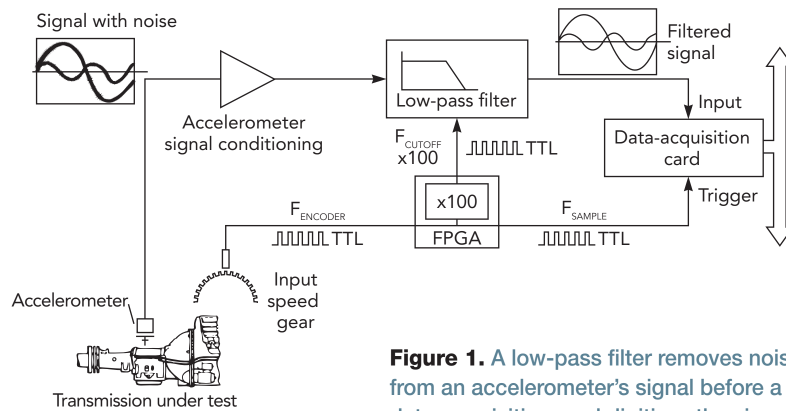


Figure 1. A low-pass filter removes noise from an accelerometer's signal before a data-acquisition card digitizes the signal.

Defective components produce a set of energies, or vibrations, different from those generated by good parts. Some of these defects appear at certain speed and torque conditions only. Thus, tests are performed while the speed or torque is ramped very quickly, typically from several hundred rpms to several thousand rpms within a few seconds, throughout the assembly's operating range.

To eliminate measurement errors, you must collect and analyze data in a way that eliminates errors by aliasing, which produces distortion and unwanted frequency components. To remove aliasing, the signal needs filtering to reduce its bandwidth to a frequency range lower than the Nyquist frequency, which is defined as one-half the data-acquisition sampling rate.

You can overcome this problem by using a position-based data-acquisition system with a low-pass anti-aliasing filter. **Figure 1** shows the measurement system. The accelerometer signal consists of frequency components that contain low frequencies and other irrelevant content (two sine waves in the upper left box). The system uses an Alligator Technologies anti-aliasing filter, a National Instruments data-acquisition card, and a National Instruments FPGA (field-programmable gate array) card. The filter dynamically adjusts its cutoff frequency as the transmission's rotational speed changes under software control.

The speed signal—a TTL-level pulse train—passes through the FPGA that multiplies the signal's frequency by 100 so it can become the input to the programmable low-pass filter. The filter limits the accelerometer signal's bandwidth, keeping it below the Nyquist frequency. The filtered signal goes to a National Instruments' analog input card (box in the upper right). As the speed of the system changes, the pass bandwidth changes dynamically, eliminating data distortion.

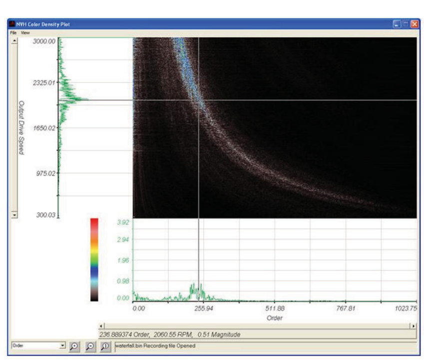


Figure 2. This plot shows the intensity of the energy relative to rotational speed and order. Courtesy of Bauer Controls.

After filtering and digitizing the signal, the system converts the data from the raw time-based domain into the frequency domain through FFTs (fast Fourier transforms). The FFT shows the energy generated by the gears, bearings, and shafts making up the physical system. Because the speed is known, the software can divide all the frequencies of the FFTs by the speed, which converts frequency to "order." Order is the number of times a vibration is produced per revolution of the tracking shaft. The equation is:

$$Order = Frequency \;/\; Speed$$

where *Speed* is revolutions/s.

The spectral plot of order will be the same regardless of rotation speed. For example, a rotating 60-tooth gear will always produce a 60th order vibration. In Figure 1, each trigger pulse initiates a signal sample.

Figure 2 shows the rotational speed (vertical scale) and the order (horizontal scale). At each speed interval, say every 50 rpm, the system calculates an FFT. It then produces an intensity plot consisting of overlaid FFT "slices" much in the way oscilloscopes use color to differentiate the frequency in which time-domain waveforms occur. You can also view the FFTs individu-

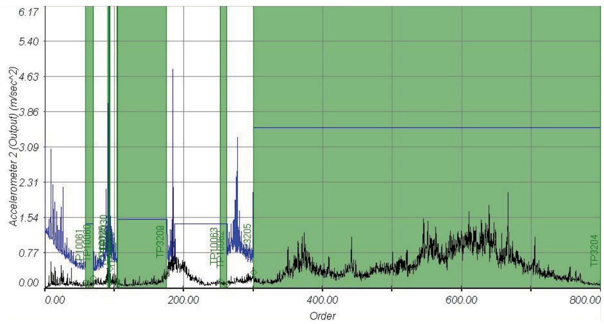


Figure 3. Peaks in the white areas indicate failed parts.

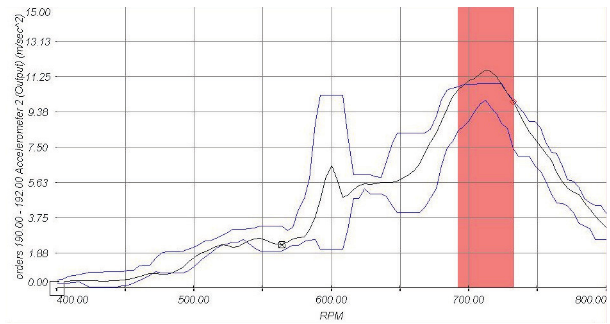


Figure 4. This part failed because the accelerometer signal at just over 700 rpm is too high.

ally in a waterfall plot. The plot also produces a "slice" for each rotational speed. Seen from a speed perspective, a speed slice shows the energy of each order at that speed. Seen from the order perspective, an order slice shows the speed at which the energy for that order is the greatest. Each physical component (gear, shaft, or bearing) correlates to a unique order slice.

By analyzing the data, the system can identify components that produce abnormal energy levels, which signify defects. A test engineer evaluates the data to find the condition where the energy or vibration is most pronounced. The production test is optimized by varying the speed and torque around the condition that produces the most vibrations. **Figure 3** shows the frequency peaks that correspond to problem parts.

Because the amplitude of the slices may vary only slightly from one UUT (unit under test) to another, we use templates to differentiate between good and defective assemblies. The template shape and limits are statistically created from a sampling of known-good assemblies.

For speed slices, we developed tests of the energy content at orders corresponding to the physical components within the assembly. We established combinations of statistically based limits and fixed limits to measure quality. Violation of a limit easily distinguishes the good assembly from the bad. In Figure 3, all of the part's energy is within the upper limit, thus all the test bands remain green.

The test setup also uses this method to test order slices. **Figure 4** shows the order for a gear mesh from a rejected assembly. You can easily recognize at which speed the noise level exceeded the limit compared to the good assemblies. The differences between assemblies might be slight, but the templates accurately separate normal from abnormal assemblies. T&MW

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Testing Rx for MEDICAL MECHATRONICS

BY LAWRENCE D. MALONEY, CONTRIBUTING EDITOR

To develop its "human interactive" robotic devices, Kinea Design relies on an eclectic array of tests that include conventional electronic instruments, homegrown solutions, and "human-in-the-loop" techniques.

