

The IEEE Instrumentation & Measurement Magazine
August 2009 issue

Best of AUTOTESTCON 2008

From the Editor's Bench

Shlomo Engelberg

Asking the Right Questions

People often request things that they believe are a means of achieving a particular end. As a department chair, I get many requests from students, and with the best will in the world, I cannot grant all the requests. When a request is denied, the student making the request often requests something else. After the student's request changes a couple of times, I begin to realize that the student is beating around the bush. The student is asking for things that student feels will help achieve some specific—but unstated—goal. By carefully prompting the student, I can usually find out what the real goal is. At that point, I can try to think of ways to help the student achieve the actual goal. Because I have been working with the system here much longer than the average student, I will sometimes think of a solution that is very different from any of the solutions the student considered. Making sure to ask the right question, to express one's true desire, is very important if one wants help in reaching one's goals.

It is amazing how much effort can be wasted trying to help someone reach a subsidiary goal that need not be reached at all. I once worked for a company that decided that in order to reach a target accuracy in a particular measurement, it had to develop a subsystem to hold a sample at a temperature that was to be constant to within 0.001°C. I was not sure that to reach their goal there was any need to keep the sample's temperature constant to that extent. The other folks were sure, and a lot of (possibly wasted) effort went into holding the temperature constant.

Recently, I was involved in purchasing a large amount of equipment. I had a reasonably fixed budget, and in order to save money, it was decided that some of the less important equipment would be bought from a reasonably inexpensive and not-too-high-quality vendor. The outlay for the less important equipment was to be about 20% of the budget.

After deciding how to acquire the less expensive equipment, I went to the high quality vendors to purchase the more important pieces of equipment. After a couple of weeks of haggling over prices, I realized that I had made a serious mistake. I should have told the expensive vendors what my true needs were and seen if they could provide for all of my needs and come in at budget. Once I realized my mistake, I went back to the high quality vendors and asked about the possibility of their supplying all of our needs. In the end, they were not able to beat the lower quality vendor's prices, but I should have explained my needs more fully to the high quality vendor. I had nothing to lose and everything to gain.

This month's issue of the *IEEE Instrumentation and Measurement Magazine* is devoted to presenting the technical highlights of AUTOTESTCON 2008 which took place in Salt Lake City in September 2008. AUTOTESTCON 2008 was sponsored by the IEEE, the Aerospace and

Electronics Systems Society (AESS), the Instrumentation and Measurement Society (IMS), and the IEEE Utah Section, and the conference covered areas that the magazine does not always have the opportunity to cover. It is always interesting to see what questions others feel are important and how they go about answering their questions. This issue lets all of us see what the “right questions” are in the test and diagnostics community. Enjoy!

Shilomo

I&M Society President's Greetings

Alessandro Ferrero

Welcome to this issue of the Instrumentation & Measurement (I&M) Magazine dedicated to the IEEE AUTOTESTCON 2008. AUTOTESTCON and I²MTC are the two major Conferences that are sponsored by the I&M Society (IMS) and cover all fields of instrumentation and measurement. AUTOTESTCON is among the most successful applications-type conferences focused on the most advanced I&M technologies in the test market. It provides a forum for top specialists and exhibitor companies to present their papers and products in an environment conducive to discussion about their achievements in current industrial measurement applications.

On behalf of the entire I&M Society, I warmly thank the Members of the AUTOTESTCON Board of Directors, the General Chairs, the Technical Program Chairs and all Committee Members, who played an important role in granting success to the conference. A special thank you also goes to the Aerospace & Electronic Systems Society (AESS) and its President, Bob Rassa, for co-sponsoring this Conference.

I hope you'll enjoy reading this issue of the I&M Magazine. It contains reprints of selected papers presented at AUTOTESTCON 2008 and an article on the history of NIST. We hope you attend this year's AUTOTESTCON 2009 and each year to come.

Alessandro

Message from the IEEE Aerospace & Electronic Systems Society

Bob Rassa, President, 2008-2009

The IEEE Aerospace & Electronic Systems Society has been a proud primary sponsor of IEEE AUTOTESTCON since its founding in 1964 in the gateway city of St Louis, MO. This Conference is one of the IEEE's most successful application-focused conferences in their overall conference portfolio, and for good reason.

AUTOTESTCON brings together the US Department of Defense community, along with their offshore and Canadian counterparts and colleagues that are actively engaged in automated test systems for military equipment – the vendors who provide the outstanding equipment, both primes and 2nd and 3rd-tier and other supporting contractors; the users from the Services, the procurement organizations from the military, and the individuals from US and offshore industry that design and build the systems.

