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Sensors and Sensor Networks

From the Editor's Bench

Shlomo Engelberg

The Magnificent Mediterranean

Recently, my family and I camped out on the beach at Beit Yannai, Israel. While standing in the waves with my children, nieces, and nephew, I looked out over the Mediterranean Sea (while keeping a close eye on the children, of course). Watching and feeling the waves, I was swept away by the power and grandeur of the sea. Feeling the strength of the waves and considering that such waves beat against coasts the world over, I could only hope that someday we engineers will find an efficient way to harness the energy in all those waves. Also, as someone who once spent a lot of time working with non-linear partial differential equations, I thought about some of the difficulties encountered when trying to produce a good mathematical model of waves. After considering these points, I realized that my feelings here were quite similar to my feelings when exploring other parts of the natural world: a mix of awe in the presence of something so beautiful and powerful and of the desire to understand, usually through the use of mathematics, the phenomenon being explored.

When speaking to non-engineers or engineering students about what we do, it is important to convey the grandeur of the subjects we study and to give our listeners a feeling for the tools we use to perform these studies. For example, people need to be reminded of what electricity is, and reminding them of what they feel while observing a thunderstorm may help. As for the tools of our trade – for some of us, the tools are largely different types of equipment: oscilloscopes, spectrum analyzers, and network analyzers to name just a few. For others, the tools are often the various types of mathematics and the more theoretical tools used in some parts of engineering. In either case, we need to cause the grandeur of the forces we work with to be associated with the work we do.

In this month's issue, we have articles that introduce several beautiful areas of engineering and the techniques used to understand them. We have articles about: MEMS biomedical sensors; about gallium nitride-based sensors; about some of the issues involved in designing wireless sensors; and one that describes how measuring certain physiological signals of children with autism can be useful. This issue also contains the second part of a tutorial series that describes some of the issues engineers face when installing equipment outdoors and, as always, a nice assortment of columns.

Enjoy!

Shlomo

President's Perspectives

Jorge Fernández Daher

A Life of Opportunities

My first job was at the National Electrical Metrology Laboratory of Uruguay, more than thirty years ago. That was really a privilege because I had just finished my first year in the university, and I had the chance to learn from both worlds: the academic and the practical world of electrical measurement. At that time, it was not easy to acquire sophisticated and precise instruments, so from time to time we had to develop our own instruments or devices. It was very interesting to try to solve real problems at work with the tools we were taught in the university. Most of the time, we had to learn independently. We tried new techniques in the field and questioned each result we obtained. I was fascinated by the mysteries of measurements.

After seven years, I was privileged to attend an IEEE Conference for the first time. It was a new world for me, and I was very enthusiastic about becoming part of it. I met with two of my colleagues during the conference, and we decided to create an IEEE Section when returning home. After some months of hard work, we finally established the IEEE Uruguay Section. Soon afterwards, we created an instrumentation and measurements local chapter, and we held very successful conferences and different kinds of activities for our members.

A few years ago, I was very surprised when I received an invitation to be part of the slate of candidates for the Instrumentation and Measurements Society Administrative Committee (AdCom). Once again, I felt privileged, and I accepted. Fortunately, I was elected by the members of the society, and I started working in the AdCom. I was very enthusiastic and decided to be part of the membership development committee. It gave me the opportunity to get to know many people from very different regions of the world. At that time, we started developing new offers to our members like educational resources, awards, and incentives. We tried to help our volunteers in many countries to create local chapters and organize as many activities as possible. It was thanks to the wonderful group of people, members of the AdCom, that we were able to achieve our goals.

But that was not the end. Imagine how surprised I was when in our last AdCom meeting I learned that my friends were proposing me as president of the society. I never imagined that I could ever become president of this society. I have no words to describe my happiness. I was very grateful to my friends who trusted me, but I was also scared because the responsibilities are weighty. I cannot disappoint them or you, the members of the society. I soon remembered my first days at work trying to measure millivolts in a high voltage laboratory and trying to connect to instruments through IEEE 488. That was also demanding, but I managed thanks to the group of people with whom I worked.

I would like to tell you that the world of IEEE and particularly the I&M Society is fascinating. Being a member of the IEEE and the I&M Society is not just receiving magazines. It has more to do with participation and networking with colleagues all over the world. Membership provides us with great opportunities to develop our careers. The officers in the AdCom are working on a list of plans to help you increase your knowledge. We would like to improve our relation to industry, we would like to increase what we can offer to students, and we are developing more educational resources than ever. Two years ago we created the Education Committee in our AdCom, and an important part of our budget is dedicated to it. This shows you the importance we place on education in our plans. Measurements are present in every engineering practice, and I think we can help other professionals in their daily activities. I also believe that measurements have a great impact on society. We have to show society how to use measurements to make this

a better world for all of us. This is a real challenge to us, so I kindly invite you to talk to us, participate in your local organizations, suggest new ideas for activities, and also tell us about improvements that should be made. I am sure that only with your help, we can strengthen our Society.