EVANSTON, IL.—When your task is to design innovative devices that will help a person regain movement after a stroke or will help prevent injury from back-breaking labor, there are no application notes to steer you through the test process. The multidisciplinary team of R&D engineers at Kinea Design address such design challenges as part of their daily workload. The engineers, who specialize in what they call "human interactive mechatronics," must be as creative in designing test setups as they are in blending the sensors, actuators, software, and control systems that form the heart of their motion-oriented inventions.

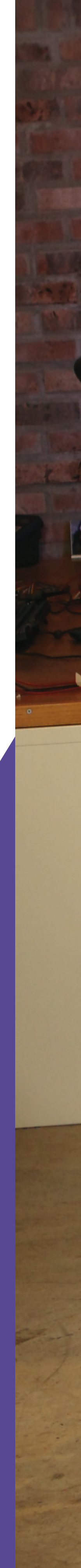
To ensure the R&D team has the necessary skills, Kinea hires versatile engineers who are as comfortable with electronics and control systems as they are with mechanical design and computing tools like Matlab, Simulink, and LabWindows/CVI.

"We look for engineers who can integrate technologies and deal with tough systems problems," said Ed Colgate, a PhD mechanical engineer who founded the company in 2003, along with Michael Peshkin, the president of the company as well as a PhD mechanical engineer, and David Brown, a PhD and a physical therapist. All three are professors at Northwestern University, just a few blocks from Kinea's design lab.

The skills Colgate described have spawned the creation of new test and measurement devices, both for use by patients and for development of inventions ranging from advanced prosthetics and rehabilitation equipment to a "HookAssist" that removes much of the burden of handling beef carcasses in meat-processing plants (see "On TM-World.com," p. 33).

Where robots meet people

"In our assist systems, the robot provides assistance, but it is always the person, not the robot, who initiates and controls the movement," explained Peshkin, who



Kinea relies on users—and its own engineers—to provide critical "human-in-the loop" testing for the company's mechatronics devices, said Julio Santos-Munné, director of operations.

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also co-founded an earlier company called Cobotics that specialized in hoists, arms, and other assistive devices for assembly-line workers.

Peshkin called Kinea's "KineAssist" system a prime example of this robot-human interface. Targeted for rehabilitation of stroke victims, the device partially supports the upper-body of patients and protects against falls, freeing the physical therapist to focus on walking and balance training.

KineAssist's chief components include pelvic and torso harnesses, trunk- and pelvic-support mechanisms, and a wheeled base that allows a patient to turn and to move laterally, forward, and backward (**Figure 1**). The patient's intent for motion is detected by potentiometers and force sensors integrated into the pelvic-support structure. Control algorithms move the motorized base in response to the patient's own forces and motions.

In addition, the pelvic-support structure provides a vertical force of up to 150 lbs to "unweight" the patient. It allows the walking patient to bend forward, but includes a Safety Zone feature that provides compliant constraint to protect against falls.

"The biggest challenge was the open-ended nature of the project, as we worked to define the requirements of the design," said Julio Santos-Munné, Kinea's director of operations.

Kinea engineers spent many weeks observing therapists at work in clinical settings, including the prestigious Rehabilitation Institute of Chicago (RIC). During those visits, Santos-Munné and controls engineer Alex Makhlin worked closely with physical therapist Ela Lewis, also a member of the development team.

"It was clear that the therapists did not want robotic technology that would interfere with their hands-on work," said David Brown. "Instead, they wanted an intuitive robot that would enhance their skills, ease the patient's fears of falling, and allow for more challenging therapy work."

FIGURE 1. In the KineAssist system, control algorithms move the motorized base in response to the patient's own forces and motions. Courtesy of Kinea Design.

To test the device, the team made extensive use of finite element analysis (**Figure 2**) to ensure the structural integrity of major components, such as the pelvic mechanism and mobile frame, which were designed with SolidWorks' 3-D modeling software.

Makhlin also used The MathWork's Matlab software for data analysis and dynamic simulation of certain subsystems, especially the kinematics of the wheels and mobile outrigger. Matlab analyzed signals that came from various sources within the system's embedded computer, including optical encoders integrated with the motors, potentiometers at structural joints, and customized load cells placed throughout the system's five axes to sense user intent.

"The Matlab analysis helped us calibrate the sensors and examine the system's dynamic response," said Makhlin, a mechanical engineer whose master's degree is in control engineering. Other software on the embedded processor allowed him to run frequency response analysis and Bode plots, also displayed in Matlab. In addition, Makhlin used Matlab's System ID tool to construct models of the pelvic and torso subsystems, which helped determine stability margins in the design.

Kinea engineers also stress the importance of "human-in-the-loop" testing, where patients or the engineers themselves evaluate prototypes of the device. "On the KineAssist, I would strap myself into the device to see how well it performed, then maneuver it to my desk to make changes in control algorithms in real time," recalled Makhlin.

Among other examples of "human-in-the-loop" feedback, Brown noted that researchers did EMG (electromyogram) tests to determine a patient's muscle activity both in traditional therapy and while using the KineAssist. And to help determine the therapy activity most needed in an assist device, a special lab equipped with eight video cameras was set up at the RIC. There, patients performed functional tasks both with and without KineAssist on a 5-m walkway, and EVaRT software from Motion Analysis was used to reconstruct body-segment motions for analysis. Result:

Walking and balance activities were determined to be the greatest needs for the KineAssist technology.

Value of virtual instruments

The KineAssist project also led Makhlin to develop a virtual instrument called EKG that has served the Kinea team on several mechatronics projects. "Just as a medical EKG allows the doctor to study the electrical activity of the heart, I needed a tool that would allow me to probe the whole range of signals coming into the control system from a complex array of sensors and actuators," Makhlin explained.

The software-based tool comprises two segments. One resides on the embedded system and is written in C++ and runs on QNX. The other runs on an external laptop or desktop and is written in Java. Engineers can run EKG without modification on Windows, Linux, and Unix. One researcher at RIC even uses it on a Mac.

EKG, which has a graphical user interface that shows real-time signal plots, communicates with the device's controls software via an Ethernet connection. From a list on the display, the user chooses a signal to visualize, such as that of a force sensor, and EKG plots the corresponding signal (**Figure 3**).

"There is no limitation on the number of channels you can graph, and you can gather as much data as you like," said Makhlin. "For example, I might want to look at a signal from a potentiometer as well as a command signal to an actuator to analyze the velocity and position that I am asking an actuator to maintain."

Makhlin added that EKG is a great tool for looking at the dynamically changing variables within an embedded control system. If the variables become too numerous, he collects the data and exports it to Matlab for analysis. What's more, the tool is easy to learn and has been used extensively by physi-

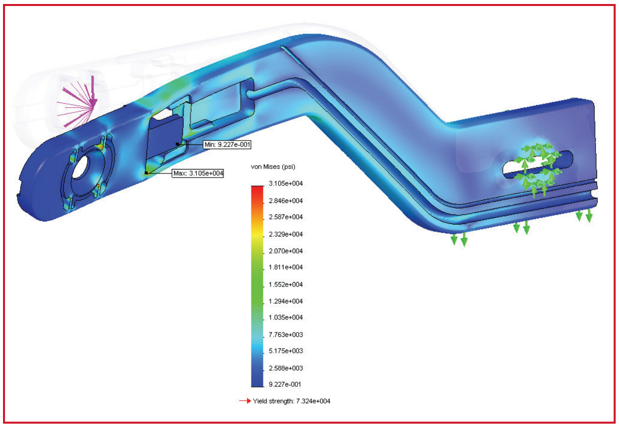

FIGURE 2. The Kinea team made extensive use of finite element analysis software to ensure the structural integrity of major components in the KineAssist device. Courtesy of Kinea Design.

cal therapists to collect data from the KineAssist while working with patients.