The local Conference Committee, this year being the highly experienced crew from southern California, will provide a week-long forum for the exchange of new ideas, lessons learned, advanced concepts, and problem solutions in the broad field of interest that befits the complexity of sophisticated automated test systems. Tutorials are offered that enhance the conference experience by giving the opportunity to learn some of the in-depth concepts behind successful automated test. Several focused panels during the technical sessions will address the most current “hot” issues. We are greatly appreciative of the Conference Committee planning and execution of IEEE AUTOTESTCON 2009, and of the participation of all attendees and especially our Exhibitors, all of whom have added tremendous value to this Conference.

Our thanks go to the AUTOTESTCON Conference Committee and the AUTOTESTCON Board for their tireless support of this amazing Conference, and to our co-sponsor, the Instrumentation & Measurement Society, for their excellent magazine and this special issue dedicated to the furthering of the AUTOTESTCON objectives. We also appreciate the support of the IEEE Los Angeles Council and IEEE Orange County Section, who provided invaluable assistance in key areas of the Conference.

Bob

Article Summaries

Cost Effective, Versatile, High Performance, Spectral Analysis in a Synthetic Instrument

(Summary)

Fred Harris and Wade Lowdermilk

This article discusses signal conditioning options for processing raw data samples from the A/D converter and delivering a filtered, resampled version of those data samples to a conventional FFT based spectrum analyzer. The conditioning performs a number of important processing functions, including spectral translation to baseband, noise bandwidth reduction to signal bandwidth, and arbitrary resampling to obtain specified spectral spacing with available sized FFTs. The versatility of an FPGA based processor and signal conditioning block enables the use of the signal conditioner blocks to align sample rate with transform sizes without the need to vary input sample clock rate or the cut off bandwidth of analog anti-alias filters in the signal path.

This summary includes text from the article.

RFID Threshold Accelerometer

(Summary)

Benjamin Todd, Mallory Phillips, Stephen Schultz, Aaron Hawkins, and Brian Jensen

This paper introduces a shock sensor design that requires zero power, is small, low cost, and can be remotely monitored. The sensor combines a latching accelerometer with a Radio Frequency Identification (RFID) chip. The accelerometer is a mechanical element that changes states when threshold acceleration is met. The element’s state can be relayed wirelessly to an electronic reader via the RFID chip. Multiple RFID chips can be read simultaneously, making sensor networks possible.

Signal Intelligence and Surveillance with COTS Hardware

(Summary)

Ryan Verret and Patrick Webb

This paper examines how technologies map to specific signal intelligence solutions. It examines how GPS can provide timing synchronization for triangulation to meet the electronic intelligence requirements of those who need to locate and track transmitters. For spectral monitoring applications, this paper includes software-defined solutions on both microprocessors and FPGAs for detecting unauthorized transmitters. It also covers RAID-based storage solutions for the continuous logging of wide bandwidths of the electromagnetic communications spectrum. Finally, for custom or atypical needs, this paper discusses how a modular approach to instrumentation can still provide a COTS, or predominantly COTS, solution. Because the PXI platform offers products for these applications, it is referenced throughout this work as the recommended COTS architecture for signal intelligence.

This summary includes text from the article.

Multicore Programming Techniques for High-Performance ATE

(Summary)

Murali Ravindran and Jeff Meisel

This paper examines how recent innovations in processor technology are pushing the limits for ATE applications. Various multicore programming techniques are discussed, including task parallelism, data parallelism, and pipelining. An example of optimizing complex analysis is presented. The benefits of adopting multicore technology and parallel software architectures include a reduction in overall test time, more sophisticated simulation approaches, and the ability to analyze complex systems.

This summary includes text from the article.

Noise Concerns and Remedies in VXI and PXI Systems

(Summary)

Anthony Estrada

This paper addresses the sources of radiofrequency interference in our modern VXI and PXI systems and describes practical, efficient ways to suppress bus noise and radiated energy from the desired signals. For optimum performance, a modern, high performance, synthetic instrument (SI) must be designed to keep RF energy that is outside the module from leaking in—and not let any of its energy leak out into other modules. Every detail must be addressed. DC power lines, signal lines, air cooling holes, and conventional RF shielding are all important design considerations in the small confines of an SI chassis.

This summary includes text from the article.

Second in a Series: The Creation of the National Bureau of Standards

(Summary)

James F. Schooley, Sr.

