The IEEE Instrumentation & Measurement Magazine
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AUTOTESTCON 2015
Presented Jointly by the IEEE Instrumentation and Measurement and IEEE Aerospace and Electronic Systems Societies

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President's Messages

Welcome to IEEE AUTOTESTCON 2016

On behalf of the IEEE Instrumentation and Measurement Society (IMS), I welcome you to IEEE AUTOTESTCON 2016 in Anaheim, California! It is the premier opportunity to learn about the newly developed and implemented automated testing technologies, meet with colleagues, and make new acquaintances. The long-lasting, collaborative sponsorship of ATC by the IMS and the IEEE Aerospace and Electronic Systems Society (AESS) has been highly successful in fostering the exchange of innovative ideas and information among our two engineering professional societies, government entities, and industry for more than 50 years. The student-travel awards and best-paper awards assist our student members financially in being able to attend, recognize their valuable contributions to emerging technologies, meet, and establish important relationships with professionals in the military and the aerospace industry. There are also a large number of exhibitors that attend to showcase the pioneering ideas developed by researchers come to life in these novel instruments and it is truly exciting!

We also select papers presented at ATC to highlight in the next year's *I&M Magazine*, August issue. So, here are the papers from 2015! We hope you will find the information useful to you. We look forward to seeing you in Anaheim at IEEE AUTOTESTCON 2016!

Ruth A. Dyer

President, IEEE Instrumentation and Measurement Society

As President of IEEE Aerospace and Electronic System Society, I am pleased to be able to join the IEEE I&M Society in welcoming you to this year's IEEE AUTOTESTCON 2016. This incredibly exciting conference brings together students, researchers, academics, government, and industry participants from all over the world in a beautiful setting to discuss the most advanced automated test technologies of our era. Covering Performance Based Logistics, Health Monitoring and Diagnostics, Embedded Instrumentation, Support Economics, and Test & Support Management, the conference provides an excellent venue for dialogue and information exchange on topics that are of significant interest to the Aerospace and Electronic Systems community. System readiness and automatic test are critical components in providing government and military users with equipment that is reliable, dependable, and effective and this conference is precisely the place to be to discover, share, and discuss the latest developments in these areas.

The IEEE AES Society is proud to be a co-sponsor of this conference along with the IEEE I&M Society, with whom we have had the honor of collaborating for many years. Enjoy IEEE AUOTESTCON 2016!

Teresa Pace

President, IEEE Aerospace and Electronic Systems Society

Article Summaries

An Efficient Technique Based on DORT Method to Locate Multiple Soft Faults in Wiring Networks

(Summary)

Moussa Kafal, Andrea Cozza, and Lionel Pichon

Decomposition of the time reversal operator (DORT) recently adapted to wiring fault detection and location presented effectual results when dealing with a single soft fault along with complex network configurations. On the other hand, it failed to handle the task of locating multiple faults within even simple ones. In this article, the authors

propose an enhanced version of the standard DORT technique (EDORT) based on a complementary procedure that enables the accurate and selective location of multiple soft faults in various wiring systems.

This summary includes text from the introduction of the article.

Mitigating the Impact of False Alarms and No Fault Found 16 Events in Military Systems

(Summary)

Mustafa Ilarslan and Louis Y. Ungar

False Alarms (FAs) and No Fault Founds (NFFs) impose a devastating impact on aircraft systems. An entire aircraft can be grounded because of a single avionic for which there are insufficient spares available. If an FA or NFF causes a particular Line Replaceable Unit (LRU) to be called out incorrectly, that same LRU could be called out in many aircraft, possibly shutting down the entire fleet. This article reviews results of the studies in the literature addressing the various aspects and impacts of the FA and NFF phenomena. The authors discuss the impact of FAs and NFFs on TurAF F-16 avionics maintenance activities and evaluate measures that could or should be taken to improve the effectiveness of maintenance personnel in light of these complex events. The paper concludes with recommendations that could assist in mitigating FAs and NFFs in military systems.

This summary includes text from introduction of the article.

Predicting Field Performance of On-Board Diagnostics Using Statistical Methods

(Summary)

David Hetherington

On-board diagnostics will play a crucial role in the emerging era of the Internet of Things. With billions of devices deployed, traditional manual preventive maintenance approaches will be cost prohibitive. This paper will review historical approaches from the 1960s and 1970s and show how they can be practically applied to a wide variety of

diagnostic systems. The paper discusses for businesses: How to set business performance objectives for the on-board diagnostics; practical methods of quantifying failure modes; the statistical measurement approach; how to prepare testing programs; and how to administer the tests and evaluate the results.

This summary includes text from introduction of the article.

Power Law Behavior in Navy and Marine Corps Avionics Systems

(Summary)

Russell Shannon, Maria Legato, Steven Stockhamer, and Crystal Wagner

Avionics failures within the Naval Air Enterprise (NAE) typically involve a small population of bad actors which account for a large portion of failure conditions. Therefore, the authors were eager to investigate whether Navy and Marine Corps avionics systems failures fit a power law distribution. To address this question, the top five hundred avionics degraders from across the NAE were analyzed using a method laid out by Clauset *et al.* First, data was gathered and candidate systems were identified using visual inspection of the data. Data from candidates was then analyzed such that the tail of the distribution could be compared to the power law distribution. Finally, a goodness of fit calculation was performed to find whether or not the power law distribution appropriately described the behavior of the candidate system.

This summary includes text from introduction of the article.

Development, Integration, and Test Architecture for a 39 Software-Based Hardware-Agnostic Fault Tolerant Flight Computer

(Summary)

Andrew Cunningham and Michael Kass

The authors describe the development, integration and test architecture of a Fault Tolerant Flight Computer System designed by the Charles Stark Draper Laboratory for

a manned spacecraft and elaborate on how this architecture might be improved upon and used generically among similar fault-tolerant systems. As the sophistication and complexity of software-defined fault tolerance systems continue to grow, leveraging commercial hardware and flexible architectures to support and verify the performance of fault-tolerant systems becomes critical. It is hoped that the methods described in this article provide a foundation for future programs to save on costs and resources, as well as develop and validate future systems with the highest possible level of functionality and reliability.

This summary includes text from introduction of the article.

Characterization and Calibration Techniques for Multi-Channel Phase-Coherent Systems

(Summary)

Shivansh Chaudhary and Abhay Samant

Electronic Warfare and Radio Detection and Ranging are two of the many applications that rely on multi-channel and phase-coherent configurations for signal processing. This paper provides an overview of the complexities and requirements of a multi-channel phase-coherent measurement system. Multiple Input Multiple Output (MIMO) systems have to overcome key technical challenges related to phase, time, and frequency synchronization to coherently receive and process the data acquired/ generated from each input/output. In practical MIMO systems, the radio hardware should be capable of acquiring and/or generating such phase coherent signals across the multiple channels. Further, the systems need to be able to sustain the phase coherence over considerable duration of time, depending on the sensitivity of the system.

This summary includes text from introduction of the article.

Columns

Erratum

In the June 2016 issue of the *IEEE I&M Magazine*, there is a typo error in the Basic Metrology column "Don't use your Imagination!" by Dr. Bryan Kibble (pg. 42, in the second-to-last paragraph of the column, line 2 from the end).

In the inline equation "$\sqrt{\left(\sqrt{-1}\right)} = \pm \left(1 + \sqrt{-1}\right)\sqrt{2}$ ", please make note that the forward slash is missing before the "$\sqrt{2}$ ".

The corrected equation is "$\sqrt{\left(\sqrt{-1}\right)} = \pm \left(1 + \sqrt{-1}\right)/\sqrt{2}$ ".