"EKG is a fundamental tool that I can't imagine not having," said Makhlin. "I use it all the time for development and debugging control systems."

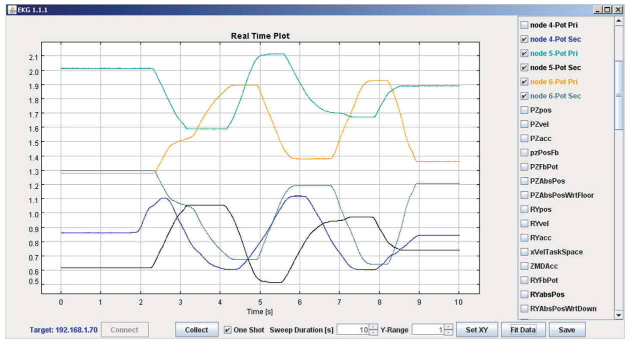

FIGURE 3. Using its homegrown "EKG" virtual instrument, Kinea engineers can probe the whole range of signals coming into a mechatronics control system from an array of sensors and actuators. Courtesy of Kinea Design.

Helping to revolutionize prosthetics

While developing its own mechatronics projects, Kinea also has been an active participant in what many experts consider to be the most sophisticated prosthetics design project ever attempted. Sponsored by DARPA (Defense Advanced Research Projects Agency) and involving more than 30 partners from industry, academia, and government, the $60 million Revolutionizing Prosthetics 2009 project sought to design a bionic limb that closely resembled the look, feel, and movement of a human arm and hand.

Kinea has worked on several phases of the project, including an earlier Revolutionizing Prosthetics 2007 project, and has designed innovative devices that include:

- miniature fingertip sensors and haptic devices that deliver a variety of touch sensations to an amputee (**Figure 4a**),
- a sophisticated "cobot" assembly featuring CVTs (continuously variable transmissions) to actuate motion in the wrist and fingers of a prosthetic hand (**Figure 4b**), and
- a motorized finger and palm assembly featuring a differential linkage and cycloidal drive system.

For these designs, the Kinea team invented new test equipment and devised a litany of homegrown test solutions. These range from mechanical fixtures with load cells for measuring force and flexure on prosthetic fingers to elaborate computer-controlled testbeds that demonstrate the viability of complex electromechanical systems. Time and again, the team relied on feedback from amputees who used the devices—the all important "human-in-the-loop" dimension.

Take, for instance, the work Kinea did on haptic interfaces in the early phase of the DARPA project. These systems basically consist of a fingertip sensor on the prosthetic hand, a haptic tactor placed on the amputee's chest, and an embedded control system to translate signals from the fingertip sensor to recreate the sensation of touch at the haptic tactor.

For this technology to make the most impact, a person must first undergo targeted reinnervation surgery, pioneered by Dr. Todd Kuiken of RIC. In this procedure, a surgeon reroutes nerves from the residual limb of the amputee to the pectoral muscles both to control a hand prosthesis and to receive tactile sensations from it.

The most advanced fingertip sensors that Kinea designed for DARPA provided several different sensations to the amputee: contact, pressure, vibration, temperature, shear force, and four discrete points of contact. The engineers performed a whole battery of tests to validate each of these sensations and used LabWindows/CVI to create the GUI for displaying the results, such as force or heat flux.

"Our test setups for the haptic interface also involved a lot of human-in-the-loop work," recalled Santos-Munné, "and it was amazing to see the patient's reaction to touching different surfaces, like ribbon cable, Teflon, or sand paper."

Answers from the "Greenbox"

To test the tactor system, Makhlin developed a special piece of test hardware he calls the "Greenbox," which has since been used on many Kinea projects (**Figure 5**). Running on the QNX real-time operating system on software developed in C++, the instrument performs a variety of testing and verification tasks, such as calibrating load cells, checking the closed-loop response of custom actuators, and serving as a CAN bus master during hardware development. It can also interface with a variety of sensors and has a long list of interfaces, including:

- 16 analog inputs with 12-bit resolution,
- 16 digital I/O channels (source sink approximately 20 mA),
- eight analog output channels with 16-bit resolution,
- six quadrature encoder channels,
- six differential amplifiers (with a gain of up to 1000X),
- two linear DC motor amplifiers (peak current of 2 A), and
- four ports: RS-232, RS-422/485, CAN bus, and Ethernet.

"I developed the Greenbox originally to serve as a controller/test system for the tactor," said Makhlin, "but I had a hunch that it would be useful elsewhere, because we use a lot of the same hardware in many of our mechatronics systems, such as an embedded CPU, digital/analog I/O,

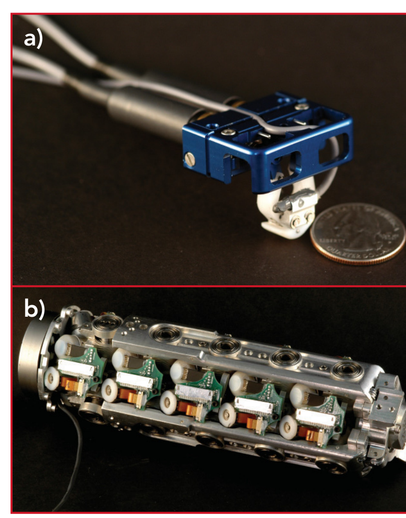

FIGURE 4. For DARPA's Revolutionizing Prosthetics project, Kinea developed several devices including (a) tactors as well as fingertip sensors to deliver a variety of touch sensations to amputees and (b) a "cobot" assembly with 15 continuously variable transmissions that actuate motion in the fingers and wrist of a prosthesis. Courtesy of Kinea Design.

strain-gage amplifiers, signal conditioning for potentiometers, and CAN boards."

The device's wide array of I/O lets it port to a variety of electronic modules, and its onboard x86 computer allows it to run the EKG tool. "If I am working on a microcontroller project, I can interface the microcontroller board to the Greenbox and then stream the data through the EKG," noted Makhlin.

The Greenbox comes into play often in tactor testing. For example, one test measures the closed-loop frequency response of the tactor while its sensored tip presses against a silicone pad. The Greenbox sends sinusoidal commands to the tactor to measure frequency response, and it sends two types of pulse commands for measuring tapping response. Later, data from the test can be exported to Matlab for analysis.