This is the second of four articles that describe the early years of the National Bureau of Standards (now known as the National Institute of Standards and Technology). The first article described the work of Ferdinand Rudolph Hassler, America's first metrologist, whose efforts during the first half of the 19th century created the first survey of the coastal United States and provided the young country with the beginnings of a coherent system of weights and measures. This article discusses the Convention of the Meter of 1875, offers a brief look at 19th century science and invention in America, and gives an account of the creation of the National Bureau of Standards.

This summary includes text from the first paragraph of the article.

Departments

New Products

Robert Goldberg

Spectrum Analyzers in a Smaller, More Affordable Package

Aeroflex unveils its new 3250 Series of spectrum analyzers designed to offer impressive RF and microwave capabilities, exceptional connectivity and many ease-of-use features in a smaller package and with a lower price tag than ever before available. With RF frequency ranges spanning 1 kHz to 26.6 GHz, the 3250 Series is ideal for wireless design, research, development and production test engineers in numerous applications including military communications, satellite test, radar and portable mobile radio (PMR) test.

The 3250 Series is comprised of four spectrum analyzer models, each measuring a frequency range beginning at 1 KHz, with the 3251 ranging up to 3 GHz, the 3252 to 8 GHz, the 3253 to 13.2 GHz and the 3254 to 26.5 GHz. All models have a Windows[®] XP operating system, remote control capabilities via LAN, GPIB and RS-232C as well as a 7" touch panel screen, making them easy to operate with exceptional connectivity. The display gives the user ample viewing area so data can be seen easily, even in split-screen mode or with multiple windows open. Three traces can be displayed per window and as many as nine markers can be selected with a marker table viewable in an alternate window.

The 3250 Series includes digital demodulation capabilities for the analysis of 802.11a, b and g wireless networks, enabling engineers to analyze the transmitter characteristics of a wireless device. Also available are optional measurement personalities including GSM/EDGE, WCDMA, WiMAX and WLAN as well as EMC pre-compliance test.

Built-in functions can simplify the evaluation of many common measurements and the 3250 Series offers several, including: channel and multi-channel power, pulsed measurement, gated

sweep, occupied bandwidth, spectrum emission mask, TOI measurement, total harmonic distortion, AM/FM and digital demodulation analysis, X-dB down and phase noise measurement.

All the performance of a larger bench-top instrument has been designed into these easily portable, compact and efficient spectrum analyzers that range from just 24 lbs. (11 kg.) to 29 lbs. (13 kg).

Find more information on the Company's web site: www.aeroflex.com.

In-Circuit Tester with Digital Capabilities Uses Low-Cost Fixturing

Agilent Technologies Inc. announces it has launched the Medalist i1000D in-circuit test system with digital test capabilities. The i1000D bridges a growing solution gap between high-functionality in-circuit testers and low-end manufacturing defects analyzers.

Designed for cost-sensitive manufacturers looking for a solution with both analog and digital capabilities to tackle today's more complex printed circuit board assemblies (PCBAs), the i1000D offers:

- per pin programmability;
- digital PCF/VCL library-based testing;
- native boundary scan capabilities;
- I2C/SPI serial programming;
- simple, low-cost long-wired test fixture; and
- flexible, easy-to-use graphical user interface.

These features present an excellent opportunity for customers looking for better test coverage without increasing the cost of test.

The i1000D comes with full native boundary scan test capabilities and Agilent's latest VTEP v2.0 Powered vectorless test suite, which offers the latest award-winning Cover-Extend Technology.

Details about the tools in this suite can be found at www.agilent.com/see/vtep.

Family of Ultra High-speed Digitizers

GaGe announces the CobraMax™ family of ultra high-speed 8-bit digitizers. The CobraMax family of digitizers is available with 1 or 2 digitizing channels, 3 or 4 GS/s sampling per channel and up to 1.5 GHz of input bandwidth. With up to 4 GS of on-board acquisition memory per card, CobraMax digitizers offer the ideal combination of ultra high-speed data capture rates and huge amounts of on-board memory.

By taking advantage of GaGe's Expert™ FPGA on-board signal processing technology, such as Signal Averaging, users can also perform on-board data analysis to reduce the amount of captured data before transferring them to the host PC for further analysis.

For applications that require several simultaneous digitizing channels, it is possible to interconnect up to 8 CobraMax digitizers in a single chassis and achieve true multi-card synchronization using GaGe's advanced internal clock distribution technology.

Using short and controlled timing signal propagation paths and automatic timing calibration, GaGe claims this technology provides far superior inter-card time skew and jitter performance, as compared to alternate external multi-module synchronization techniques.

For ease of integration, CobraMax digitizers also provide Reference Clock In and Clock Out, External Trigger In and Trigger Event Out.