Now, I thank my colleagues who introduced me to the world of instrumentation and measurements thirty years ago and my friends at the AdCom who have entrusted me with the society's presidency at this critical juncture.

Jorge

Article Summaries

Recent Advances in MEMS Sensor Technology – Biomedical Applications

(Summary)

Farbod Khoshnoud and Clarence W. de Silva

This article is the first part of a three-part series on MEMS sensors. Here, the authors provide a general introduction to MEMS sensing and the primary sensing techniques. MEMS-based bio-medical sensors are explained, including MEMS devices that are: designed to detect triglycerides, c-reactive protein, and glucose; bio-inspired robotic fingers with tissue softness characterization sensors for pressure measurement during surgical procedures; for counting blood cells; acoustic sensors for 2-D sound source localization; pressure measurement sensors on the wings of an insect-like flying robot; and ultra-miniature sensors for intramuscular pressure measurement.

This summary includes text from the article.

Gallium Nitride-Based Gas, Chemical and Biomedical Sensors

(Summary)

S. J. Pearton and Fan Ren

This article summarizes recent progress in AlGaN/GaN HEMT sensors. These devices make use of the advantages of microelectronics, including high sensitivity, possibility of high-density integration, and mass manufacturability. The goal is to realize real-time, portable and inexpensive chemical and biological sensors and to use these as handheld exhaled breath, saliva, urine, or blood monitors with wireless capability. Limitations of these sensors in current applications are discussed, including the need for: sensors that are sensitive to certain antigens (such as prostate or breast cancer) and allow sensing in body fluids (urine, saliva) other than blood; a sandwich assay allowing the detection of the same antigen using two different antibodies (similar to ELISA); and designs with multiple sensors on a single chip with automated fluid handling and algorithms to analyze multiple detection signals.

Issues in Designing Practical Wireless Sensors

(Summary)

Bill Nickerson

This article outlines design considerations that will contribute to making practical wireless sensors a reality in widespread applications. These issues include the systems' power demands, its security and encryption capability necessary to protect the integrity of the data transmitted, and its ability to incorporate robust data authentication. The author describes that only through experience, will decision makers gain sufficient trust to authorize wide-spread deployment just as we've observed for mobile phones and wireless LAN technology.

Physiological Signals of Autistic Children Can be Useful

(Summary)

Karla Conn Welch

This article covers the latest research concerning the measurement of physiological signals of children with autism, particularly for the study of changing emotions in various environments. Within a non-social environment, physiological responses are the same between children with and without autism but different in environments with social contexts, and physiological signals can be used as a reliable indicator of emotions of children with autism. The latest developments in wearable sensor technologies available for measuring on-the-go are described.

Practical Issues for Installing Instrumentation Outdoors, Part 2: Tutorial 37

(Summary)

Kim Fowler and Michael F. Gard

This tutorial is the second of a two-part series on the challenges of installing instrumentation outside in the wild. The first part introduced problems with physical extremes and attacks by insects, animals, and human beings. In this part, we follow up with solutions for: environment-appropriate packaging; cables and connectors; electromagnetic compatibility (EMC); conditions

that may apply to mechanical movement of the system; some aspects of power and cooling which include batteries, other energy sources and energy storage, types of power distribution and a few case studies; installation of the system; operation of the system; maintenance; disposal; and cost considerations.

This summary includes text from the article.

Columns

Instrumentation Notes

Compressive Sensing

(Summary)

Shlomo Engelberg

In this brief introduction to compressive sensing, the author presents one technique and a simple application to demonstrate that there are "exceptions" to the Nyquist sampling theorem. Under certain conditions, even when the Nyquist sampling theorem says that a sensor needs to store N samples of a signal per second, compressive sensing lets the sensor store M<<N linear combinations of samples per second.

This summary includes text from the article.

Recalibration

The Evolution of Time Measurement, Part 4: The Atomic Second

(Summary)

Michael Lombardi

This article is the fourth of five installments of a discussion on the measurement of time throughout history. In this article, the author discusses the transition from astronomical time units to atomic measurements and how their amazing accuracy and stability was revolutionary. Even so, an atomic clock still needs to be synchronized to a reference source before it can be used to keep time.

This summary includes text from the article.

Departments

New Products

Robert Goldberg

New Mixed Domain Oscilloscope Combines Scope and Spectrum Analyzer Functionality in Single Instrument

Tektronix, Inc. introduces the world's first mixed domain oscilloscope (MDO) that delivers the functionality of an oscilloscope and a spectrum analyzer in a single instrument. The new MDO4000 Mixed Domain Oscilloscope Series gives engineers the unique ability to capture time-correlated analog, digital and RF signals for a complete system view, helping them to rapidly solve complicated design issues.