In other instances, Makhlin uses the Greenbox in combination with a controller and digital force gauge to verify a number of functions, including proper calibration of the tactor's load cells, control of

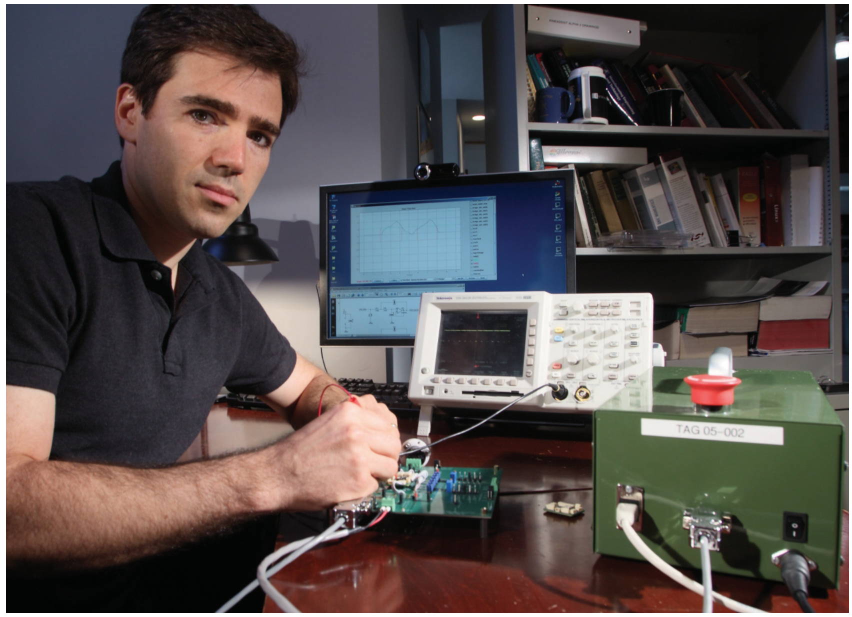

FIGURE 5. To test the tactor system, controls engineer Alex Makhlin developed a special piece of test hardware he calls the "Greenbox." Running on the QNX real-time operating system, the Greenbox test instrument calibrates load cells, checks the closed-loop response of custom actuators, and serves as a CAN bus master during hardware development.

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the tactor itself, and proper operation of the position sensors integrated with the tactor's miniature DC brushless motors.

Testbed for credibility

Kinea's creativity in testing also played a big role in expanding its involvement with the Revolutionizing Prosthetics 2009 project, particularly in its proposal to develop the cobot assembly. Located in the forearm area and attached to a prosthetic hand, the 2-lb cobot contains a customized 40-W brushless motor, a single drive shaft, and 15 CVTs that activate 15 high-strength fibers. In effect, the fibers serve as tendons for moving the prosthetic hand and wrist.

"Cobots have basically one source of power, but multiple transmissions that can tap that power for multiple degrees of freedom for your robot," explained Kinea's Eric Faulring, the project's lead mechanical engineer. "So, you save on weight and space."

Sounds impressive, but would the concept really work? For a crucial meeting with DARPA and the prime systems integrator, the Johns Hopkins University Applied Physics Lab (APL), Faulring developed in six weeks a three-degrees-of-freedom testbed to demonstrate the concept (**Figure 6**).

The testbed consisted of the main 40-W motor, the drive shaft, and three spherical CVTs needed to move a single prosthetic finger. Each transmission had a miniature motor to adjust the transmission ratio, a potentiometer, a gear reducer, a tiny spool for pulling a finger tendon, and an encoder to measure that pulling action. The output in this testbed was the finger pushing against a force sensor.

To control the demonstration, Faulring designed a "black box" electronics testbed that included a computer running on the QNX operating system with control code written in C, data-acquisition boards, and brushless DC motor amplifiers for the main drive and for the smaller motors that adjust the transmission ratios. Finally, the testbed had two Kinea-designed boards, one for conditioning and filtering signals from the potentiometer, and the other for conditioning and amplifying strain-gage channels.

Measuring muscle recovery

Not all of Kinea Design's inventions are robot-related. For example, the company has developed a special-purpose medical instrument called the QMAD (Quantitative Motor Assessment Device).

Designed in collaboration with Dr. Robert Grossman, chairman of the Department of Neurosurgery at Methodist Hospital in Houston, the portable device can measure muscle activity in patients with conditions ranging from stroke and spinal-cord injury to multiple sclerosis and related diseases.

The nature of muscle-strength recovery after a spinal-cord injury, for instance, demands a strength-testing apparatus that can assess the entire range of forces that a muscle might generate as it gradually recovers neural innervation. "Because QMAD can measure minute force outputs, physicians are better able to determine whether surgical or pharmacological interventions are having a positive impact on muscle strength and motion recovery," said physical therapist David Brown, one of Kinea's founders.

By measuring minute force outputs, QMAD helps physicians determine whether surgical or pharmacological interventions are helping a patient regain muscle strength and motion. Courtesy of Kinea Design.

The QMAD system consists of a computer, data-acquisition and signal-processing electronics, and a mechanical structure to accommodate the limb to be measured. The configuration shown in the **figure** performs isometric measurements of elbow torque during flexion and extension, effectively measuring contractions of biceps and triceps.

During a procedure, the patient is harnessed into a brace-like structure equipped with an Omega torque sensor integrated with an ETI potentiometer. The sensors connect to the system electronics, which include conditioning modules, an interface box, a data-acquisition card, and a laptop computer for processing and display. The Kinea engineers used LabWindows/CVI to develop the user interface and to manage acquired data.

"The idea was to design a compact, easy-to-operate system, featuring off-the-shelf components," said Kinea controls engineer Alex Makhlin.

"One of the beauties of the system," added Brown, "is that it gives the patient immediate feedback. The therapist selects flexion/extension targets and asks the patient to generate as much torque as possible, and the computer displays colored bars showing progress toward that goal."

The device records not only the position of the joint during flexing but also the trace or path of the torque, which gives clinicians information on how quickly a patient can apply muscle force and how long he or she can maintain it. The QMAD system is also designed to accommodate different joints, such as fingers, wrist, elbow, knee, and ankle.

QMAD replaces much larger systems or uncomfortable handheld devices with integrated force transducers. In the latter case, a clinician must press down hard on a target muscle, while the patient tries to apply an opposing force.—*Lawrence D. Maloney*

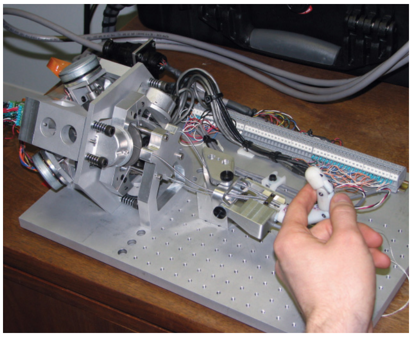

FIGURE 6. **Kinea engineer Eric Faulring developed a three-degrees-of-freedom testbed to demonstrate how the cobot's continuously variable transmission actuates a prosthetic finger.**
Courtesy of Kinea Design.

During the demonstration, Faulring used the EKG to visualize force signals and position signals from the testbed's control system, displaying them on a laptop's GUI. "No one in the program was familiar with a spherical CVT, and people didn't believe it would work," recalled Santos-Munné. "But this successful demo gave project leaders confidence in our team and its concepts."

Engineering and testing refinements

Not only did Kinea get the go-ahead to complete the full cobot design, but the company moved on to tackle additional design concepts for DARPA. For example, the final Revolutionizing Prosthetics 2009 design included not only Kinea's fingertip sensors but also its modular one-motor finger, actuated by a cycloidal gear box to curl in a natural motion around an object. In addition, Kinea's palm module, designed and tested to withstand a fall, serves as the principal electromechanical interface and enclosure for all the electronic and mechanical components connecting the prosthetic hand and wrist.