In Memoriam

Bryan Kibble
(1938–2016)

Wendy Van Moer

Editor-in-Chief, *IEEE I&M Magazine*

Thursday, April 28th, 2016, that day the universe was shaking. That day we received the very sad news that Bryan Kibble passed away.

Two years ago, when I became the EIC of the magazine, I started to look for some good columnists and I wanted the renowned and highly respected Bryan Kibble as columnist for our new column on basic metrology. He would be the perfect person for this job! However, I still remember that one of my colleagues told me "You will never be able to convince Bryan Kibble to write for your magazine. He is one of the most respected scientists!" So, I said to myself, "Let's try!" I still remember my email to Bryan … And to my own surprise, he sent me back almost immediately an email telling me that he was so honored and that he … accepted! I was so happy!

That was the start of an amazing period! Every two months I was looking eagerly forward to his column and his drawings! The drawings were not made by using one or

the other fancy program, Bryan drew them by hand, and they were just perfect: simple, clear and informative. He seemed to have a natural ability to explain clearly and simply any idea he wanted to describe. Bryan was my most enthusiastic columnist, always so punctual and his columns were most appreciated by our readers. They loved his drawings!

Bryan Kibble was not only a gifted columnist, he also reshaped the SI system through his determinations and definitions of the ampere, volt, ohm, and kilogram, and his principles have become the established methods for generations of metrologists who have followed him. Dr. Kibble measured the gyromagnetic ratio of the proton, which improved the realization of the SI definition of the ampere.

This work was significant in uncovering a substantial error in the traditional realization of the ampere with current balances. Subsequently, his best-known work involved the development of what would become known as the *watt balance* and resulted in worldwide acceptance of the Josephson and von Klitzing constants to represent the conventional values of the volt and ohm. Prior to this, major industrialized nations had different representations for these units, presenting a trade barrier to the sale of electrical measuring instruments. Watt balances are now playing a role in redefining the kilogram.

Bryan was not only an extraordinary scientist, but also a very humble man who did not expect personal glory. His satisfaction came from getting science out there. The title of Bryan's contribution of the April issue was "Is the Universe Shaking?" Yes, Bryan, you made our universe shake!

Bryan P. Kibble was originally from Berkshire, U.K, received the B.A. Degree in physics and the D.Phil. Degree from Oxford University, Oxford, U.K., in 1960 and 1964, respectively. From 1960 to 1967, he did research in the field of atomic spectroscopy. From 1965 to 1967, he was with the University of Windsor, Windsor, ON, Canada. Until 1998, he was with the National Physical Laboratory, Teddington,

U.K., where he was concerned with accurate measurements of physical constants and realizations of the base SI electrical units, i.e., watt, farad, ohm, and henry.

Dr. Kibble was a Fellow of the Institution of Engineering and Technology (IET) and the Institute of Physics, which awarded him the Duddel Medal in 1985. He was a recipient of the SUNAMCO Medal in 1992, the IET Achievement Award in 2000, and the IEEE Joseph Keithley Award in 2009. He retired in 1998 and then acted as a Consultant in alternating-current impedance measurement with the Physikalisch-Technische Bundesanstalt, Braunschweig, Germany.

Basic Metrology

(Summary)

Sherlock Holmes and the Rules of Scientific Reasoning

Jürgen Schurr

In empirical research, established theoretical explanations are often not available, prompting researchers to create a number of imaginable hypotheses to explain what they observe. Each hypothesis is tested, following clear principles and strict consequences. A hypothesis is disproved if it does not conform to all of one's own results or is inadmissible or incompatible with an already-proven fact or theory. Drawing from Newton's Laws, the author discusses that is true that the hypothesis with the fewest assumptions might be oversimplified and, ultimately, not fully correct, but it nevertheless can guide scientists in their development of theoretical models. In the case of limited knowledge and incomplete information, it allows scientists to arrive at probable statements or practical solutions in less time without blocking further progress in applying the phenomenon. Finally, when a proven hypothesis is published, it enables other working groups to refine the investigation and explanation. In the end, this process allows a satisfactory explanation of the phenomenon to be found in the least amount of time.

This summary includes text from the column.

Life After Graduation

(Summary)

Asking the Right Questions

Max Cortner

Engineers are taught to use formulas, physical laws, and complicated calculations to get answers. But it is often more important to ask the right questions. Asking the right questions requires a broad understanding of systems and the applications. It also requires knowledge of the kinds of data that can be acquired with a broad variety of instruments. Asking questions that cannot be answered is useless. The right questions are ones that solve the problem and can be answered.

This summary includes text from the column's introduction.

Future Trends in I&M

(Summary)

Multi-Disciplinary Dialogue and Collaboration are the Key

John Lataire

This issue's column is written by engineer John Lataire, a Researcher with the Department ELEC-VUB, Brussels, who astutely discusses his interest in a multi-disciplinary approach to design and innovation. In his words, "Instrumentation and measurements (I&Ms) form the first interface layer between the real world and our understanding of it. For that reason, it has connections with all engineering fields, sometimes resulting in a vagueness of the boundaries of an I&M journal in scope… I propose a shift of focus, from the development of theories and methods which are intrinsically and fundamentally novel, towards the synthesis work, combining ideas, concepts, and methods of different fields, resulting in unifying frameworks and aggregate comprehensive solutions which are better than the sums of their parts. The simple fact of making an existing method available to an existing problem in a field where it had not been applied before can be a highly valuable contribution to

engineering science, to industry, and to the society in general. Let users focus on their own expertise, while benefitting from the knowledge of others."

Society News- IEEE Council Representatives' Reports

IEEE Sensors Council

Mike McShane, IEEE Sensors Council President

From an early age, we are taught about the five human senses of sight, hearing, taste, touch, and smell. Interest in technology to enhance, replace, and supplement these senses can be traced back to ancient civilizations. With electronics, the development of devices to transduce one form of energy to an electrical signal with a proportional feature has been realized in many embodiments of the modern concept of a sensor. Recent capabilities in precision manufacturing have enabled further miniaturization of the transducer, micro/ nanoelectronics for signal processing and control, power harvesting/supply, and wireless communication systems that are driving what is truly an explosion in connected devices that interact with the world: the *Internet of Things* (IoT). These are not just *gadgets* but critical tools that promise automation of tasks that do not require creative elements and will allow us to devote more attention to the things that matter most. Sensors are one of the key components of this exciting revolution of technology that is changing the way we experience life.

The IEEE Sensors Council (SC) comprises 26 IEEE member societies that come together to create a sensor-related community to promote development and use of sensors in all fields. The fields of interest of the SC and its activities are "the theory, design, fabrication, manufacturing and application of devices for sensing and transducing physical, chemical, and biological phenomena, with emphasis on the electronics, physics and reliability aspects of sensors and integrated sensor-actuators." As one can easily tell from this broad list, sensors are relevant to a wide variety of applications. They rely upon all forms of energy and physical phenomena. Research, development, and uses of sensors involve individuals with expertise spanning all hard

science and engineering disciplines.

When the SC was formed in 1999, each joining member society paid a one-time fee of $2,000. Since then, the SC has been fully financially independent; member societies do not share the financial risks undertaken by the Council. The only on-going financial obligation of our member societies is the annual costs to send one volunteer (their appointed member representative) to the AdCom meetings. Through 2015, one AdCom meeting was held each year at the IEEE SENSORS Conference location. Starting in 2016, a second meeting was added to achieve the following: early engagement of new volunteers (waiting until November was not efficient); consistency of programs/projects; better training and mentoring of volunteers; and a deeper involvement of AdCom members.