GaGe's Cobra family of digitizers is compatible with GageScope® oscilloscope software that allows users to acquire and analyze signals without writing a single line of programming code. GaGe also offers powerful Software Development Kits (SDKs) for C/C#, MATLAB®, or LabVIEW® and other popular programming environments for users that want to create their own custom software applications.

Find more information at www.gage-applied.com.

Ethernet Analog I/O units for 8-channel 16-bit A/D Modules are Low Priced

Acromag releases commercial and industrial-grade versions of its new 8-channel Analog Input Ethernet I/O modules to offer great cost savings for applications that don't require wide temperature and hazloc ratings.

Acromag has expanded its BusWorks® Ethernet I/O series of modules for distributed I/O and SCADA with new 967EN and 968EN models providing an 8-channel interface for differential analog voltage or current input signals. Industrial-grade units add superior accuracy, a signal integrator/totalizer function, peer-to-peer messaging, -40 to 70°C capability, and are designed to meet UL/cUL Zone 2 Class 1 Division 2 ABCD requirements. All units provide 16-bit A/D conversion of sensor inputs for Modbus TCI/IP control network communication.

Two models, each with 8 differential analog inputs, support a variety of I/O ranges. The 967EN accepts DC current with $\pm 20\text{mA}$, 0-20mA, or 4-20mA input ranges. 968EN models accept $\pm 5\text{V}$ or $\pm 10\text{V}$ ranges. Fast scanning updates all eight channels in less than 10mS. Dual-format data registers support both 16-bit integers and 32-bit floating point formats. IEEE-754 32-bit floating point scaling registers are configurable on a per-channel basis. A sample averaging function is also configurable. On industrial-grade units, an integration function can totalize inputs with non-volatile counter registers on all channels. Surge protection and 3-way 1500V isolation between I/O, power, and network circuits increase reliability.

These input modules are very easy to use. No software is required as the units are configured using any web browser to set operating parameters on embedded configuration menus. An auto-copy function lets users rapidly apply a saved configuration to multiple units. The automatic calibration function uses built-in precision sources and on-demand self-test capability verifies the calibration. Front-panel LEDs provide a visible confirmation of proper operation.

Please visit www.acromag.com for more information.

Ultrasonic Sensors Feature Smooth Barrel, Stainless Steel Design for Use In Sanitary Procedures

Banner Engineering Corp. introduces U-GAGE® M25U Ultrasonic Sensors, opposed mode ultrasonic sensor pairs specifically designed for use in sanitary environments. The sensors, rated IP69K, IP67 (NEMA 6), are constructed of heavy-duty 316 stainless steel, allowing them to withstand the recurring high-pressure washdowns, severe temperatures, and aggressive cleaning chemicals common in food and beverage applications.

With a smooth barrel housing, free of threads, gaps or seams that could accumulate debris, M25U sensors allow for thorough cleanup with minimal effort. Additionally, IP68-rated washdown cordsets and FDA compliant brackets are available to further ensure reliable, long-lasting performance in the harshest environments.

M25U sensors can be wired for either normal or high speed. Normal speed offers a longer sensing range, while high speed provides a shorter response time, ideal for high-speed counting applications.

Features of M25U sensors include:

- Smooth, hygienic design for easy cleaning in food processing and other washdown applications; rated IP69K, IP67 (NEMA 6)
- Robust stainless steel housing with 25 mm smooth barrel for use in demanding environments
- Wide operating temperature range of -20° to 70° C; can withstand sprays up to 80° C and 1500 psi occurring every few hours
- Dual range/dual speed opposed mode ultrasonic sensors; ideal for sensing clear objects or materials
- Highly immune to ambient sonic and electrical noise
- Bright LED indicators for power and output status
- 10 to 30V dc operation

For further information please visit www.bannerengineering.com.

Datalogger Now Has 5x Capacity

Now you can easily measure and record humidity, temperature, pressure, light and position/acceleration simultaneously over a whole year. The Swiss Engineering firm, MSR Electronics GmbH, now offers the MSR145 mini datalogger with a 900 mAh lithium-polymer battery and light sensor.

Long-term measurements are often inevitably required in order to get to the root of a problem. Only clear results allow the user to make a correct evaluation. In order to accommodate these requirements the MSR145 datalogger with a 900 mAh battery provides a five times greater capacity over the standard battery. This allows you to easily record measurement parameters over a whole year and even over a period of up to two years, depending on the measurement rate.