More than sixty percent of oscilloscope users also use a spectrum analyzer to troubleshoot embedded system designs with integrated wireless functionality, requiring them to work in both the time and frequency domain. Traditionally, an engineer was either a mixed signal/digital engineer or an RF engineer. But with wireless becoming more commonplace, design engineers must often work in both domains.

The MDO4000 Mixed Domain Oscilloscope Series is the first oscilloscope ever to integrate the functionality of a spectrum analyzer to provide a unique toolset which will save days or even weeks of debugging time. With the MDO4000, engineers can replace both a scope and spectrum analyzer with a single instrument. This enables them to continue using their tool of choice, the oscilloscope, to look at the frequency domain rather than having to find and relearn a spectrum analyzer. Also, the MDO4000 goes well beyond typical spectrum analyzer functionality by allowing users to capture time-correlated analog, digital and RF signals across 1 RF, 4 analog, and 16 digital channels.

The RF input frequency range extends up to 6 GHz and provides a capture bandwidth of ≥1 GHz at all center frequencies, 100 times wider than typical spectrum analyzers. Users can even see up to 4 decoded serial and/or parallel buses at one time on the same display. Due to this time correlation between domains, engineers can now make accurate timing measurements to understand delays and latencies between command/control events in their design and changes in the RF spectrum.

The MDO4000 also allows designers to see the RF spectrum of a signal at any point in time within a long acquisition to see how the spectrum changes over time or with device state. By simply moving the unique and patent pending Spectrum Time throughout the time domain acquisition, designers can see the RF spectrum for any point in their acquisition while simultaneously seeing their analog, digital and/or decoded buses at the same point in time.

Find more information at www.tektronix.com.

Fast, Precise, Multiport Network Analysis

The latest generation network analyzer from Rohde & Schwarz now comes with four test ports and a second internal generator. Users who need to characterize multiport DUTs, mixers and amplifiers will benefit from the extremely wide dynamic range, short measurement times and exceptionally easy operation.

The new four-port R&S ZNB models cover the frequency ranges from 9 kHz to 4.5 GHz or 8.5 GHz. Rohde & Schwarz has designed the powerful instruments for demanding applications in the production and development of RF components with multiple ports. Two internal signal

sources and a frequency converting mode enable comprehensive measurements on mixers or amplifiers. Using mixed-mode S-parameter measurements, the R&S ZNB fully characterizes even balanced DUTs such as the SAW filters used in mobile phones.

For balanced measurements, the network analyzer determines the mixed-mode S parameters without using external baluns. Extensive analysis functions make it possible to display the desired measured quantity directly on the screen in real-time. External post processing is not necessary.

The four-port network analyzer can also be used to measure high-blocking duplex filters, couplers, splitters or isolators. They need only be connected once to the R&S ZNB. In addition to mixer conversion loss and impedance matching, users can determine virtually any secondary measured quantities, including crosstalk between ports. With R&S ZNB's second internal source, intermodulation measurements on amplifiers can be configured with a single, compact instrument – and considerably faster than would be possible using an external generator.

All of R&S ZNB models feature a wide dynamic range of more than 140 dB, low trace noise, IF bandwidths of 1 Hz to 10 MHz and an output power of up to +13 dBm, which can be lowered electronically by 100 dB. Therefore, the network analyzer ensures high throughput and short measurement times, which makes manual adjustment significantly easier, even with high signal attenuation. Due to the large touch screen (12.1 in / 30.1 cm), configuring and analyzing are particularly easy. All instrument functions are accessible in no more than three operating steps via the soft panel. A toolbar and drag & drop functionality allow users to configure the R&S ZNB very quickly. Users can switch between measurement setups at the touch of a finger.

Find more information at www.rohde-schwarz.com.

Audio Analyzer with New Digital Audio Interface Options

Agilent Technologies, Inc. introduces the enhanced Agilent U8903A audio analyzer with new digital audio interface options. These options expand the U8903A's capabilities with AES3, SPDIF and DSI (digital serial interface) formats for versatile, high performance analog and digital audio testing.

The DSI format offers four sub-formats, I2S, Left Justified, Right Justified and DSP, allowing R&D engineers to analyze and verify a wide range of digital audio applications. The upgraded U8903A audio analyzer contains the full functions of analog domain and digital domain audio measurement in a single unit, letting engineers and technicians quickly perform complex cross-domain measurements in industries such as IC component and module design, wireless communications and consumer audio.

The U8903A offers a wide logic level input range of 1.2 V to 3.3 V and lets users set the logic level to any value within that range. This permits the U8903A to support and test future designs with continuously smaller logic levels in addition to the majority of current digital audio ICs.

Built for ease of use, the U8903A is equipped with a 5.7-in (14.5 cm) color screen (capable of displaying up to four channel results simultaneously) and one-button access to four main operating modes through the front panel soft keys.

Information about the U8903A audio analyzer and the new digital audio interface options is available at www.agilent.com/find/audioanalyzer.