The SC engages in a number of our own activities to accomplish the goal of promoting the development and use of sensors, including publications, conferences, educational products, awards, and standards. The SC also collaborates with member societies and other entities to sponsor other sensors-related projects, such as co-sponsoring journals and conferences. Finally, the SC participates in various IEEE initiatives of direct relevance to our constituents; an example of this is the IoT initiative, where SC participation is critical because sensors are one of the key critical components of the IoT. Each of these activity areas is discussed only briefly in the following sections; for details on these and more about the SC, the reader is referred to our website (ieee-sensors.org).

Publications

The primary SC publication is the *IEEE Sensors Journal*, which was started in 2001 as the first journal "devoted solely to the science and technology of sensing" [1]. In scope, the publication focuses on the numerous sensor technologies spanned by the IEEE as well as on emerging sensor technologies. In 2001, four issues were published with a total of 384 pages; in 2015, 12 issues including more than 7,500 pages were produced! The latter corresponds to roughly 1,000 papers published, accepted from approximately 4,000 submissions per year. To achieve this 20-fold increase in size, the *IEEE Sensors*

Journal has experienced nearly exponential growth in submissions. It has truly been a monumental task for Editor-in-Chief Krikor Ozanyan and his editorial board to manage this rapid expansion without sacrificing quality of product and while maintaining a very stable rejection rate (~75%). As of late 2015, the journal ranked 26th out of 165 IEEE publications in annual total downloads and was 4th in downloads of 2015 papers (526,000 downloads). In 2016, the number of annual issues of the *IEEE SENSORS Journal* has been increased to 24, and the publication is now fully digital—there are no longer paper versions or print subscriptions.

In addition to the *IEEE Sensors Journal*, the SC has also invested in co-sponsored publications in partnership with a number of our member societies. The SC owns 34% of the *IEEE Internet of Things Journal*, which was initiated in Feb. 2014 along with the Computer Society and the Communications Society. The SC also has invested in three other journals at smaller but still significant ownership levels: *IEEE Transactions on Big Data* (7.5%), *IEEE Transactions on Computational Intelligence and Artificial Intelligence in Games* (5%), and *IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology* (10%). The latter is in the final stages of approval and is expected to launch in 2016.

Sensors Letters is a new publication that is currently being planned and is progressing through the approval channels of IEEE. Expected to launch in 2017, the letters journal will publish 2-page rapid communications. This journal will provide a direct link to the SENSORS Conference, as all letters accepted for publication will automatically be accepted for presentation at the next annual meeting.

Conferences

The flagship conference of the Council is SENSORS, a 3-day annual meeting with parallel technical tracks that began in Orlando, Florida in 2002. The meeting is immediately preceded by an additional day of tutorials. The meeting location rotates geographically between Americas, Europe/Africa, and Asia Pacific, with the most recent meetings held in Baltimore, Maryland, Valencia, Spain, and Busan, South Korea.

Recent attendance at the meeting has been consistently near 700. Changes to the format and additions to the conference program promise to increase enhance overall quality, attendance, and especially bolster the industry participation in the near future. Specifically, acceptance decisions will be made based on 3-page papers (submitted for the proceedings) rather than 2-page abstracts (followed by 4-page proceedings papers). A dedicated industry track was added in 2015 to encourage participation from commercial sensor developers and users.

Recent innovations implemented at the SENSORS Conference include presentation capture, live sensors demonstrations, a Young Professionals reception, an Industry Track, a Professional Development Track, and a Standards Panel. The first of these bears some additional mention, as it is a significant synergistic activity with our publications group. Specifically, the SC uses Camtasia to record approximately half of the presentations at the annual conference. These recordings of voice over PowerPoint slides may then be downloaded for free by all attendees, allowing each participant to hear all of the recorded presentations. This is a very effective way to expand the access to and impact of each conference presentation; now, attendees who previously would have to choose between two simultaneous presentations may attend both, albeit without the benefit of personal interaction. Collections of these recordings are made available for download through IEEE Xplore. The other additional features have been aimed specifically at increasing participation of and value for students and industry, through workshops geared towards professional development and networking, sessions focusing on presentations of progress in industry-based research and development, and workshops aimed at identifying critical sensors-related standards development needs that require multidisciplinary collaboration.

An additional fully-owned SC conference is INERTIAL, the International Symposium on Inertial Sensors and Systems (formerly ISISS), which started meeting in 2013 as a response to a demand in the defense and aerospace fields. The meeting is a smaller single-track symposium targeting about 150 attendees. After three successful symposia, all indications are that there is a consistent demand for this meeting to continue for the

indefinite future.

In 2015, a new conference offering was initiated: the Virtual Conference on Applications of Commercial Sensors (VCACS). VCACS is an online-only conference, an ongoing experiment aimed at getting more student involvement in the sensors technical field as well as connect directly to industry by encouraging reporting on new applications for commercial sensors. The format is well-suited for student design teams to publish technical reports from design projects. This will allow more widespread dissemination of information that might not be appropriate for a research-focused journal; these reports function effectively as application notes, providing insight into various implementations and enabling more rapid adoption of sensors for new purposes.

The SC also co-sponsors a number of meetings and workshops with member societies. The SC currently financially co-sponsors IEEE World Forum on Internet of Things (re-named "Internet of Things Summit," starting in 2016). The SC is also supporting the International Symposium on Olfaction and Electronic Noses (ISOEN), a partnership with Micro-Nano-Bio Convergence Systems and the European Commission.

Awards

The SC offers a series of awards that recognize technical achievement and impact on the sensors field and community, including:

- Four Technical Achievement Awards:
    - Early Career Technical Achievement Award – Sensors
    - Advanced Career Technical Achievement Award – Sensors
    - Early Career Technical Achievement Award – Sensor Systems or Networks
    - Advanced Career Technical Achievement Award – Sensor Systems or Networks
- Meritorious Service Award
- *IEEE Sensors Journal* Best Paper Awards (first place, runner-up)
- Young Professional Award

These awards are open to all IEEE members, and nominations are welcome from anyone. The awards include cash prizes, a commemorative plaque, and recognition at an awards luncheon at the annual conference. In addition to the awards that are fully managed and underwritten by the SC, there is also a mechanism by which the SC may nominate IEEE members for consideration to be elevated to the grade of IEEE Fellow. An experienced Fellows committee handles nominations on behalf of the SC.

Technical Operations

Historically, the SC has not been highly active in technical operations. With a focus on the conference and publications, only recently have the financial and human resources become available at sufficient levels to expand offerings in outreach, education, standards, and local leadership development. Our current technical activities aim to promote sensors knowledge and usage via distinguished lecturers, educational resources, chapters, and standards.

Distinguished Lecturers are traveling speakers with outstanding achievement records in some aspect of sensors as well as strong presentation skills. They are allocated a travel budget of up to $6,000 per year to support travel to a number of sites for presentations. Distinguished Lecturers are expected to make several trips each year to give invited talks to chapters and other meetings where large groups of individuals interested in sensors are gathering.

Educational resources include online tutorials and a summer school. Currently, tutorials are PDF versions of presentations given at conference-related tutorials sessions. A plan for the future is to expand this offering to capture voiceover-screen versions of presentations and possibly full video. The SC is currently exploring the infrastructure required to compile and efficiently distribute multimedia tutorials. Most importantly, the SC has set a specific goal of building a larger and broader library of high-quality tutorials. Therefore, by the end of 2017, there should be a significant expansion of this component of the SC's educational contributions to the community.

IEEE Sensors Council Chapters

Chapters are organized by local groups with interest in promoting sensors. At present, chapters are a fledgling program within the SC; however, the number is growing rapidly. Sensors Chapters are typically formed in partnership with leaders from multiple member societies that already have IEEE chapters with sensors-related activities, and they see value in additional community organization around the topic of sensors. The primary support offered by the SC is assistance in starting and maintaining the chapter as well as prioritization of distinguished lecturer travel to visit chapters. Chapters are also expected to serve as a nucleus for industry and standards-related activities and eventually will likely play key roles in conferences. On the latter point, chapters will be logical sources of strong bids to hold the annual conference, as they will have critical mass and an understanding of SC expectations for the flagship conference.