The light, 3-axis acceleration, temperature, humidity and pressure sensors of the mini datalogger may be used in industrial applications. Today, datalogging is an essential requirement from manufacture right through delivery of a product to the end customer. The MSR Electronics dataloggers record all stages of production and transport so they can be traced. Meaningful data helps users to ensure the quality of their goods while minimising cost and safety risks. If for example, you want to find out if and when a package has been opened (by customs for example), the sensor will provide you with exact data through brightness logging.

Currently there are no comparable dataloggers available that combine five measurement parameters in one small and handy single unit. A recording capacity of 2m measurement parameters means superior efficiency. Furthermore, the MS145 comes with optional 2 or 4 analogue inputs to connect traditional sensors. A sealed model is also available.

Technical information and international sales points may be found at www.msr.ch.

Pressure Transducers

Omegadyne announces the most durable version of its high accuracy MM Series micro-machined silicon pressure transducers. The new hermetically sealed version of the MM Series features all welded Stainless Steel construction, 316 wetted parts and glass to metal seals (GMS) at the electrical outlets. This ensures that the unit is hermetically sealed from external environments and the media. Designed for use on automotive and aircraft test platforms and anywhere environmental concerns demand the most durable characteristics.

The sealed MMA500V Series has a micro machined silicon core that provides high accuracy, low drift and excellent long term stability in the harshest environments. Ranges from 100 psi to 5000 psi, accuracies from 0.08% to 0.03% and a variety of pressure and electrical connections make this MMA500V Series Transducer extremely versatile. The temperature compensation range can be as broad as -40 to 200°F (-40 to 104°C) and thermal errors as low as +/- 0.3% over the compensated range. Operating temperature range is -49 to 250°C (-45 to 121°C). The MMA500V Series design is further ruggedized with a secondary containment system in the event of diaphragm rupture. A 5-Point NIST traceable calibration certificate included.

Find more information at www.omega.com

New 2009 Sensor Product Resource Offers Information on Sensing Solution Applications, Products And Programs

Endevco, a Meggitt Group company and a leader in sensing solutions for demanding shock, vibration and pressure applications, has announced publication of its new 2009 Product Resource. The volume is a comprehensive guide including applications, technical specifications and support programs for the company's extensive line of products.

The 2009 Endevco Product Resource offers detailed information on key applications for Endevco sensing solutions in aerospace, automotive, medical, energy, and test and measurement. It also provides specifications for the company's piezoresistive accelerometers, piezoelectric accelerometers, variable capacitance accelerometers, Isotron accelerometers, piezoresistive pressure sensors, signal conditioners, amplifiers and cables. In addition, information is included on the Endevco Guaranteed In-Stock and Replacement Sensors programs.

To view the 2009 Endevco Product Resource online or order a hard copy, go to <http://endevco.com/resources/Catalog.aspx>. For complete information on Endevco products and services, visit www.endevco.com.

Micro Color Vision Systems

Cognex® Corporation announces three new color vision systems for the In-Sight® Micro product line. Building on last year's introduction of the small vision system, the In-Sight Micro, this new release provides a complete suite of color models within this product family.

The entry level In-Sight Micro 1100C model provides a highly capable, standard (640 x 480) resolution color vision system at a competitive price. The high performance In-Sight 1400C model doubles the processor performance for more demanding applications. And, the new In-Sight 1403C model is a two megapixel (1600 x 1200 resolution) system that enables high resolution inspection for a wide variety of color applications.

In addition to the new color vision systems, Cognex is announcing the release of In-Sight Explorer version 4.3 software. This release introduces two powerful new color tools to the industry-leading library of vision tools. The Color Match tool is a high speed color sortation tool that brings the power of 24-bit color resolution. The Color Extract tool allows users to quickly train highly complex color models for state-of-the-art color analysis.

In-Sight Explorer 4.3 software also brings six new vision tools and twenty-two filters to the EasyBuilder® configuration environment. In addition, support for two communications protocols, CC-link and MC Protocol, used predominately by Mitsubishi Electric's automation sequencers, has been added to the extensive list of communication capabilities available in In-Sight vision systems.

For more information and to download trial software, visit www.cognex.com/micro.

Embedded Modem Card Enables Cellular Connectivity for Remote G3 Series Operator Interface Applications

Red Lion Controls, Inc. announces the G3GSM - GSM Cellular Modem card for their G3 line of HMIs. The G3GSM allows the G3 operator interface products to communicate with operators via cellular technology, providing unprecedented connectivity for remote and mobile applications. The expansion card is easily configured with Red Lion's free Crimson® software, and uses a SIM card— allowing customers to choose their own cellular provider.