Battery Powered Microohmmeter

TEGAM, Inc. has expanded its line of microohmmeters with the development of the Model 1750/BAT. Based on the design of the highly successful Model 1750, the battery powered version fills a need in the aerospace industry as it replaces the discontinued Keithley 580 for testing electrical and mechanical bonds. The Model 1750/BAT has an internal Lithium ion battery pack sized to run for a full day of typical use. The recharge time is 8 hours with an input voltage range of 90 to 250 Vac, 50- 400 Hz. The 1750/BAT has measurement ranges from 2 mΩ to 20 MΩ with a resolution as low as 100 nΩ while automatically correcting for offset errors common in low resistance circuits. Additionally, there is a wide range of probe styles offered to make proper measurements in a diverse set of circumstances.

For more information, please visit www.tegam.com.

MEMS Capacitive Accelerometer Family

Kistler has introduced its K-Beam® high-sensitivity, low-noise MEMS capacitive accelerometer family. The K-Beam family is designed to support single axis and triaxial measurement requirements where high precision, low-frequency measurements are required.

The K-Beam family is offered in ranges from ±2 g to ±200 g and with frequency response from DC to 1000 Hz (5%). Accelerometers are available in four different models of either single axis (Type 8315) or triaxial (Type 8395A) versions and incorporate a MEMS variable capacitance sensing element, consisting of a small inertial mass and flexure element sandwiched between two parallel plates (electrodes). As the mass deflects under acceleration, the capacitance between the sensing element and plates changes, which is then converted to a proportional voltage by the internal analog signal conditioner.

All of the units offer excellent thermal stability and reliability over an operating temperature range of -65 °F to +250 °F (-55 °C to +125 °C), with 6,000 g pk shock survivability. The Type 8315 single axis version features a 1-in (25.4 mm) footprint and is powered by a single wide range supply between +6 and +50 Vdc. Type 8315 models are offered with three different housing options (AC, TA, TB), which determine available output signal formats. The AC option features a lightweight, hard anodized aluminum housing with environmental sealing, integral ground isolation, epoxy seal and integral PVC cable, with a maximum operating temperature of +185 °F (+85 °C). Available AC option output signal formats are: bipolar at 0±4 V, single ended 2.5 V±2 V, or differential 0±8 V. Series TA and TB options feature lightweight, welded titanium housings with a choice of 4-pin, ¼-28 connector or integral Teflon jacketed cable, for a fully hermetic design with integral ground isolation.

The Type 8395A triaxial version is designed to simultaneously measure acceleration and low-frequency vibration in three mutually perpendicular axes (x, y and z) with a compact design that occupies a 0.85-in (21.6 mm) cube footprint. The output format of the Type 8395A series is bipolar at 0±4 V and provides a high-sensitivity, low-noise signal that is compatible with a variety of data acquisition or readout devices.

For additional information, visit www.kistler.com.

Digital Pressure Gage

OMEGA is now offering new ranges on its DPG409 Series digital pressure gages. In addition to Gage and Absolute pressure ranges, new models are now available with:

- Sealed Gage ranges from 100 to 5000 psi
- Compound Gage ranges from +/- 10 inH2O to +/-15 psi
- Vacuum (negative gage) Ranges from 0 to -10 inH2O to 0 to -15 psi
- Barometric Ranges from 0 to 1100 hPa to 880 to 1100 hPa or 0 to 32 inHg to 26 to 32 inHg.

Omega's new DPG409 series of high accuracy digital pressure gages feature a large backlit display that makes it possible for the user to read digits from over 10.7m. The rugged Stainless Steel enclosure is designed specifically for wash-down, sanitary and marine applications.

This DPG409 has also been tested to Industrial CE specifications. Ranges from Vacuum to 5000 psi are available, and all units include setup software which allows for fast installation and calibration via a USB connection. The Wireless Transmitter Option sends readings to remote locations and permits PC-based chart recording and data logging.

For further information, visit http://www.omega.com/ pptst/dpg409.html.

Advanced Brake Pad Pressure Measurement System Captures Dynamic Pressure Data

Pressure Profile Systems, Inc. (PPS) introduces the Dynamic Brake Pad Pressure Measurement System (DBPPS) which captures pressure distribution between a brake pad surface and a spinning rotor during actual braking. Detailed and dynamic pressure data has helped automotive engineers evaluate brake pad performance and improve brake pad designs.

PPS originally developed the DBPS to help a leading automobile manufacturer test brake pad designs and their wear-and-tear. PPS developed sensors that were embedded within brake pads for measuring dynamic pressure distribution. The sensors included an integrated thermocouple that, when combined with PPS visualization software and signal conditioning electronics, is capable of compensating for the extreme temperature changes developed during deceleration. By understanding dynamic brake pad pressure distribution, the manufacturer was able to select the best brake pad designs and materials for their vehicles.