Standards

As a new undertaking, the SC initiated work with the IEEE Standards Association in 2015. The goal of the SC's Standards Committee is to work with the SC's Member Society Relations Committee to organize standards workshops at member society conferences, with an emphasis on sensor-related needs. Also in 2015, the SC formed an Industry Liaison Committee, which will coordinate SC's industry initiatives, including the search for new sensor standard topics. These groups are currently working together on hosting multiple standards workshops distributed throughout the year. One will be held at the SENSORS Conference in Orlando, while others are being arranged in conjunction with member society conferences and non-IEEE events with sensors focus and strong industry participation.

Council Membership Benefits for Societies

A common question regarding the purpose and benefit of councils is: *What's in it for members* (*member societies*)? The SC recently developed a brief set of points that comprise a "Return on Investment" statement for our member societies. In addition to highlighting the status of the SC products as indicated above, we emphasize the following aspects of SC membership to justify the existence of the SC as a partnership

among the IEEE societies:

- A Society-appointed representative holds a voting seat on the administrative committee, providing direct input to SC direction. Each representative can participate in SC committees, similarly influencing future activities.
- Councils have no dues-paying members, only member societies. Therefore, there is no competition in society membership between member societies and the SC.
- The SC website links to each member society's home page. Social media accounts are similarly linked.
- Splash ads for member societies (if provided) will appear on a rotation in the SC Newsletter. A new newsfeed is planned for the SC website and will integrate splash ads as space is available.
- Member society conference advertising is available in several forms.
- Member society informational slides can be shown between sessions at the annual IEEE SENSORS Conference.
- Distinguished lecturers are available. They have presented at conferences and chapter meetings, most frequently in collaboration with member society chapters. The SC's Distinguished Lecturer Program (DLP) promotes the field of sensors to the broad engineering and scientific community and to the public at large.
- The SC does not infringe on society memberships. The SC has not used member societies membership lists from IEEE SAM to make *any* announcements. Instead, the SC has created its own database of sensor professionals who attend our conferences, publish in our journal (and other journals), and participate in other sensor events around the world. This protects member society members not interested in sensors from getting SC email.
- Annual IEEE SENSORS Conference shared booth space available at no cost to member societies. SC AdCom members staff and re-stock the shared booth. AdCom members are available at our exhibit booth at the annual IEEE SENSORS Conference to assist IEEE-member attendees in obtaining IEEE Senior Member elevation.
- The SC delivers value to society members who are technology-focused IEEE members whose careers involve sensors technology research, development, and its

applications. This is accomplished through technical conferences, presentations, standards and publications.

- Member societies (or groups of societies) can choose to partner with the SC in joint ventures.

Beyond these general benefits to all member societies, some questions more specific to I&M are: *What is the link between the SC and the Instrumentation and Measurement Society? What are the similarities and differences in fields of interest? How can there be collaborations between members of the council and Instrumentation and Measurement Society? Can there be joined efforts on standards?*

The SC field of interest has many strong relevant connections to that of I&M. Sensors are an example of measurement tools, and the application of sensors is a measurement; so, sensors match directly to the "M" in the Instrumentation and Measurement Society (IMS) name. The SC is concerned with everything involved in sensor technology development, to the fundamental level of materials science and physical phenomena. In this sense, the SC domain diverges from the IMS areas of concern.

The most direct link between IMS and SC is the appointed representative. These representatives serve on the SC Ad-Com as well as various committees and/or subcommittees, representing the interests of IMS in both strategic and operational matters. In addition, SC has initiated a Member Society Presidents' luncheon or dinner at recent TAB meetings, which has led to sharing some ideas for best practices as well as potential joint projects. Standards is a prime example where both groups can work together effectively. The SC does not have much history in this area but has also made building a vibrant sensors standards program with strong industry connections a strategic priority. On the other hand, SC has natural linkages to many other parties interested in sensor-related standards, due to the inherent nature of the SC; as such, the SC can provide value in helping IMS connect to other partners that are needed to contribute to standards development.

The SC aims to make the partnership with member societies a mutually beneficial endeavor. There are many opportunities to leverage the interdisciplinary nature of the SC to assist societies in pursuing initiatives that are larger than their own field, and all ideas for projects and activities to promote sensors to the technical community, potential users, and the general public on the whole.

Mike McShane is the current President of the IEEE Sensors Council and can be contacted at mike.mcshane@ieee.org.

Reference

[1] V. J. Lumelsky and J. R. Vig, "Editorial," in *IEEE Sensors Journal*, vol. 1, no. 1, pp. 2-3, June 2001. DOI: 10.1109/JSEN.2001.923582.

IEEE Systems Council Perspective: Systems and Measurement Systems

Paolo Carbone, IEEE Systems Council President

Since the beginning of my research activity at the University, I was involved in instrumentation and measurement. In fact, the majority of my research results are published these days by the *IEEE Transactions on Instrumentation and Measurement*. However, in the last several years I have been involved in the activities of the IEEE Systems Council and discovered how much systems engineering and instrumentation and measurement have in common.

As stated by the IEEE, technical councils are groups of societies working together in interdisciplinary areas of technology. Thus, councils do not have individual members, but rather, have member societies. The IEEE Instrumentation and Measurement Society is one of the member societies participating in the IEEE Systems Council.

The goal of the Systems Council is to integrate IEEE activities regarding aspects of multiple disciplines and specialty areas associated with the engineering of systems, especially complex, large-scale systems and systems-of-systems. In systems engineering, aspects emerge that may not be evident when one concentrates on the single

parts instead of on the whole system. For example, when you design and realize a wide area measurement network, based on distributed sensors, issues arise regarding the chosen system architecture, risk management, quality control, and product/project management interactions. At the same time, every working system needs to consider safety, security, and human-related factors, such as usability. It becomes evident that when the focus of engineering activities is put on the system level, there is a need to cope with the effects of interactions among the various subsystems, and questions arise about the methodologies that allow the production of effectively working products. Methods to anticipate problems and unexpected consequences of system design when producing systems to satisfy the stated requirements are the key aspects debated within the Systems Council.

Aerospace and defense organizations must be credited with the origin of this discipline as a standalone discipline within engineering. However, the tools and methods proposed within this framework have found applications beyond the military and aerospace domains, and several other areas of technology now benefit from the holistic view taken by systems engineers [1], [2].

Instruments are complex systems that may require usage of a systems-thinking approach. Professionals must put the focus on the system rather than on only the single functioning parts when a whole working instrument must be put in operation and need to use state-of-the-art techniques to manage their projects and products. As an example, the design and realization of a data acquisition system implies the definition of system architecture, the definition of the exposed functions, and the physical design. At the same time, there is a need to address the so-called specialty-engineering disciplines such as reliability, maintainability, safety, electromagnetic compatibility, testability, manufacturability, and human factors. Moreover, every instrument contains software which represents a system by itself and requires an entire set of tools and methodologies for managing the corresponding requirements.

Other meaningful examples of complex measurement systems can be found in several

engineering areas: from large geographical sensor networks (such as the network for Deep-ocean Assessment and Reporting of Tsunamis), to the extreme low-scale (such as lab-on-a-chip for genetic analysis), to wide area measurement systems (such as the network for controlling smart energy grids). In all of these cases, the availability of reliable and accurate measurement results is necessary to guarantee functionality of many other complex engineering systems.