Upon establishing a cellular connection to a G3 with G3GSM installed, users can take advantage of the G3 series unprecedented remote capabilities:

- A built-in web server allows viewing of the same screens that are displayed on the G3 or viewing of data only or logged files
- Ability to upload/download G3 databases without being onsite
- The G3 will auto-dial to send out alarm or event information via text message to a cell phone or email address, or to send scheduled backup of logged data to an FTP site or email address
- A powerful port-sharing feature allows many PLCs and other attached devices to be remotely reprogrammed through the G3, eliminating the need to be onsite

With the G3GSM and required SIM card, users can choose the cellular provider and plan that best meets their level of desired connectivity—either on-demand or permanent. The on-demand connection is established only when the G3 needs to perform a function of sending or receiving data and is usually less expensive than the permanent connection which is continually established and requires a fixed URL and/or an IP address.

For more information go to www.redlion.net.

New Frequency Tailored Pressure Sensors

PCB Aerospace & Defense announces a new frequency tailored ICP[®] and charge output piezoelectric pressure sensors, Series 113B and 102B. The new quartz dynamic pressure sensors have an extremely fast 1 micro-second response time, with resonant frequencies above 500 kHz. Frequency tailoring, a combination of mass balancing and microelectronics, provides a fast response to shock waves without the high ringing amplitudes experienced with general purpose piezoelectric sensors or resistive silicon semiconductor sensing technologies.

Each sensor is 100% in-process tested for resonant frequency, rise time, and acceleration compensation, and are supplied with NIST traceable, A2LA accredited calibration to ISO17025. Optional gas driven shock-tube response curves can be provided upon request. The sensors are ideal for measuring blast over-pressure and explosion pressure in free-field or closed arenas to obtain peak pressure, total impulse, shock wave and time-of-arrival measurements often used to study blast effects on structures, vehicles, and other surrounding objects. Frequency tailoring allows the sensors to capture both peak pressure and total impulse calculations. Other applications include pulsations, closed bomb combustion, airbag testing, pneumatic, hydraulic, fluid, and other such dynamic pressures.

ICP[®] technology features integral microelectronics that provides a high signal-to-noise ratio compared to resistive silicon semiconductor sensing technologies, which require external amplification. The high-level 5-volt output signal is capable of driving long cable runs, hundreds of feet in length, to a safe zone for data acquisition. Solid-state construction, hermetically-sealed housings, and laser-welded flush diaphragms provide undistorted high frequency response and durability, even in adverse environmental conditions. PCB[®] Series 113B and 102B pressure sensors are available with dynamic ranges to 15 kpsi (103 MPa) and sensitivities to 100 mV/psi (14.5 mV/kPa). Stock models and alternate mountings are available.

For more information please visit www.pcb.com.

New Linear Magnetic Encoders for Harsh Environments

Renishaw LM13 linear magnetic encoders bring big performance to small spaces and tough applications. Consisting of only a read head and separate self-adhesive scale, the LM13 gives OEM designers an ultra-compact package that's ideal for industry's toughest applications in woodworking, metalworking, stone cutting, paper converting, packaging, plastics processing, laser/flame/water-jet cutting, chip/board production or assembly and packaging machinery. Magnetic sensing delivers dependability in applications too dusty, dirty, greasy or destructive for optical encoders.

Engineered for extreme service, LM13 encoders handle operating temperatures from -10°C to 85°C, providing waterproof sealing to IP68 and high resistance to shock, vibration and pressure. Frictionless operation eliminates wear, while reducing system inertia and hysteresis for high precision at high speeds and acceleration loads. LM13 encoders produce a digital, square-wave signal output to RS422, with customer-selectable resolution of 1, 2, 5, 10, 20, 25, 50, 125 and 250 µm. The encoder comes with bidirectional reference that can be actuated by a preset mark integrated into the scale, or by adding a reference sticker on top of the scale using the self-aligning installation tool.

Simple to install, the LM13 features integral go/no-go LEDs on the read head, wide installation tolerances, and an applicator tool for the adhesive-backed scale. The scale is available either “cut to length” or in lengths up to 100 m in easy-to-handle coils.

For more information on the LM13 linear magnetic encoders visit Renishaw's web site at <http://www.renishaw.com/encoders>.

Awards

I&MS Fellows in 2009

The IEEE Fellows Program was established to recognize and honor outstanding members for their significant accomplishments in the advancement or application of engineering, science, and technology and for their contributions to the mission of the IEEE: to advance global prosperity by fostering technological innovation, enabling members' careers and promoting community worldwide.