Key System Features:

- Measures pressure distribution during braking while the rotor is spinning with no need to slow down or cool off
- Thermal compensation for accurate data collection
- Industrial Kapton® construction for pressure measurements in high-temperature and high-pressure environments

Key System Components:

- Two dynamic brake pad sensors with 1.5 m cable
- Embedded thermocouple for managing temperature transients
- Signal conditioning electronics with USB connection to PC
- Chameleon TVR software for real-time visualization and data acquisition
- API for integration into Windows-based custom software

For a demonstration of the Dynamic Brake Pad Pressure Measurement System, please call +1 310 641 8100 or email info@pressureprofile.com.

Stamp Sized Reconfigurable IC Module Shortens Time to Market

Imsys announces a new member of its "Simple Network Application Platform", SNAP. This new module – named Stamp for its small size and similarity to a postal stamp – includes everything needed for the intelligent control of a networked final product. Compared to a custom design using an IC, the typical customer's PCB will be simplified and less costly since the main routing, especially the part requiring high density, multilayer technology and attention to EMC issues, has been taken care of.

Perhaps even more important is that any necessary changes to this part, needed for ensuring a long commercial life of the customer product – e.g. design changes motivated by component availability issues – will also be taken care of, including changes to associated firmware. The module is complete with IM3910 MCU, SDRAM, flash memory, 10/100 Ethernet PHY (plus MII interface for a 2nd Ethernet port), 3 UARTs, SPI/I2C, RTC, 8 timers, 8-ch ADC (16 bit), 2 DAC (16 bit), and a high-speed, 83 MB/s data channel.

The module is made for surface mounting (LCC84 standard footprint) and will be delivered on tape for automatic assembly. This is the smallest (29 × 29 mm) and most cost efficient hardware module in Imsys' SNAP family. The SNAP Stamp is based on the Imsys IM3000 family of processors, which can process important routines – among them the Java bytecodes – internally, with dramatically increased efficiency. This allows Java applications to run without the slowness of Java byte code interpretation or the need for a resource-hungry just-in-time compiler.

Firmware and application software can be loaded, managed, and upgraded remotely through the network connection.

For more information, please visit www.imsystech.com.

Handheld Accelerometer Signal Output Simulator and Tachometer

Meggitt Sensing Systems has announced the global market introduction of the Endevco® model 4830A, a handheld, lightweight battery-operated electronic instrument, designed to simulate a variety of transducer outputs. The simulator offers a convenient and portable means of verifying instrumentation settings and cable integrity in aerospace and automotive test cells, as well as other in-laboratory and field testing environments.

Available output signals from the model 4830A include single-ended and differential charge (pC), single-ended voltage (mV) and current-sinking ISOTRON® (IEPE). The further inclusion of a tachometer (TTL) output signal makes the unit a convenient and portable means of on-site instrumentation testing and servicing. Simulated outputs are available in either English or Metric units over an available frequency range of 1 Hz to 10 KHz, with an adjustable output amplitude of up to 10,000 pC or mV pk and with overall noise of <2 mV or 2 pC rms. In addition, the model 4830A uses a menu-driven 80-character LCD display to establish appropriate settings.

The key panel contains four sealed switches (per IP65) marked with arrows for cursor control. In addition to the manual on/off switch, the unit can be set for automatic power shutdown. The last setup is automatically stored within its non-volatile memory.

For detailed technical specifications or additional information, visit www.meggittsensingsystems.com.

Non-Contact Laser Sensor Delivers High-Speed, High-Precision Performance for Challenging Measurement and Quality Control Inspections

Banner Engineering introduces the new L-GAGE LH Series laser sensor, a non-contact measurement sensor designed to provide accurate and stable measurements. The LH Series is used for precision displacement and thickness measurements, developed to solve demanding measurement and quality control inspections on materials such as wood, metal, rubber, ceramic and plastic parts.

Providing high-precision capabilities, the robust, self-contained laser displacement sensor features a 1024 pixel CMOS linear imager that can achieve up to a 1 micron resolution under nominal conditions.

The new LH features target displacement or thickness measurement with high resolution 4-20 mA or RS-485 serial communication outputs. Two sensors can be configured to self-synchronize for thickness measurements—performing the thickness calculation within the sensors—requiring no external controller for operation. The LH can be used in a network of up to 32 sensors, providing the capability to perform multiple, simultaneous inspections. Plus, with a narrow laser spot, the LH easily aligns to the smallest of targets.

The LH sensor comes equipped with an intuitive Graphical User Interface (GUI), which guides the user through setup and performance monitoring when adjusting the sensor parameters. After the LH is installed, the GUI provides data acquisition tools to graphically display the current measurements. Parameters such as analog output scaling, averaging, sample size and other advanced features can all be set within the GUI.