There is much in common between the activities done when designing and realizing instruments and systems: modeling, validating, and measuring, just to name a few. The community of people in the Systems Council can provide hints and insights on how to address these issues effectively. At the same time, systems engineers need effective measurement tools, both to know how to perform *hard* measurements correctly, such as when measuring properties of physical quantities, and to challenge measurement theory for providing knowledge and tools to deal with *soft* measurement, such as when trying to measure *the effectiveness of a design process* or *the level of complexity of a system* [3].

An interesting aspect of the IEEE Systems Council is the equally enthusiastic participation and contribution of practitioners and academics. This discipline is strongly driven by the requirements associated with practical applications, and practicing engineers play a major role in the advancement of knowledge in this field.

Several Technical Committees are active in this Council: Analytics and Risk, Industrial Interface, Intelligent Transportation Design, Security and Privacy in Complex Systems, Systems Biology, and Workforce Development. To get involved in the activities of these committees, contact Roger Oliva, the Council VP Technical Operations, whose contact information can be found on the Council website: http://ieeesystemscouncil.org.

The Systems Council organizes and participates in conferences and workshops. Currently, the two most important conferences are the *IEEE International Systems Conference* and the *IEEE International Symposium on Systems Engineering*, typically

held in North America and Europe, respectively. This year, the Systems Conference was held in Orlando, Florida, USA in April (http://2016.ieeesyscon.org), and the Symposium will be held in Edinburgh, UK in October (http://2016. ieeeisse.org). Special sessions at these conferences are one way to foster interaction among systems engineering experts and experts in the area of instrumentation and measurement..

The main publication of the Systems Council is the *IEEE Systems Journal* (www.ieeesystemsjournal.org), managed by the Editor-in-Chief Prof. Vincenzo Piuri and his Co-editors in Chief Prof. Amir Aghdam and Prof. Saeid Nahavandi. Submissions to the journal grew quickly over the years and are now in the order of 900 per year. To serve the community of scientists, researchers, and practitioners in the field, several special issues have been published on diverse topics. One such special issue recently published was about *Complex Measurement Systems*.

To be updated about the System Council's activities, please join our community by updating your IEEE membership to include the Systems Council. You can add this membership *at no cost*, simply by checking the Systems Council box in your personal IEEE account. You can read our newsletter published quarterly on the website (http://ieeesystemscouncil. org/content/newsletter-archive) and subscribe to our Facebook (https://www.facebook.com/IEEESystemsCouncil/) and Linked-in pages (https://www.linkedin.com/groups/6792294).

Please get in contact and get involved in this fascinating area of knowledge and practice that truly represents the essence of being an engineer: join the IEEE Systems Council and be an active part of this community!

References

[1] D. Hitchins, *Systems Engineering -A 21st Century Systems Methodology*, Hoboken, NJ, USA: John Wiley and Sons, 2007, ISBN: 978-0-470-05856-5.
[2] A. Kossiakoff, W. N. Sweet, S. Seymour, and S. M. Biemer, *Systems Engineering Principles and Practice, 2nd ed.*, Hoboken, NJ, USA: John Wiley and Sons, 2011,

ISBN: 978-0470-40548-2.
[3] D. Petri, L. Mari, and P. Carbone, "A Structured Methodology for Measurement Development," *IEEE Trans. Instrum. Meas.*, vol. 64, no. 9, pp. 2367-2379, Sep. 2015.

IEEE Council on RFID

George Xiao, IMS Representative

Radio Frequency Identification (RFID) is a term that describes a technique that uses electromagnetic waves or a magnetic field to automatically identify and track tags attached to objects. A typical RFID system consists of tags (transponders), readers with antennas, and a host system (as illustrated in Fig. 1). RFID tags can be categorized into three broad categories:

- passive tags (they do not have a power source such as a battery on board and need to harvest power to operate),
- active tags (they have a power source so their lifetime is limited and thus they are only used for specific applications), and
- semi-passive (semi-active) tags which are a hybrid between passive and active tags.

Each tag contains electronically stored information about the object to which it is attached, such as the object ID. Two basic components of a traditional RFID tag are a microchip (integrated circuit) and an antenna. (More recently, chipless RFIDs are also becoming popular.) The chip provides functions and memory. It is usually pre-programmed with a unique serial number assigned by the chip manufacturer for use in tracking. The antenna is used for data communication and for power harvesting in the case of passive tags. Tags are generally in the form of labels, inlays, cards, etc. (The print article includes a figure photo).

The RFID reader and the reader antenna can be an integrated unit or separated, as illustrated in Fig. 1b and 1c. The reader antenna is a conduit through which communication between the tag and the reader can be established. Furthermore, the antenna can deliver power to the tags.

The RFID reader is usually a networked device, being fixed or mobile. It sends out commands and power (in systems where the tags are passive) to the tags. It also collects the tag data and relays the data to a host system. A reader can identify/track multiple tags (tens or hundreds) simultaneously without direct contact/line-of-sight to the objects.

The host system, also called RFID middleware, processes the information gathered by RFID reader. RFID systems have found applications in a broad range of fields. Some of these fields are healthcare; retail; e-tickets for public transportation; contactless payment systems such as credit cards, etc.; electronic passports; access control; animal identification; industrial automation; object tracking in hospitals; location services; cold chain management; anti-counterfeiting; logistic and asset management; near field communication and energy harvesting; and near field wireless sensing.

IEEE Council on RFID

The IEEE Council on RFID (IEEE CRFID) is a new organization (http://www.ieeerfid.org). It was accepted as an IEEE Technical Council in June 2015. However, its predecessor, the Technical Committee on RFID was established in November 2008. The CRFID focuses on the theory and practice of matters relating to RFID and RFID-related systems. The main topics covered are as follows:

- Antennas & Propagation: Antenna theory and design, channel measurements and modeling
- Applications: The introduction and operational experience with RFID applications, usually with a strong technical focus. Research issues are also addressed
- Circuits, Devices & Sensors: Low-power RFID circuit designs, integrated sensors, energy harvesting, and non-silicon and chipless RFID
- Communication Protocols: Coding, modulation, anticollision, and medium access schemes for RFID systems
- Deployment Issues & Concerns: EMC compatibility, tag recycling, issues in patient safety
- Interrogators: Architecture, algorithms, detection, sensitivity, read rate optimizations, multi-interrogator coordination and interference
- Policy & Regulatory Issues: Spectral management, privacy issues, co-existence of RFID systems, social implications of RFID technology
- RF-based Localization: Novel system approaches, technologies, and algorithms
- RFID System Architecture: RFID middleware, large-scale discovery services
- Security & Privacy: Cryptographic protocols and privacy-enhancing techniques
- System Tools: Tools for the design, deployment, and evaluation of RFID systems

The activities of CRFID include, but are not limited to publications, public outreach via web-based and other media, conferences, educational tools, standards sponsoring and coordination, and broad regional/international communication of the mission. As per IEEE and Technical Activities governance documents, appropriate approvals for such projects/ products will be sought. Activities of CRFID are expected to reach across all IEEE communities, to include subject matter experts in the development and achievement of its functions and to bring visibility

to the entire IEEE community.

The IEEE CRFID provides a focus for RFID technology across the technical spectrum of IEEE. Fifteen societies have joined the CRFID so far, including:

- IEEE Antennas and Propagation Society
- IEEE Circuits and Systems Society
- IEEE Communications Society
- IEEE Computer Society
- IEEE Consumer Electronics Society
- IEEE Engineering in Medicine and Biology Society
- IEEE Instrumentation and Measurement Society
- IEEE Intelligent Transportation Systems Society
- IEEE Microwave Theory and Techniques Society
- IEEE Signal Processing Society
- IEEE Society on Social Implications of Technology
- IEEE Solid-State Circuits Society
- IEEE Systems, Man, and Cybernetics Society
- IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society
- IEEE Vehicular Technology Society

Each member society selects two volunteer representatives who actively participate in the governing of the CRFID. One of the major responsibilities of the CRFID is the planning and oversight of its two conference series: *IEEE International Conference on RFID* and *RFID-Technical Applications* (RFID-TA). CRFID also fosters technical exchange through workshops and technical forums. Most importantly, CRFID supports IEEE members and the general public in furthering the technical aspects of RFID systems.