Integrating its design with those of other companies under APL's direction also enhanced Kinea's expertise with such prime test tools as Matlab and Simulink. "Simulink is wonderful for laying out your control system and getting the data acquisition set up," explained Faulring. "Then, when you want to exercise your model, such as running a motor at different speeds or loads, it is easy to take Matlab and write an M-file script to do that. It is also easy for the Simulink framework to set up parameters in your code that you can change in real time. And you don't need a GUI. It's easy to make tunable parameters on the fly while you are doing debugging."

Moving forward, Faulring and the rest of the Kinea team will have plenty of opportunity to use such tools. Kinea expects to be involved in a new DARPA contract to refine some of technologies pioneered in Revolutionizing Prosthetics 2009. The company also has received another DARPA contract to develop a robotic haptic hand to grasp and manipulate objects for potential use in hazardous environments, such as explosive ordinance disposal.

Kinea president Michael Peshkin foresees plenty of opportunity for human interactive mechatronics in applications ranging from academic research to industrial equipment to assistive devices for surgery. "Traditionally, people have viewed the robot as something to steer clear of," he explained. "What is new here is that humans and robots are working together hand in claw." T&MW

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To learn about some of Kinea Design's mechatronics projects outside the medical field, read "From meat to fish" in the online version of this article. The story describes a power-assist device that takes some of the heavy lifting out of processing beef carcasses, relieving the burden on workers who debone meat in processing plants. It also describes a sensor targeted for underwater navigation research; the 8-in.-long SensorPod features electro-sensing for mapping and object avoidance. To demonstrate the concept, Kinea engineers, including controls engineer James Solberg (pictured), designed a testbed featuring a passive gantry that suspends the SensorPod in a tank of water. Also in the online version: links to short videos on some of Kinea's projects.

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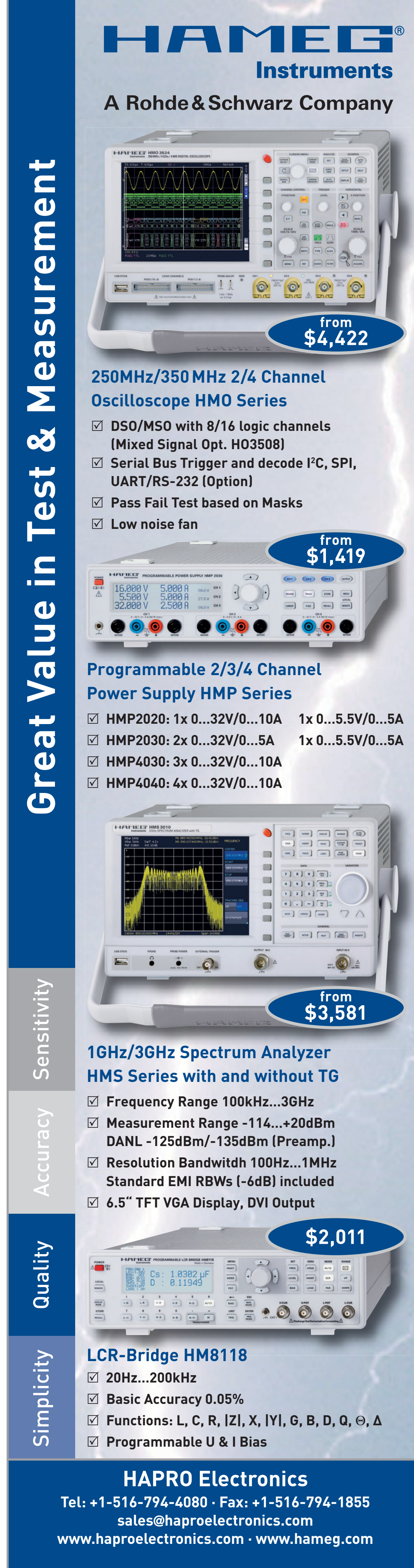

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RF FADING simulation

BY ROLAND MINIHOLD, ROHDE & SCHWARZ

A signal analyzer and vector signal generator with digital baseband interfaces combine for testing wireless devices and airborne radio.

Critical to the quality of communication between a base-station transmitter and a mobile receiver is the signal's propagation channel. As it is transmitted over the air, the signal is subject to fading. The signal can be absorbed or reflected by obstacles such as buildings, mountains, and trees, and the resulting fading can influence its amplitude and phase significantly.

Reflection, diffraction, and local scattering can cause a signal to take multiple paths from base station to receiver (**Figure 1**). In a so-called multipath scenario, several copies of the same signal arrive at the receiver with different path lengths at different times and with varying amplitudes and phases. With a moving receiver, additional challenges occur such as maxima and minima of signal strength and Doppler shift.

Wireless devices such as mobile phones must be tested under real-world conditions to guarantee their performance. For this purpose, the ITU (International Telecommunication Union) has specified fading that simulates diverse propagation conditions and also some special receiving conditions.

But fading is not limited to mobile radio networks. Another area where fading is critical is in military communications systems based on SDRs (software-defined radios). Such systems use time-critical complex waveforms that can have extremely short synchronization sequences.

Airborne radios are especially subject to extreme conditions. Long distances introduce considerable delays into the transmitted signals. Radio waves propagate at the speed of light, leading to time delays of about 1 ms per 300-km distance between communicating radios. Thus, the performance of hopping radio systems under worst-case conditions needs to be verified by radio manufacturers so they can optimize their designs, and it also must be evaluated by test houses to verify whether a radio complies with the specification.

By using a vector signal generator with a fading option in conjunction with a signal analyzer—both of which are equipped with a digital baseband interface—you can create repeatable, real-world test scenarios in a time-saving and cost-efficient manner. You can use the combined instruments to check the performance of receivers during development and acceptance testing in order to uncover areas that need adjustment prior to costly field tests.

General methods of fading simulation

There are several methods for performing fading simulation. Normally, the optimum method is to generate fading within the digital baseband section of a signal generator that is used to test a receiver. This method is widely used and is cost-effective, and it ensures the best performance and repeatable signal quality. Another

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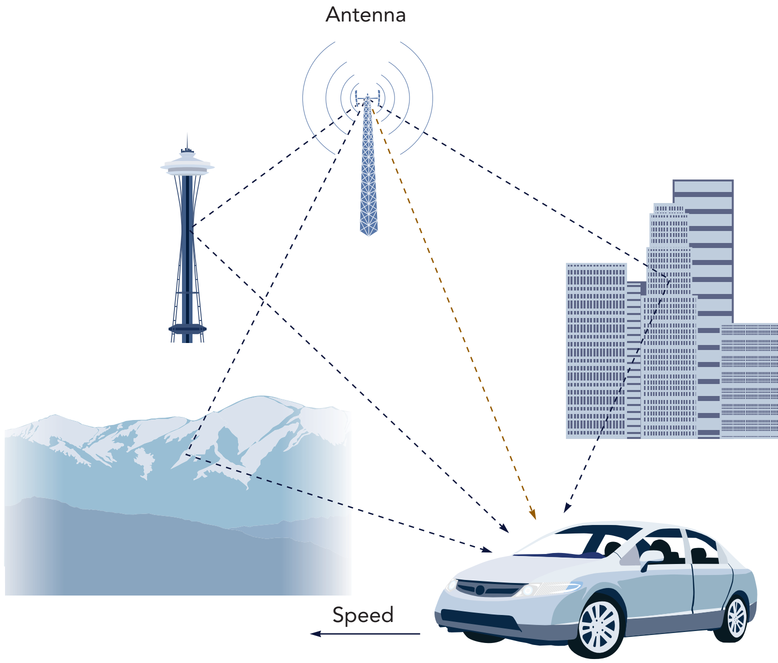

FIGURE 1: **Signals experience fading during transmission. Obstacles such as buildings and mountains reflect or absorb the signals, influencing the signals' amplitude and phase.**

method operates on an RF-in/RF-out basis. But stand-alone RF fading simulators that work with this method are expensive. Plus, the signal quality may be degraded by the effects of the necessary multiple conversions from IF to baseband and vice versa.