For more information, please visit www.bannerengineering.com. Learn more about displacement measurement with the L-GAGE LH Series laser sensor at the following link: http://www.youtube.com/watch?v=pMgA80BiVf0. Learn more about thickness measurement with the L-GAGE LH Series laser sensor at the following link: http://www.youtube.com/watch?v=Rl0sSI4iZ8U.

Four Port Serial Interface Adds RS-232/422/485 Ports to PCI Express Bus

Sealevel Systems, Inc. introduces the new COMM+4.PCIe serial interface, which delivers the ultimate flexibility for expanding serial communications in a variety of test and measurement, process control, and point-of-sale applications. The COMM+4.PCIe serial interface provides four multifunction serial ports, each individually field-configurable for RS-232, RS-422, or RS-485. Each serial port utilizes a 16C954 UART with 128-byte Tx/Rx FIFOs that enables data rates to 921.6K bps for reliable highspeed communications in data intensive applications.

This high-performance UART includes 9-bit framing support and is register compatible with legacy software applications designed for 16C550 UARTs. In addition, the board derives a 62.5 MHz clock from the PCI Express bus. This ultra-high speed clock is divided by a flexible 8-bit clock prescaler with 1/8 steps to provide support for the widest range of standard and non-standard baud rates.

In RS-485 mode, the board provides automatic control of the RS-485 driver in hardware, allowing the 7404e to be used with standard serial communications without the risk of bus contention and data corruption. Additionally, RS-485 network termination, critical to robust multi-drop communication, can be selectively added to the circuit via DIP-switches.

For more information, visit www.sealevel.com.

New USB Mixed-Signal Oscilloscope

The PicoScope 2205 MSO provides a two-channel oscilloscope combined with a 16‑channel logic analyzer, all in one compact, portable USB instrument. Now you can view analog waveforms and digital data on the same screen with the efficient and easy-to-use PicoScope software. With 25 MHz analog bandwidth, analog sampling rates up to 200 MS/s and 100 MHz maximum digital input frequency, the PicoScope 2205 MSO is suitable for general-purpose analog and digital circuit design, testing, and troubleshooting.

As it is USB-powered, there is no AC adapter to carry; just plug it into your PC or laptop and start the software. The included PicoScope software delivers a high-resolution, uncluttered display and a range of advanced signal processing features: spectrum analyzer, automatic measurements with statistics, channel math, reference waveforms, multiple scope and spectrum views, I2C, UART, SPI and CAN bus serial decoding, XY mode, advanced triggers, mask limit testing, and color persistence display modes.

The Software Development Kit (SDK), also included, allows you to control the new scopes using your own software. The SDK and PicoScope are compatible with Microsoft Windows XP, Vista and Windows 7. Example programs in C, Excel and LabView are included.

More information on Pico Technology can be found at www.picotech.com.

TC News

John Schmalzel

Technical Standards Activities:

The "How-Tos" of Standards
Technical Standards & Activities and the Role of Technical Committees

Technical Standards & Activities is the component of IMS that is concerned with technical standards and related activities. The action arms are the Technical Committees (TCs), which are formed to develop, maintain, and promulgate those standards and related activities within their chartered focus areas.

To form a TC, a charter proposal is submitted to the AdCom by an interest group for review and approval. Alternatively, the AdCom may elect to charter a TC to capitalize on a perceived standards opportunity. Organizationally, TCs consist of at least a Chairperson, a Secretary, and members. A Vice Chair is recommended as well as a Treasurer if significant funds are involved in the operation of the TC and/or its subgroups.

Standards: A Critical Component of IMS

A brief summary of IMS standards developed by the slate of TCs and an overview of the standards development process follows. The intent is to whet your appetite for participation.

Involvement in standards development has a number of benefits:
- Contributes to the advancement of the state of the art
- Provides professional development
- Affords networking opportunities, and
- Raises the visibility of you, your company, IMS, and IEEE

Standards Sponsorship
The overall development of standards is managed by the IEEE Standards Association (IEEE-SA); Sponsors do the actual development of standards [1]. (Go to Etools and, then My project; access requires your IEEE web account information.) A Sponsor is composed of any of the categories of membership described in IEEE Bylaw I-403. A Sponsor must have a professed interest in the development of standards in technological areas that fall under the general scope of interest to the IEEE.

All IEEE standards development projects must be approved by the IEEE-SA Standards Board, and each project must be managed by a Sponsor. Sponsors of IEEE standards projects are committees with responsibility for the development and coordination of the standards project and the maintenance of the standard after approval of the standard by the IEEE-SA Standards Board.