CRFID is launching the *IEEE Journal of Radio Frequency Identification* (RFID) in 2017. *IEEE*

Journal of RFID will publish peer-reviewed manuscripts that address various aspects of RFID systems. The articles describe advances in theory, algorithms, design techniques, implementations, and applications of RFID systems. Both emerging research and commercial trends in the rapidly evolving field of RFID are covered. Applications span a wide range of fields including healthcare, asset monitoring, security, finance, energy, and transport. For more information, please contact Dr. Larry Zhang (larryzhang@ ieee.org).

For those IMS members interested in the RFID subject, CRFID welcomes you to join its ranks. Simply send an email to CRFIDmembership@ieee-rfid.org, and CRFID will add you to its mailing list to keep you updated on upcoming events and opportunities for participation in its technical committee activities. CRFID-sponsored activities provide participants the opportunity to publish and collaborate on research, network with colleagues, stay current on news and events, develop standards, and participate in educational activities.

Instrumentation and Measurement Society (IMS) members can participate in the CRFID. If you are a current member, simply add "IEEE Council on RFID" to your cart when you register for IEEE membership, for free. Given that CRFID is a Council, local CRFID chapters or joint chapters with IMS can be formed. IMS members are welcomed to contact the CRFID VP Member Services, Chen Zhi Ning (National University of Singapore) if you are interested in forming a chapter.

CRFID can also be reached at LinkedIn, Twitter, and Face-book. Current officers of CRFID welcome your inputs:

- President: Emily Sopensky
- Past President: William Lumpkins
- Secretary/Treasurer: Gisele Bennett
- Vice Presidents:
    - Conferences: Apostolos Georgiadis
    - Publications: Shahriar Mirabbasi
    - Membership Services: Chen Zhi Ning
    - Technical Activities: Magdy Bayoumi

- Chair, Standards Committee: Carole Carey
- Chair, Education Committee: Greg Durgin
- Young Professionals Coordinator: Matt Trotter The current IMS representatives to CRFID are Dr. Gaozhi (George) Xiao and Prof. Maceij Zawodniok. They can also be IMS members' contact points to IEEE CRFID.

RFID Standards and Opportunities

Low Frequency (125–134.2 kHz and 140–148.5 kHz) and High Frequency (13.56 MHz) RFID systems can be used globally without restriction, but for Ultra High Frequency (beyond 860 MHz) RFID systems, the operation frequency varies from country to country. As an example, 902–928 MHz which is one of the Industrial, Scientific and Medical (ISM) bands is used in North America.

Current RFID standards are mainly set by the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), ASTM International, the DASH7 Alliance and EPCglobal.

The following is a list of major RFID standards copied from Wikipedia (https://en.wikipedia.org/wiki/ Radio-frequency_identification):

- ISO 14223 – Radiofrequency identification of animals – Advanced transponders
- ISO/IEC 14443: This standard is a popular HF (13.56MHz) standard for HF RFIDs which is being used as the basis of RFID-enabled passports under ICAO 9303. The near field communication standard that lets mobile devices act as RFID readers/transponders is also based on ISO/IEC 14443.
- ISO/IEC 15693: This is also a popular HF (13.56 MHz) standard for HF RFIDs widely used for non-contact smart payment and credit cards.
- ISO/IEC 18000: Information technology—Radio frequency identification for item management:
    - Part 1: Reference architecture and definition of parameters to be standardized
    - Part 2: Parameters for air interface communications below 135 kHz

- Part 3: Parameters for air interface communications at 13.56 MHz
- Part 4: Parameters for air interface communications at 2.45 GHz
- Part 6: Parameters for air interface communications at 860–960 MHz
- Part 7: Parameters for active air interface communications at 433 MHz

‣ ISO/IEC 18092: Information technology—Telecommunications and information exchange between systems—Near Field Communication—Interface and Protocol (NFCIP-1)

‣ ISO 18185: This is the industry standard for electronic seals or "e-seals" for tracking cargo containers using the 433 MHz and 2.4 GHz frequencies.

‣ ISO/IEC 21481: Information technology—Telecommunications and information exchange between systems—Near Field Communication Interface and Protocol -2 (NFCIP-2)

‣ ASTM D7434: Standard Test Method for Determining the Performance of Passive Radio Frequency Identification (RFID) Transponders on Palletized or Unitized Loads

‣ ASTM D7435: Standard Test Method for Determining the Performance of Passive Radio Frequency Identification (RFID) Transponders on Loaded Containers

‣ ASTM D7580: Standard Test Method for Rotary Stretch Wrapper Method for Determining the Readability of Passive RFID Transponders on Homogenous Palletized or Unitized Loads

‣ ISO 28560-2: specifies encoding standards and data model to be used within libraries.

IEEE is a late-comer in the field of RFID, but as the applications of RFID are extremely broad, there are still tremendous opportunities in standardizing various RFID applications. CRFID is encouraging its member societies to work together on RFID standards.

Departments

New Products

Robert Goldberg

Please send all "New Products" information to:

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UHF Arbitrary Waveform Generator

Zurich Instruments has announced the launch of a new ultra-high frequency arbitrary waveform generator (UHF-AWG) for its UHF 600 MHz lock-in amplifier platform. The UHF-AWG integrates signal generation and detection in a single instrument.

The UHF-AWG is a dual channel 600 MHz arbitrary waveform generator (AWG) with 128 Mega-Sample waveform memory per channel, 1.8 GSa/s temporal and 14-bit vertical resolution. Integrated detection options include a pulse counter, multiple demodulators, an oscilloscope and a boxcar averager. The integration of signal generation and detection in a single instrument helps to minimize feedback times and reduces the complexity of the experimental setup. The AWG is fully integrated into the LabOne instrument control software that provides a powerful scripting language with high-level AWG commands. Pulse sequences and waveforms can be easily defined and adjusted.

Developed in close collaboration with advanced quantum physics researchers in Europe, it features standard waveform playback and amplitude modulation. In amplitude modulation mode, each AWG channel shapes one of up to 8 internally generated sine wave signals. This optimizes the generation of phase-coherent pulse patterns using the sequencer and generic pulse envelopes and does not require uploading the entire waveform.

As a result, waiting times for transfer of long phase-coherent patterns are significantly reduced. To learn more about the AWG, visit http://zhinst.com.

Expanded Range of PXI RF Multiplexers

Pickering Interfaces is expanding its range of PXI 50 Ω 600 MHz RF Multiplexers with 18 different configurations, including a PXI two slot 32:1 configuration. This new range of PXI

RF Multiplexers (series 40-760) is available in the following configurations: dual, quad and octal SP4T, single, dual and quad SP8T, single and dual SP16T and single SP32T. All of the multiplexers have versions with automatic terminations to manage VSWR effects, which could degrade the performance of a test system.

All versions of this range of PXI RF multiplexers exhibit low insertion loss and VSWR through the use of modern RF relay technology. Each version has been carefully designed to ensure excellent and repeatable RF characteristics to frequencies of 600MHz, with each path having a nominally equal insertion loss.

The injection of noise and unwanted signals into the signal paths of the 40-760 range has been minimized by careful attention to the mechanical and electrical design. These multiplexers are compatible with any PXI chassis and can be fitted to PXI hybrid slots in a PXIe chassis. They can also be used in Pickering Interfaces LXI Modular chassis for users preferring control via an Ethernet port. More information is supplied on their website at www.pickeringtest.com.