The IEEE Fellows are an elite group from around the globe. The IEEE looks to the Fellows for guidance and leadership as the world of electrical and electronic technology continues to evolve.

The Instrumentation and Measurement Society Fellows Identification and Evaluation Committees identify candidates, gather references from their peers, and submit detailed applications to the IEEE Fellow Committee in a confidential process typically extending over several years. After a further rigorous evaluation and selection process by the IEEE Fellow Committee, each year a slate of candidates for elevation to Fellow is proposed to the IEEE Board of Directors for approval.

Per IEEE rules, the number of successful candidates, in any year, must not exceed one-tenth percent of the IEEE voting membership on record as of 31 December of the preceding year. This year 302 Fellows were elevated from approximately 302,000 members. Five I&M Society members were elevated this year from 4,455 members. IEEE Fellows receive a certificate and pin.

The Instrumentation and Measurement Society members elevated to Fellow in 2009 are:



Pasquale Daponte

University of Sannio, Benevento, Italy

For contributions to the metrology and standardization of analog to digital and digital to analog converters.

Pasquale Daponte (M '91, SM '99, FM '09) obtained his bachelor's degree and master's degree *cum laude* in Electrical Engineering in 1981 from University of Naples, Italy. He is a Full Professor of *Digital Signal Processing and Measurement Information* at

University of Sannio, Benevento. Since 1992 he has been a member of the Board of the Electrical and Electronics Measurement Group.

He is chairman of the IMEKO Technical Committee TC-4 Measurements of Electrical Quantities and coordinator of the IMEKO Working Group on ADC and DAC Metrology.

Mr. Daponte is a member of the AdCom of the IEEE Instrumentation and Measurement Society, the Editorial Board of the Measurement Journal (Elsevier), of IEC SC47A Semiconductor Devices, of the IEEE Instrumentation and Measurement Society TC-10 Subcommittee for Waveform Measurements and Analysis, Editor of the new draft IEEE-1658 Standard for Terminology and Test Methods for Digital-to-Analog Converters, a member of the Italian Electrical Engineering Association, and a member of the International Society for Ultrasonic Diagnostics in Ophthalmology.

He has organised national and international meetings in the field of Electronic Measurements and European co-operation and he was General Chairman of the IEEE Instrumentation and Measurement Technical Conference for 2006.

He is Vice Rector for International Relations of the University of Sannio and is involved in several European projects.

Mr. Daponte has published more than 220 scientific papers in journals and at national and international conferences on ADC and DAC Modelling and Testing, Digital Signal Processing, and Distributed Measurement Systems.

In 1987 he received the Italian Society of Ophthalmology (SOI) prize for his studies on the digital signal processing of ultrasound in echo-ophthalmology.

He received the Laurea Honoris Causa in Electrical Engineering from Technical University Gheorghe Asachi of Iasi (Romania).



Abdulmotaleb El Saddik

University of Ottawa, Ontario, Canada

*For contributions to interactive haptic
audio visual systems.*

Abdulmotaleb El Saddik is University Research Chair and Professor, SITE, University of Ottawa and recipient of the Professional of the Year Award (2008), the Friedrich Wilhelm-Bessel Research Award from Germany's Alexander von Humboldt Foundation (2007) the Premier's Research Excellence Award (PREA 2004), and the National Capital Institute of Telecommuni-

cations (NCIT) New Professorship Incentive Award (2004).

He is the director of the Multimedia Communications Research Laboratory (MCRLab). He is a Theme co-Leader in the LORNET NSERC Research Network. He is Associate Editor of the ACM Transactions on Multimedia Computing, Communications and Applications (ACM TOMCCAP) and IEEE Transactions on Computational Intelligence and AI in Games (IEEE TCIAIG) and Guest Editor for several IEEE Transactions and Journals. Dr. El Saddik has been serving on several technical program committees of numerous IEEE and ACM events. He has been the General Chair and/or Technical Program Chair of more than 20 international conferences symposia and workshops on collaborative haptic-audio-visual environments,

multimedia communications and instrumentation and measurement. He was the general co-chair of ACM MM 2008. He is leading researcher in haptics, service-oriented architectures, collaborative environments and ambient interactive media and communications. He is the founding chair of the IEEE I&M International Workshop on Haptic Audio Visual Environments. He has authored and co-authored two books and more than 200 publications. He has received research grants and contracts totaling more than \$10 million and has supervised more than 90 researchers. His research has been selected for the BEST Paper Award three times. Dr. El Saddik is a Senior Member of ACM, and an IEEE Distinguished Lecturer.