IEEE-SA defines Sponsors as being any of the following:
- A Technical Committee within an IEEE Society/Council
- A Standards Committee or Standards Coordinating Committee (SCC) of an IEEE Society/Council
- An SCC established by the IEEE-SA Standards Board
- A Standards Subcommittee organized by or reporting to one of the above or
- Other organizations as recommended by the IEEE-SA Standards Board and approved by the IEEE-SA board of governors

IMS TCs with Standards
- A list of the IMS Society's nearly 40 TCs, their missions, and Chairs is maintained on the IMS website [2]. Once formed, a TC is reviewed biennially to determine vitality and relevance; low-activity TCs are sunsetted. A number of the Society's TCs are actively engaged in standards development work:

TC-4, High Frequency Measurement
- IEEE STD P378, Draft Standard for Recommended Practice for Scattering Parameter Measurements and Uncertainty Analysis Using Network Analyzers

TC-8, Automated Test Systems and Instrumentation
- IEEE Std 488.1-2003, IEEE Standard for Higher Performance Protocol for the Standard Digital Interface for Programmable Instrumentation
- IEC 60488, IEC/IEEE Standard for Higher Performance Protocol for the Standard Digital Interface for Programmable Instrumentation - Part 1: General (Adoption of IEEE Std 488.1-2003)
- IEEE Std 488.2-1992, Standard Codes, Formats, Protocols, and Common Commands for Use With IEEE Std 488.1-1987, IEEE Standard Digital Interface for Programmable Instrumentation
- IEEE Std 1155-1992, Standard for VMEbus Extensions for Instrumentation: VXIbus

- IEEE Std 1174-2000, Standard Serial Interface for Programmable Instrumentation

TC-9, Sensor Technology
- IEEE Std 1451.0-2007, Standard for a Smart Transducer Interface for Sensors and Actuators – Common Functions, Communication Protocols, and Transducer Electronic Data Sheet (TEDS) Formats
- IEEE Std 1451.1-1999, Standard for a Smart Transducer Interface for Sensors and Actuators – Network Capable Application Processor (NCAP) Information Model (In revision)
- IEEE Std P1451.2, Draft Standard for a Smart Transducer Interface for Sensors and Actuators Transducer to Microprocessor Communication Protocols and Transducer Electronic Data Sheet (TEDS) Format
- IEEE Std 1451.3-2003, Standard for a Smart Transducer Interface for Sensors and Actuators – Digital Communication and Transducer Electronic Data Sheet (TEDS) Formats for Distributed Multidrop Systems
- IEEE Std 1451.4-2004, Standard for a Smart Transducer Interface for Sensors and Actuators – Mixed-mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats
- IEEE Std 1451.5-2007, Standard for a Smart Transducer Interface for Sensors and Actuators Wireless Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats
- IEEE Std 1451.7-2010, Standard for Smart Transducer Interface for Sensors and Actuators – Transducers to Radio Frequency Identification (RFID) Systems Communication Protocols and Transducer Electronic Data Sheet Formats
- IEEE Std 1588-2008, Standard for A Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
- IEC/IEEE Precision Clock Synchronization Protocol for Networked Measurement and Control Systems (Adoption of IEEE Std 1588-2008)

TC-10, Waveform Generation, Measurement and Analysis
- IEEE Std 181-2003, Standard on Transitions, Pulses, and Related Waveforms
- IEEE Std 1057-2007, Standard for Digitizing Waveform Recorders
- IEEE Std 1241-2010, Standard for Terminology and Test Methods for Analog-to-Digital Converters
- IEEE Std P1658, Draft Standard for Terminology and Test Methods for Digital-to-Analog Converter Devices
- IEEE Std P1696, Draft Standard for Terminology and Test Methods for Electronic Probes

TC-25, Medical and Biological Measurements
- IEEE Std P1721, Draft Standard for Objective Measurement of Systemic Arterial Blood Pressure in Humans

IMS and SCCs
The majority of IMS standards activities occur within the TC framework; however, some TCs participate in a broader SCC activity. One example is the recent migration of TC-8's P1693, "Standard for Modular Interconnect Packaging for Scalable Systems" to SCC20. SCC20 members include several IEEE Societies, DoD, and others.

Standards: The Six Steps
The standards development process consists of six basic steps. A typical timeline is 18-24 months.

1) Project Authorization Request (PAR)

The first step in beginning a standards development project is the submittal of a Project Authorization Request (PAR). The PAR defines the scope, purpose, and contact points for the new project. A PAR is typically brief (1 page) and can be submitted on-line; once approved, the Sponsor Chair and Working Group Chair are informed. The project title will include a P prefix—e.g., P1451.1.

2) Formation of the Working Group (WG)

After a PAR has been approved, a working group (WG) must be formed. Of course, it is very likely that the initial development of the PAR involved the core of a WG. Individual-based IEEE working groups (one individual-one vote) can be comprised of a variety of members; participants do not have to be IEEE or IEEE-SA members. Entity-based IEEE working groups (one entity-one vote) have specific membership requirements for an entity to observe or attain membership and voting rights. Each sponsor has specific rules and procedures for determining the voting rights of the participants. The composition of the WG should reflect the cross-section of stake-holders expected to have an interest in the standard as developers, manufacturers, users, and others.