New HF Tuner Delivers Unmatched Speed and Dynamic Range in Signal Detection

DRS Technologies Inc. has announced the launch of a high performance digital tuner that is better able to capture weak high-frequency radio waves in mission-critical settings. The innovative Harrier Multichannel Wideband High-Frequency Digital Tuner design gives users the ability to examine the entire HF spectrum, from 0.5 MHz to 30 MHz, cutting through signal interference and focusing on signals of interest. This high level of performance is achieved by a proprietary full-band digitizer that enables dramatic improvements in 2nd and 3rd order intermodulation distortion that significantly increases the spurious-free dynamic range. DRS claims that this capability is unmatched compared to competing tuners.

With a typical dynamic range of 120 dB, Harrier is ideal for a host of critical HF collection applications. Harrier’s extremely fast digital tuning is ideal for commercial use in environments where there is a need to quickly identify and overcome service disruptions caused by interfering signals. The technology can also be used for government customers in need of identifying hard-to-detect signals.

Housing four wideband channels in a compact 1U half-rack form, Harrier weighs only ten pounds and consumes less than 100 Watts of power. With 28 digital down converters (DDCs) across its four channels, Harrier intensively processes signals of interest while discarding unwanted data. Through DDCs, its wide 30 MHz bandwidth is compartmentalized into seven narrow sub-bands of 4.27 MHz per channel to manage a vastamount of data and focus on signals of interest.

Currently in production are two and four wideband channel variations, with each channel directly digitizing the entire HF spectrum from 0.5 MHz to 30 MHz. Harrier's design is an extension to DRS's Talon VHF/UHF Receiver with each unit sharing the same form factor. When the two units are rack-mounted side by side, this Harrier and Talon combination creates an easily deployed, high-performance digital HF/VHF/UHF capability tuning from 0.5 MHz to 6 GHz.

For more information, visit www.drs.com/Harrier.

E-Band Signal Analysis Reference Solution for Multichannel Millimeter Wave Test

Keysight Technologies, Inc. has announced an E-band Signal Analysis Reference Solution to provide low-cost millimeter wave analysis capability for applications in the 60-90 GHz range. The reference solution is based around the 10-bit ADC Infiniium S-Series oscilloscope to provide 2.5 GHz of high-fidelity, millimeter wave frequency analysis bandwidth.

The E-Band Signal Analysis Reference Solution provides a powerful test platform for analyzing emerging communication standards operating at millimeter wave frequencies. Two channel capability allows for: testing of multichannel devices; different antenna polarizations simultaneously; and channel sounding measurements.

The reference solution is made up of a combination of hardware instruments and software. The new N8838A external mixer assistant software enables the S-Series oscilloscope to control the N5183B MXG X-Series microwave signal generator and the M1971E waveguide smart mixer. Also, with the 89601B vector signal analysis software, engineers can make insightful

measurements for complex signal analysis. This makes it simple to get accurate, calibrated measurements on E-band signals.

Additional information is available at www.keysight.com/find/UXM and www.keysight.com/find/cellular. A knowledge library of application notes, CDs and more is available at www.keysight.com/find/cellular-insight.

Record Measured Data Using a Wireless Mini Logger

Permanently record temperature, humidity and pressure at various measuring points, in inaccessible locations and at operating temperatures from -20 °C to +125 °C, and monitor them globally via the cloud. The MSR385WD data logger from MSR Electronics is equipped with wireless sensors and is now also available with a GSM terminal.

The constantly increasing demand for remote monitoring of measured values via the Internet and mobile communications is not only attributable to the many benefits, such as cost and time saving as there is no need for manual checks locally. In fact, the transmission of measured data via the mobile network makes control easier for the user, even where measured values need to be monitored in locations that are difficult to access.

The MSR385WD data logger is equipped with a memory capacity of more than one million measured values. This multi-channel data logger has an integrated ISM band receiver module through which it receives and stores data from up to ten MSR385SM transmitter modules. The data logger is supplied with power by means of a USB connection; with the integrated rechargeable 2400 mAh lithium-polymer battery, it can be operated autonomously for up to two days. The measured data of the small wireless transmitter modules recorded by the data logger can subsequently be read out via a USB interface and processed further using the MSR PC software for data analysis purposes.

The temperature-resistant mini transmitter modules that are equipped with sensors are a distinctive feature of the MSR385 system: depending on the type of case, they facilitate metrological applications even at high operating temperatures of up to +125 °C.

The transmitter module weighs approximately 25 grams and measures just 35 x 55 x 25 mm externally. Therefore, it can be positioned even in difficult to access locations.

For further information on the MSR385WD, please visit www.msr.ch/en/product/msr385wd-wireless-data-logger.php.

Flying Probe Test System

Digitaltest, Inc. introduces their New Flying Probe and Reverse Engineering Software. The new MTS 505 Condor is the latest and most advanced flying probe solution from Digitaltest. The new Condor flying probe solution provides larger board capability, faster programing and increased optical capability. When these are combined with the speed, test capabilities and accuracy provided by the Condor flying probe system, the Condor provides a capable and cost-effective test solution for all low to medium volume production applications.

The new Condor flying probe also provides the highest fault coverage for high reliability environments and now provides capabilities for larger boards.

The new Digitizer 2.0 helps you recover CAD. With the help of the Digitizer the board/CAD data is re-created and all the connectivity is learned. The Digitizer generates a CAD file for the board that contains all the board components and nets. This file can be used for test, repair and/or re-manufacturing of the board.

For more information, visit www.digitaltest.com.

SWIR (Short Wave InfraRed) Linear Array with Low Read Noise

Princeton Infrared Technologies, Inc. (PIRT), introduces the 1024L1-12.5-T Linear Array, an indium gallium arsenide (In-GaAs) sensor designed for both spectroscopy and machine vision in the shortwave infrared (SWIR) spectrum. The linear array provides 1024 x 1 resolution with a small 12.5 micron pitch and according to PIRT, delivers the lowest read noise currently available at <550e- for a 250 μm tall pixel. For some spectroscopy applications, the advanced SWIR on-

chip noise-suppression circuit will achieve read noise levels to an unprecedented low of <100e-. This is also the only SWIR linear array available that can image the visible and SWIR bands with response from 0.4 to 1.7 mm.

The 1024L1 uses a single digital ROIC chip to minimize variation from output to output, which is often an unwanted feature on linear arrays with multiple ROICs. The chips have built-in 14-bit analog-to-digital converters that maximize dynamic range (>6000:1) and minimize noise, while delivering 34 klines/s at 1024 elements.

It also has the largest selection of full wells, from 75 ke- to 100 Me-, which PIRT claims to be the best in the industry. The lattice-matched InGaAs array is backside illuminated to enable detection in the visible to the SWIR from 0.4 to 1.7 μm. A distinct advantage to backside illumination is that it minimizes stray reflections that plague competing front-side illuminated arrays; bond pads and the many wire bonds near the active imaging area of front-side illuminated arrays often create odd light apertures that adversely affect image quality.

The new backside-illuminated 1024L1 Linear Array can also be customized by depositing optical filters directly onto the active detector area; this is nearly impossible to do with a frontside illuminated device with its wire bonds.

To learn more about the new line of affordable SWIR linear arrays and cameras, go to www.princetonirtech.com.

Rugged Industrial Notebooks for Efficient Automation Engineering

Siemens has equipped the latest generation of its rugged, ready-to-run industrial notebooks with a multitude of practical functions for mobile engineering.