For some applications, however, there is no alternative to RF fading because the baseband signal is not available. For example, fading tests performed on actual transmissions from mobile radio base stations including signaling require a simulator for RF fading. The same is true for military radio links with frequency hopping. In addition, TV signals and even simple FM signals must be tested under fading conditions.

For mobile radio testing, the ITU has specified fading profiles, such as the channel models for GSM and UMTS/WCDMA standards. GSM defines three propagation models: typical urban, hilly terrain, and rural area. UMTS/WCDMA channel models are derived from the ITU channel model for indoor, pedestrian, and vehicular environments. All these channel models simulate the propagation conditions in different environments by modeling the expected impact of the environment. The ITU channel models are based on a tapped delay-line channel model and differ, for instance, in the number and distribution of fading paths and delay spread of the channel. Besides the actual fading profile, the models require that the relative movement of the receiver with respect to the transmitter in the form of a Doppler frequency shift be simulated as well.

When a receiver or any of the reflectors in the receiver's environment are moving, the receiver's relative velocity causes a shift in the frequency of the signal transmitted along each signal path. Signals take different paths and can have different Doppler shifts, corresponding to different rates of change in phase.

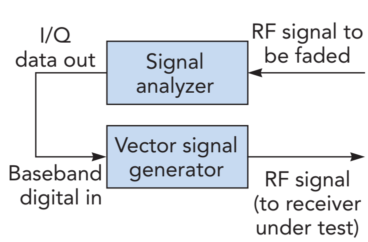

FIGURE 2: **An RF fading simulator using R&S FSQ and R&S SMU200A instruments composed of a signal analyzer and a vector signal generator can provide a real-time bandwidth of 28 MHz.**

Setting up an RF fading simulator

You can build a versatile simulator for RF fading by combining a signal analyzer that has a digital baseband interface with an RF vector signal generator that has digital baseband inputs and a fading option. If a suitable signal generator and signal analyzer are already available in a lab, this solution is more cost-effective than investing in a stand-alone RF fading simulator.

To use this setup, you feed the RF signal to be faded into the signal analyzer's RF input. The signal analyzer works as a downconverter and digitizes the signal's IF. (The R&S FSQ signal analyzer, for example, enables a real-time bandwidth of up to 28 MHz.) The digital baseband interface in the signal analyzer must send a continuous digital data stream that is compatible with the signal generator's digital I/Q input; the data stream should be fed into the I/Q input via an LVDS (low-voltage differential-signaling) cable (**Figure 2**).

The signal generator will deliver an RF signal at its RF output with the same level, modulation, and frequency as the signal fed into the signal analyzer's RF input. The baseband fading functions of the signal generator, along with superimposed AWGN (additive white Gaussian noise), can be applied to the baseband signal before upconversion to the RF. The combination of the R&S FSQ signal analyzer and R&S SMU signal generator provides an RF fading simulator with a real-time bandwidth of up to 28 MHz and an RF frequency up to 6 GHz. It covers all current digital radio standards for both uplink and downlink signals.

Setting up fading tests

The most important tests on digital mobile radio receivers are fading tests, which ensure that communications between a base station and a mobile device can be maintained even under adverse conditions. **Figure 3** shows how to set up fading tests on a mobile radio receiver. Using a power attenuator, feed the base station's RF signal into the RF input of the signal analyzer. Then, connect the digital baseband output of the signal analyzer to the digital baseband input of the vector signal generator. Next, feed the signal generator's output signal to the mobile radio receiver input at the required level. Some vector signal generators, such as the R&S SMU200A, permit you to implement a fading scenario according to the mobile radio standard to be tested (such as GSM, 3GPP, or LTE).

Fading tests for military airborne transceivers require a different setup. Military communication systems based on SDRs use complex waveforms that can have extremely short synchronization sequences. In addition, wideband fast frequency-hopping schemes are employed as electronic protective measures. Such hopping sequences cover frequency bandwidths beyond 100 MHz with hopping rates of up to thousands of hops per second. Before secure communication can take place, all radio systems involved are synchronized to a master clock. Subsequently, each radio follows the same master-defined hopping scheme, relying solely on its internal system clock.

The synchronization window for establishing a connection between two radios is very short. Time delays and the accuracy of the individual system clocks can become critical. System clocks are frequently resynchronized through the master. But the radios always must be able to cope with the time delays as well as with the signal's characteristics resulting from the arbitrary hopping schemes.

Airborne radios are especially subject to extreme conditions. Long distances between radios can cause signal delays of up to several milliseconds, and in the worst cases, a communication link cannot be established at all. In addition, the supersonic speed of the aircrafts create significant Doppler shift on the received signals, which may create problems.

The performance of hopping radio systems under worst-case conditions needs to be verified by radio manufacturers so they can optimize their designs and verify the compliance of a radio to the system specifications. Usually, test houses rent helicopters, an airfield, and antennas to carry out "real-world" tests, which are costly and time-consuming. The test results of this conventional approach can be corrupted by many known and unknown sources of errors, such as antenna placement and other parameters. **Figure 4** shows a setup for testing military fast-frequency-hopping airborne transceivers.

The synchronization of the receiver under test (lower device) to the transmitter (upper device) can be tested by introducing signal delays of several milliseconds to the transmitted signal set by the fading section of the signal generator. These delays occur in real-world conditions when two aircraft communicating with each other are several hundred kilometers apart.

For the test, the reference transceiver sends an RF signal to the signal analyzer, where it is downconverted to the baseband. The resulting digital I/Q stream is forwarded in real time to the vector signal generator. The generator's fading option applies the intended delay, fading, and Doppler speed scenario to the signal to simulate a real-world environment, such as when two aircraft are traveling at significantly different speeds. The test signal is upconverted to RF before being passed to the transceiver under test for demodulating the signal content. Correct synchronization is checked by comparing the synchronization signals from the two transceivers with an oscilloscope. If the hopping waveforms exceed the bandwidth of the signal analyzer, you should be able to test the waveforms by using reduced bandwidth hopping schemes provided by the radio manufacturer.