3) Drafting the Standard

The working group now begins to develop the draft standard. Again, there are likely to already be talking papers, conference publications, etc., that have described some preliminary elements. There are many resources available to help with the standard development process including templates, style manuals, and access to IEEE editorial staff. The conduct of all WG members must follow IEEE-SA guidelines, including review of IEEE Code of Ethics, avoidance of WG domination by a single voice, etc. One important requirement is to maintain vigilance for potential intellectual property issues. WG members will be asked whether they are aware of any patent claims that are potentially essential to implementation of the proposed standard. Once the WG concludes the draft development, the standard is ready to be balloted.

4) Balloting the Standard

Before balloting can begin, IEEE-SA staff completes a mandatory editorial coordination, which includes review of the draft standard and all accompanying support documents such as copyright permission letters, etc. At the end of the review process, the draft can start the balloting process. First, a ballot group is formed, and then a ballot is initiated. Members of the ballot group are given a time frame to complete their review and cast their vote. A number of things can happen. The draft may pass with only minor technical modifications; it may also result in significant modifications. Further balloting can occur as a recirculation ballot. A detailed record of comments and their resolution are maintained. Members of the balloting group can modify their original vote based on changes to the draft. Once the proposed standard has achieved 75% approval after a ballot, subsequent ballots will only focus on changed portions or parts affected by the updates.

5) The Approval Process

Final professional editing takes place after the document is approved to ensure consistency with the broader portfolio of IEEE Standards. Final approval of an IEEE standard is obtained by submitting the final draft document with supporting materials to the IEEE-SA Standards Review Committee, which provides a recommendation to the IEEE-SA Standards Board. The Review Committee meets quarterly. In addition to new standards, The Review Committee is also

responsible for reviewing revised standards projects, reaffirming existing standards, and approving the withdrawal of existing standards. Among the things checked during the review process are the title, fit to the scope stated on the most recently approved PAR, and potential dependencies on other projects. When a standard is approved, the "P" is dropped and a date is appended.

6) Maintaining the Standard

Effective January 2012, the maintenance cycle for standards will be extended from 5 to 10 years. Standards will either be in an active or inactive state. Options for maintenance will include revision or withdrawal. The process for revising an existing standard follows the procedure above—i.e., it begins with a PAR.

Moving On
I have enjoyed the opportunity to manage the TS&A process for the past two years; please join me in welcoming Mihaela Albu as the new VP-TS&A. If you are interested in actively supporting the work of a TC, or if you have other ideas for new standards, please contact Mihaela at albu@ieee.org.

References:
[1] IEEE Standards Association. [Online] Available: http://standards.ieee.org/ .
[2] "Tech Committees," IEEE Instrumentation Measurement Society. [Online] Available: http://ieee-ims.org/main/index.php.

Society News

Join us at I2MTC 2012

Alexandru Nechifor

The annual International Instrumentation and Measurement Technology Conference (I2MTC) is the flagship conference of the IEEE Instrumentation and Measurement Society (IMS). This conference provides a venue for some of the best engineering minds in the field of instrumentation and measurement to meet and discuss their research. This year's I2MTC will take place between the 13th and 16th of May 2012 in Graz, Austria.

The Graduate Student Panel Discussion is organized for students attending I2MTC. Each year, the panel discussion features several talks given by members of industry and academia intended to broaden the attendees' perspective on job opportunities, research and education while facilitating professional networking on an international level. In 2012, a Graduate Student Panel Discussion will be held at I2MTC for the fifth time. The panel discussion is being organized by Alexandru Nechifor, the current graduate student representative to the Administrative Committee (AdCom) of the IEEE IMS.

If you would like to volunteer to join the select group of panelists who have contributed to the panel discussion, please contact Alexandru at alexandrun@ieee.org. Look for more information regarding the 2012 Graduate Student Panel Discussion at I2MTC 2012 in Graz, Austria on the IMS website (www.ieee-ims.org) in the Student Activities area of the Membership Section.

Women in Instrumentation and Measurement Panel Discussion

Kristen Donnell

The Instrumentation and Measurement Society (IMS) strives to continually support the needs of our female members and conference attendees. This year, at the 2012 International Instrumentation and Measurement Technology Conference (I2MTC) in Graz, Austria, the IMS will be offering the Women in Instrumentation and Measurement Panel Discussion.

The Women in Instrumentation and Measurement Panel Discussion will provide an opportunity for conference attendees to address and discuss issues, concerns, and professional topics that are not of a distinctly technical nature. The panel will consist of four female members who work in the field of instrumentation and measurement, encompassing different geographical, technical/career and age groups.

If you would like more information or are interested in serving as a panelist for this inaugural year, please contact Kristen Donnell at kristen.donnell@mst.edu. More information about this exciting event is also available on the IMS website, www.ieee-ims.org, in the Membership Section, as well on the I2MTC 2012 conference website, imtc.ieee-ims.org.