The Simatic Field PG M5 programming device has been designed with pre-installed Simatic TIA Portal (Totally Integrated Automation) engineering software for fast and efficient configuration,

commissioning, service and maintenance, as well as for engineering work in technical bureaus. There are two versions of the new notebook with robust hardware for mobile use in industrial plants: the Comfort version is equipped with an Intel Core i5 processor and the Advanced version with a more powerful Intel Core i7 processor. The Advanced device can also be configured with the interfaces of the previous Simatic S5 controller generation.

The new Simatic Field PG M5 has all of the interfaces required for the efficient engineering of industrial automation applications. Simatic memory cards can be programmed directly on the industrial notebook through the Simatic Card Reader interface. The Simatic Field PG M5 is delivered ready-to-run with pre-installed Simatic engineering software. The high-quality Simatic Field PG M5 programming device is made of specially selected materials and has been designed for use in machines and plants in harsh industrial environments. The lightweight, robust and fully shielded cast magnesium enclosure offers protection against electromagnetic interference.

Bumpers on exposed parts of the housing and rubber buffered corners protect against shocks and vibrations. The keyboard is dirt-resistant with abrasion proof, laser-cut key labeling. The brilliant, anti-reflection, powerful 300 cd (candela) bright, high-resolution 15.6 inch (39.6 cm) full HD widescreen display offers high sharpness and luminance irrespective of the angle of view.

The Simatic Field PG M5 is equipped with a fast DDR4 work memory of up to 32 gigabytes and an impact-resistant, fast, exchangeable, solid-state technology mass storage device of up to 1-terabyte.

Find more information at www.siemens.com/simatic-pg.

New Auto-Test and Alignment Capabilities for Motorola APXTM 8000 Radios

Cobham announces the release of two new, automated test and alignment software applications to support the new Motorola APX 8000 Radios. The two software applications are available as options to both the 3920B Series Analog and Digital Radio Test Platform and the 8800 Series Digital Radio Test Set. Both applications fully automate APX 8000 radio testing and alignment.

It also ensures optimum radio performance in significantly less time, while minimizing service and support costs for end users and dealers.

The 3920B, with its low phase noise RF signal generator, is the primary radio test system approved by Motorola for automated testing and alignment of the APX Series of radios. The 3920B has undergone extensive testing and approval by the Motorola Continuing Product Engineering (CPE) group for the APX radio.

The 8800S offers APX testing and alignment capabilities while also providing "pick up and go" capabilities for field test applications. With the industry's largest color display, lightweight design, ruggedness, and 2½ hour battery operation, the 8800S is ready for any test environment, whether on the bench or in the field.

Find more information at www.cobham.com. You can also receive information by sending an email to info-test@ aeroflex.com.

Portable Spectrum Analyzer

The RSA500A Series USB spectrum analyzers from Tektronix offer high performance portable spectrum analysis in a rugged battery-powered package. The RSA500 series was built to bring real-time spectrum analysis in order to solve the problems of spectrum managers, interference hunters and network maintenance personnel who need to track down hard to find interferers, maintain RF networks and keep records of their efforts. The heart of the system is the USB-based RF spectrum analyzer that captures 40 MHz bandwidths with great fidelity in harsh environments.

With 70 dB dynamic range and frequency coverage to 7.5 GHz, all signals of interest can be examined with high confidence in your measurement results. The USB form factor allows you to reduce the weight of the instrument by using it with a lightweight Windows tablet or laptop if you wish. The optional tracking generator enables gain/loss measurements for quick tests of filters, duplexers and other network elements, and you can add cable and antenna measurements of VSWR, return loss, distance to fault and cable loss as needed.

The RSA500 series operates with SignalVu-PC, a powerful program used as the basis of Tek's traditional spectrum analyzers, offering a deep analysis capability previously unavailable in high performance battery-operated solutions.

Real-time processing of the DPX spectrum/spectrogram is enabled in your PC, further reducing the cost of hardware.

Features and benefits include:

- 9 kHz to 3.0/7.5 GHz frequency range covers a broad range of analysis needs
- 40 MHz acquisition bandwidth enables real time analysis for transient capture and vector analysis
- Standard GPS/GLONASS/Beidou receiver for mapping
- Optional tracking generator for gain/loss, antenna and cable measurements
- Streaming capture can be used to record and play back long term events
- Mil-Std 28800 Class 2 environmental, shock and vibration specifications for use in harsh conditions
- Internal battery for extended field operations
- SignalVu-PC software offers real time signal processing with DPX Spectrum/Spectrogram to minimize time spent on transient and interference hunting
- 100 μsec minimum signal duration with 100% probability of intercept ensure you see problems first time, every time
- Application programming interface included for development of custom programs
- Accessories including tablet PC, calibration kits, adapters and phase-stable cables offer a complete field solution for interference hunting and transmitter maintenance

Find more information at www.tektronix.com.

Laser Modules for Harsh Environments

On land, in water, or in the air, the area of application of lasers is unlimited; however, their operational capability is generally not. To prevent the laser from being damaged as a result of its

environment, LASER COMPONENTS has placed it in a housing that can withstand a wide range of harsh conditions.

Thanks to the IP67 protective class, the FLEXPOINT ® HD laser modules not only withstand sandstorms, they can also go into one-meter-deep water for up to thirty minutes. Because they are so robust, they are called heavy duty HD laser modules.

FLEXPOINT® HD modules are available as dot lasers, line lasers with fan angles from 10° to 100°, or cross-hair lasers with fan angles from 2° to 60°; for targeting, marking, or positioning tasks in absolutely any conceivable environment, they emit at 520 nm or 635 nm. High visibility in daylight is achieved with the 520 nm version.

The major advantage of green light is apparent on black surfaces, for example, car tires; red laser light is largely absorbed on such surfaces. However, green light stands out brightly and clearly – all at a power that is classified as eye safe. The focusing settings allow optimal adjustment for any distance, which allows any line to stand out clearly and concisely against the background. Both a waterproof M12 power connection and a voltage supply of up to 30 VDC are part of the FLEXPOINT® HD package. This leads the user to be able to easily connect to any machine or switch box. For independent operation, the module can also be connected to a rechargeable battery.

For more information, please visit www.lasercomponents.com/lc/product/laser-modules-for-industrial-applications/.

Coaxial Packaged Noise Sources Cover Frequency Bands Up to 60 GHz

Pasternack has greatly expanded their lines of coaxial packaged noise sources covering frequency bands up to 60 GHz. Various types of noise source design configurations are available including octave band and broadband noise sources, amplified noise sources, noise sources with integral isolators, and precision calibrated instrumentation grade noise sources.

Pasternack's new noise sources might generally be used as a reference source to measure system level noise figure for test and measurement applications. More specific applications could involve system and component level wireless testing, signal simulation, evaluating analog and DOCSYS CATVsystems to improve the dynamic range of analog-to-digital converters by dithering and reducing correlated noise. Additional applications could involve simulation of RF jamming systems for missile guidance, use as a source for bit error rate (BER) testing for SATCOM and digital radio systems, and a source for Gaussian jitter for testing of optoelectronic devices.

Pasternack has 30 different models that cover frequency bands ranging from 100 KHz to 60 GHz. Their portfolio of coaxial noise sources boasts a wide range of output ENR levels from 7 dB to 35 dB. The amplified models have output power levels ranging from -14 dBm to +10 dBm. Circuit board designs use packaged noise diodes and other discrete components that are tuned for optimum performance. Assemblies are enclosed in rugged metal packages with a variety of DC and output RF connector options. Most models in this family are designed to meet MIL-STD-202F environmental test conditions and all models are EAR99.
You can view the new noise sources by visiting www.pasternack.com/pages/RF-Microwave-and-Millimeter-Wave-Products/coaxial-packaged-noise-sources.html.