A test setup that makes use of both a signal analyzer and a vector signal generator to perform RF fading can eliminate unknown sources of errors, enable manufacturers to optimize their radio designs, and allow test houses, military radio users, and system integrators to verify compliance with international standards and the supplier radio specifications based on realistic environmental conditions. T&MW

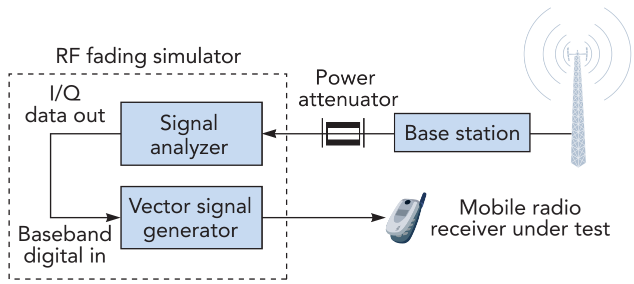

FIGURE 3: This test setup can perform fading tests on mobile radio receivers using a base-station signal.

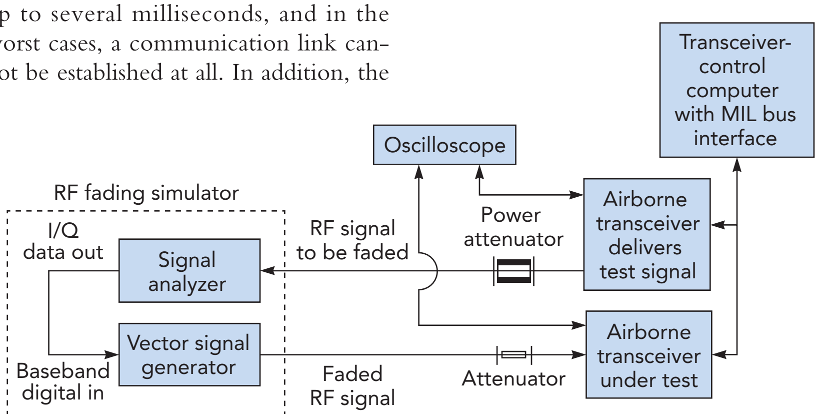

FIGURE 4: Fading tests on airborne radio transceivers present problems related to synchronization of transceivers over large distances and at high speeds. Simulation of the speeds and distances simplifies the problem.

FOR FURTHER READING

"Versatile RF Fading Simulator with R&S FSQ/FSG/FSV and R&S SMU," Application Note 1MA145, Rohde & Schwarz. www.rohde-schwarz.com/ad/RF_Fading.

Roland Minihold *received a degree in high-frequency engineering from the Technical University of Munich in 1976. In the same year, he started working as a development engineer at Rohde & Schwarz in Munich, where he was responsible for development projects for RF signal generators and for modulation, spectrum, and signal analyzers. Since 1997, he has been working as a senior application engineer in the application development department of the Test and Measurement Division at Rohde & Schwarz.*

Calibrate nearly any electrical instrument

Fluke's Model 5080A multifunction calibrator lets you calibrate a wide range of measuring instruments, including handheld and bench multimeters, analog and digital panel meters, and wattmeters. The calibrator can source DC voltage to 1020 V at 600 mA, DC current to 20.5 A at 50 V, AC voltage to 1020 V at 800 mA, and AC current to 20.5 A at 44 V. It also sources resistance to 190 MΩ, AC and DC power to 20.5 kW, phase to 179.99°, and frequency from 45 Hz to 1 kHz. The voltage and current specifications are the highest among Fluke multifunction calibrators.

With options, the 5080A can calibrate oscilloscopes, clamp meters, and megohmmeters. The oscilloscope option lets you calibrate oscilloscopes to 200 MHz. Fluke offers a 10/50-turn current coil and a 50-turn current coil for clamp-meter calibrations up to 1000 A. The ohmmeter option lets you perform calibrations up to 18 GΩ.

The 5080A can also automate calibrations through software. The 5080A/CAL software option lets you control the calibrator, manage inventory, collect data, and print reports. You can also use Fluke's MET/CAL Plus calibration software and MET/CAL Lite software.

Base price: $12,995. *Fluke, www.fluke.com.*

DC analyzer gains SMU functions

Agilent Technologies has added two SMU (source-measure unit) modules to its N6700 series of DC power analyzers. The N6781A simulates batteries, letting you analyze power consumption in cellphones, MP3 players, medical devices, and other battery-operated devices. The N6782A simulates rapidly changing sources and loads, letting you perform functional power testing as a device turns its subsystems on and off. Both SMUs can source or sink current while applying positive voltage, making them two-quadrant power sources.

As measurement units, the modules can sample voltage and current at up to 200 ksamples/s. They have four measurement ranges (10 μA to 3 A), and they can switch between ranges without causing "glitches" in power delivery. To do that, the modules use a set of shunt resistors that are all in series with the source output. This arrangement differs from the traditional configuration of having multiple resistors in parallel, with switches connecting one at a time in series with the source's output. The digitizer measures the voltage across any one of the resistors while the others are shorted. Each resistor has a voltage regulator across it that controls the source unit's output, keeping it smooth as ranges change. Eliminating the glitches removes power disruptions that affect the device under test.

Agilent has also developed the 14585A software that lets you control up to four N6705 mainframes (16 power supplies). The software enhances the instrument's data-analysis capabilities and lets you create complex power waveforms.

Prices: N6781A—$5300; N6782A—$4230; N6705B mainframe—$6900; 14585 software license—$1240. *Agilent Technologies, www.agilent.com.*

NI advances IEEE 802.11n wireless LAN test

National Instruments has introduced the NI WLAN Measurement Suite 2.0 software for IEEE 802.11n wireless LAN testing. The suite, which includes software toolkits for IEEE 802.11n WLAN signal generation and analysis, integrates with NI PXI Express RF signal generators and analyzers to deliver phase-coherent MIMO RF measurements. NI says the suite also delivers the industry's fastest speed for EVM (error-vector magnitude) and spectrum-mask measurements.

One software toolkit integrates with NI PXIe-5663E 6.6-GHz VSAs (vector signal analyzers) to help engineers make accurate multistream MIMO measurements, while another integrates with NI-PXIe-5673E 6.6-GHz VSGs (vector signal generators) to generate phase-coherent, multistream RF signals. According to NI, the new NI WLAN Measurement Suite offers a faster measurement time than the previous version, and it also adds a variety of software features to improve measurement performance and ease of use. Engineers can software-enable its new resolution bandwidth filter feature to remove broadband noise and increase EVM measurement accuracy. With front-end filtering engaged, engineers can achieve residual EVM accuracy of better than –47 dB when testing WLAN devices.

The measurement suite includes soft front panels for signal generation and analysis to support a range of

WLAN IEEE 802.11n configurations, including 4x4 MIMO, and to report measurement results and traces. In addition, engineers can use the suite as a stand-alone executable or as an API (application programming interface) in LabView, in the NI LabWindows/CVI ANSI C development environment, or in other C, C++, and .NET development systems.

Base prices: WLAN Measurement Suite 2.0—$5999; signal-generation toolkit—$3999; signal-analysis toolkit—$3999. *National Instruments, www.ni.com.*

VeriWave launches WaveDeploy for wireless LANs

With 802.11n WiFi deployments taking center stage in corporate networks, VeriWave is introducing WaveDeploy, a site-assessment tool for analyzing network readiness, real performance, and the impact of growth and change with a single pass through a facility. Using WaveDeploy, IT managers, systems integrators, and installers can tune networks, manage vendors, certify new devices and applications, verify compliance, and assess the return on investment in mobile data, voice, video, and multiplay services.