Matteo Pastorino

University of Genova, Italy

*For contributions to analysis of
electromagnetic scattering.*

Matteo Pastorino is a Full Professor of Electromagnetic Fields at the University of Genoa, where he is the Director of the Department of Biophysical and Electronic Engineering (DIBE). He teaches the university courses of Electromagnetic Fields, Antennas, and Remote Sensing and Electromagnetic Diagnostics.

His main research interests are in the field of electromagnetic direct and inverse scattering, nondestructive testing and evaluation, microwave imaging, antennas and bioelectromagnetics.

Professor Pastorino is coauthor of over 300 papers in international journals and international congress proceedings. He is the leader of the local unit of the Italian Electromagnetic Society (SIEM). He is a member of the AdCom of the IEEE Instrumentation and Measurement Society, an Associate Editor of the IEEE Transactions on Instrumentation and Measurement, an Associate Editor of the IEEE Transactions on Antennas and Propagation, and a member of the editorial board of other international journals and congresses in the area of microwaves and antennas.



Dario Petri

University of Trento, Italy

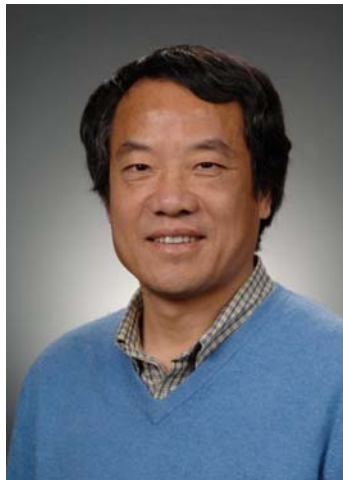
*For contributions to digital signal
processing techniques for instrumentation
and measurement.*

Dario Petri received the Laurea degree (summa cum laude) and the Ph.D. degree in Electronics Engineering from the University of Padova, Italy, in 1986 and 1990, respectively. From 1990 to 1992 he was with the Department of Electronics and Information Engineering of the same university as an assistant professor.

In 1992, he joined the University of Perugia, Italy, as an associate professor where he was the chairperson of undergraduate and graduate degree study programs in Information Engineering since 1999. In the same year, he was elevated to full professorship of Measurement and Electronic Instrumentation. In 2002 he joined the Department of Information Engineering and Computer Science of the University of Trento, Italy, where he was the chairperson of the International Ph.D. School in Information and Communication Technology from 2004 to 2007. He has been chair of the North Italy Chapter of the IEEE Instrumentation and Measurement Society since 2006. At present, he is the chairperson of undergraduate and graduate degree study programs in Information Engineering of the University of Trento.

Dr. Petri is author and co-author of almost two hundred papers published in international journals or in proceedings of peer reviewed international conferences. Research activities of Dario Petri are in the area of measurement science and technology, and they are focused on uncertainty evaluation methods, data acquisition systems design and testing, embedded systems design and characterization, statistical inference methods and application of digital signal processing to measurement problems.

Dario Petri is a Fellow member of the IEEE and an Associate Editor of the IEEE Transactions on Instrumentation and Measurement.



Yicheng Wang

National Institute of Standards and
Technology
Gaithersburg, Maryland, USA

*For contributions to precision electrical
measurements in realization of the
International System of Units Farad and
Ohm.*

Yicheng Wang (M'96-SM'03-F'09)
graduated from Zhejiang University in
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1982. He received a Ph.D. degree in atomic
physics from the College of William and
Mary, Williamsburg, VA, in 1987.

After receiving his Ph.D. degree, he continued at the College of William and Mary as a Post-Doctoral Associate until 1989. From 1990 to 1996, he was a Research Staff at the Notre Dame Radiation Laboratory, U.S. Department of Energy. In 1996, he joined the National Institute of Standards and Technology, Gaithersburg, MD, where he has been working in the Quantum Electrical Metrology Division and where he is now Leader of the Farad and Impedance Metrology Project. His current work focuses on precision ac measurements and fundamental electrical units. He has served in the IEEE Power Engineering Society and shared a Working Group Recognition Award for Outstanding Technical Report. He currently chairs the TC-2 (DC-Low Frequency) of the IEEE I&M Society. He has been invited to serve on assessment teams for KRISS (Korea Research Institute of Standards and Science), South Korea, NRC (National Research Council), Canada, and CENAM (National Metrology Center), Mexico. His work has been recognized with a U.S. Dept. of Commerce Bronze Medal. He has more than 55 archival publications covering broad areas including atomic physics, scientific instrumentation, plasma chemistry, partial discharges, and fundamental electrical standards.

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