WaveDeploy leverages VeriWave's real-client generation technology. Unlike top-down site-survey tools that map AP (access-point) signal power and perform basic ping measurements to try to deduce network quality, WaveDeploy delivers true end-user QoE measurements. Analysis of performance and interoperability is based on the nature and behavior of client devices and applications running on these devices and their interaction with APs and wired and wireless networks.

Base price: $4995. You can download a free version of WaveDeploy Basic at www.wavedeploy.com. *VeriWave, www.veriwave.com.*

Luna's reflectometer finds network faults

The portable OBR 4200 optical backscatter reflectometer from Luna Technologies offers inspection and diagnostic capabilities to manufacturers and installers of fiber-optic assemblies and short networks. According to Luna, the OBR 4200 delivers a resolution that is 1000 times that of an OTDR.

The OBR 4200 allows you to "see" any event in a fiber assembly or network out to 500 m with no dead zone. Luna says it provides a spatial resolution of less than 3 mm, Rayleigh-level sensitivity down to –120 dB over the entire measurement range, and insertion loss resolution of 0.1 dB with the

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ability to identify nonreflective failures. In addition, the OBR 4200 has an operational wavelength of 1540 nm and offers both single-mode output (standard) and multimode output (optional).

You can use the OBR 4200 to verify the quality of optical-fiber cable assemblies, connectors, and short-run networks; troubleshoot and distinguish between macro-bends, splices, connectors, and breaks; locate insertion loss points; and verify return loss of multiple points in a fiber assembly or harness simultaneously.

Luna Technologies, www.lunatechnologies.com.

JTAG updates boundary-scan development tool

JTAG Technologies' ProVision development and hardware-debug tool enables engineers to create test programs and ISP routines for PLDs, FPGAs, flash memories, serial PROMs, and other devices. The latest version of the tool, Version 1.8, includes enhancements such as ActiveTest, an interactive cluster-test generator, and Buzz, a continuity-test module for quickly checking hidden open circuits.

Version 1.8 also features an enhanced NAND flash ISP program generator, along with built-in debug capabilities for Symphony-supported in-circuit testers and flying-probe testers. The ProVision model library now contains models for more than 7500 non-boundary-scan device families, covering more than 78,000 different devices.

This latest release is available free of charge to customers with valid maintenance contracts.

JTAG Technologies, www.jtag.com.

Multifunction module sells for under $100

You can use the Check-MATE multifunction data-acquisition module from Overton Instruments to automate a variety of tests. Once the module is connected to a laptop or desktop PC, the GUI software lets you quickly build your application.

Check-MATE has eight programmable single-ended or differential analog inputs with 12-bit resolution and a sampling rate of 100 ksamples/s. It also provides a single analog output with 12-bit resolution that operates in either unipolar or bipolar mode. In addition, the Check-MATE module supplies eight independently programmable digital I/O lines.

Two options are available for controlling the Check-MATE: a host PC via an optional USB interface or an embedded microcontroller. Through the USB interface, Check-MATE responds to a simple set of ASCII commands. In addition, it can be programmed using Visual Basic, Linux, C/C++, LabView, LabWindows, or any language that allows access through a serial port. For embedded applications, you can control the Check-MATE module with Overton's Micro-MATE embedded test controller or any microcontroller, including ARM, AVR, PIC, and Stamp.

Price: $99. *Overton Instruments, www.microATE.net.*

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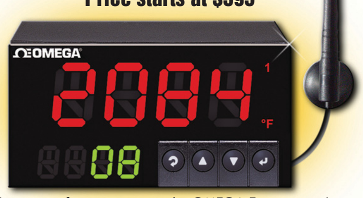

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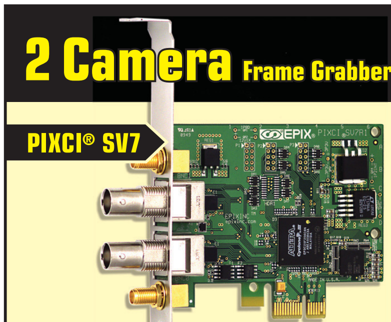

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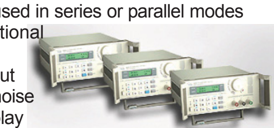

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LOOFIE GUTTERMAN
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Co-founder of Geotest—Marvin Test Systems, Loofie Gutterman has more than 25 years of experience in the test and measurement industry. During his tenure with the company, he has served as VP of systems engineering, COO, and now president. His experience in the development of commercial and military test instruments, as well as turnkey solutions, paved the way for Geotest's growth in the PC- and PXI-based product markets. Prior to joining Geotest, Gutterman held several positions with RSi, including program manager, COO, and technical director. Gutterman also serves as the president of the PXI Systems Alliance.

Contributing editor Larry Maloney recently interviewed Loofie Gutterman by phone about developments in PXI and other test industry trends.

How PXI fuels test's recovery

Q: What advantages do PXI test systems give cost-conscious companies as they recover from the recession?
A: PXI has always been a cost-effective solution for functional test. There are two reasons for this. First, PXI leverages the production volumes of both PCI and PCI Express. That allows us to offer products with excellent performance at very competitive prices versus other standards. Second, PXI is a modular standard, and the infrastructure—such as the controller and power supplies—is distributed among system resources.

Q: Are you suggesting that PXI has become the de facto standard for automated test systems?
A: We believe so. In almost any market that requires a new tester, PXI usually turns out to be the solution, or at least part of the solution. For example, Geotest has developed a line of products called GBATS (Geotest Basic Automated Test System), which are preconfigured testers. We took that step after finding that many customers were taking our chassis and PXI modules, as well other vendors' PXI modules, and creating complete test systems based only on the PXI standard. In other cases, you see companies using hybrid systems that combine PXI with LXI, VXI, GPIB, or USB. Even military testers, once based only on the VXI platform, now include a mix of VXI and PXI technology. The same is true in the area of proprietary ATE (automated test equipment) for the semiconductor industry, where testers are beginning to incorporate PXI architecture.

Q: How would you assess the growth of PXI Express?
A: PXI Express was developed to address applications requiring a wide bandwidth, with massive data transfer between the controller and the instrument, and PXI Express has become quite successful in those instances. If you are building a simpler tester, say one with a chassis and a few switching cards and analog instruments, you probably don't need PXI Express. However, we're noticing a trend in which some customers are buying a PXI Express chassis not for current testing applications but for applications that may surface down the road.

Q: Are there any new features in your ATEasy test development software?
A: The new release, ATEasy 8.0, offers much greater ease in testing multiple UUTs (units under test) simultaneously. You can take one test program and run it multiple times, either concurrently or sequentially. This saves substantially on the amount of code you would otherwise have to develop to test multiple units. The second major feature in the new release is expanded capability in ATML (Automatic Test Markup Language), the emerging standard for interfacing test system components.

Q: What other significant new products have been introduced in recent months?
A: An important one is the new GX5295, a 3U, high-performance digital test card that has a per-pin PMU (parametric measurement unit). It's not just a digital card with 32 channels, allowing you to run test vectors to the UUT. You can also conduct analog measurements using each of the channels. This card is targeted mainly for semiconductor test, and beta sites have been using it in applications like analog characterization of digital chips. Essentially, this card allows you to test your devices for both AC and DC parameters. T&MW

Loofie Gutterman discusses other PXI technologies, including new boundary-scan capabilities, in the online version of this interview: www.tmworld.com/2010_07.

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