

*The Instrumentation and Measurement Magazine,
June 2008 issue*

The World of Measurements

From the Editor's Bench

Shlomo Engelberg

Disposable Equipment

Last year, the Electronics Department at the Jerusalem College of Technology, where I work, needed to buy new test equipment. In the past, we had bought relatively top-of-the-line equipment. This time we were working with a tighter budget, and we decided to compare some of the top-of-the-line equipment with some of the “discount brands.”

We decided that for our labs, there was no need to buy equipment that would last forever and that had a near-perfect user interface. We bought oscilloscopes that cost about US\$1,000 apiece, and we bought inexpensive signal generators and power supplies as well. We figured—correctly, I hope—that it was more sensible to replace the scopes every few years than to spend three times as much in order to get scopes that would never break down. Economically, I believe we did the right thing.

On the other hand, the very *idea* of disposable equipment bothers me. It is not that I am a particularly enthusiastic environmentalist. I try not to waste resources, but that is not really what concerns me here. Everywhere you turn, you see people who are out of work. Not infrequently they are out of work not because of some particular fault in themselves, but because they have become “dispensable.” We are so used to the idea of disposable “things” and to considering the economic implications of a course of action before considering the ethical implications, that we often ignore the long term ethical implications of our actions. I worry that each time we dispose of another piece of equipment we are learning to dispose of things. Today we dispose of equipment; tomorrow we may dispose of employees.

As the one in charge of the equipment budget and as a public servant, I think that I did the right thing when I saved money by buying inexpensive equipment. Because of the way features are added, it may even be best to use “disposable” equipment and buy new feature-rich equipment more frequently. It worries me that in acting as a responsible steward of other people’s money that I may be harming society as a whole.

I know of no way to completely reconcile our duties as employees and public servants with the responsibilities we have to society as a whole. We can but try to strike a reasonable balance.

In producing this magazine, we try to produce something of value in a way that helps society as a whole. Through the efforts of the many volunteers and professionals who contribute to the magazine, we provide content that, we hope, serves our readership well. In this month's issue, we have a host of interesting articles on a wide variety of subjects written by authors from around the world. We have articles about the tangent galvanometer; and measuring oxygen saturation in blood; a multisensor data fusion tutorial; and the first in a series of control theory tutorials. Enjoy!

Shlomo

President's Perspectives

Alessandro Ferrero

Strategic Plans

I am writing this column while flying back home from Louisville, Kentucky, USA, in February 2008 where I took part in the I&M Society Officers' and Editors' Retreat. I also attended the first Technical Activity Board, TAB, of the IEEE. It was the perfect occasion to talk about strategic plans for our Society and consider them in the larger frame of IEEE.

The statement "our big, worldwide I&M community needs good strategy" is obvious. However, in the everyday business of the Society, when all the officers are volunteering their time, so much time is consumed that it is worthwhile dedicating time to the definition and refinement of strategic plans. We started our brainstorming with two fundamental questions: "Who are we" and "What do we represent within the scientific and technical fields of engineering?" The answers are not as simple as they might appear. Consider that measurement applications span every field of human activity and that we use instruments and measurement results in almost every moment of our life. For example, we read an instrument when we look at our watch to check the time, or when we check the tachometer of our car to be sure that we are not passing the speed limits.

Do we find our identity by looking at different applications? There are so many applications to consider that we will surely overlook some and even with a complete list, we will probably never reach global agreement on the answers. If we look only at applications, what could somebody working in the low-frequency field have in common, for instance, with people working in the microwave field? Looking at applications only breaks the society into small, separate entities that could not survive on their own

If we consider what making a measurement actually means, we easily find common background underlying different applications and use that to define our common identity. Consider the answers to the simple question: “What time is it?” If we answer, “It is 1:30 pm”, we are simply reading the display of an instrument. We all know that making a measurement would result in a different answer- “It is 1:30 pm, plus/minus 1 second, with a confidence level of 95%”. *We make a measurement only if, after having read the instrument, we are capable of estimating, with a known level of confidence, how far the measured value is from the unknown value of the measurand.* This is the true common background of the I&M community.

We discussed this point during our Retreat meeting, and also what would be the best strategy to reinforce this identity and disseminate the I&M background among all engineers that are involved with instrumentation and measurement.

Two ideas emerged:

- Develop short on-line tutorials on everyday problems met when making measurements or using instruments. The topics will span typical examples of uncertainty estimation to the interpretation of Standards, from the best set-up of instruments for typical measurement applications to the definition of the best sampling strategy for typical signal characteristics, just to mention a few examples. The tutorial will be short, in order to offer quick, straightforward solutions to the considered problems, and will also provide a list of references for further investigations. We will ask for volunteer members who have the competence to record these tutorials.
- Give support to universities and professors who will start subjects on the fundamental of the measurement science. This idea is related to the education of new generations of I&M engineers. We recognize that the fundamentals of the measurement science should be part of the background of an I&M engineer, but are not generally covered in the curricula

offered to students in many Schools of Engineering. We would appreciate input from our academic members who already teach similar subjects.

I will bring these strategic plans to the next AdCom meeting to have them approved and discuss the best way to implement them into everyday business. I hope to announce to you soon the first tutorials and good news about education in the I&M field.

Alessandro

IEEE I&M Society Technical Committee Listing

Technical Committee	Description	Chair
TC-1	Measurement Precision, Sensitivity and Noise	Norm Belecki, n.belecki@ieee.org
TC-2	DC-LF Measurement	Yicheng Wang, yicheng.wang@nist.gov
TC-3	Frequency and Time	Eva Ferre-Pikal, evafp@uwyo.edu
TC-4	High Frequency Measurement	Yeon-Song (Brian) Lee, brian.lee@ieee.org
TC-5	Connectors in Measurements	Harman Banning, hbanning@wlgore.com
TC-6	Emerging Technologies in Measurements	Stephen F. Adam, s.adam@ieee.org Vincenzo Piuri, Piuri@dti.unimi.it
TC-7	Signals & Systems in Measurement	Laszo Sujbert, sujbert@mit.bme.hu
TC-8	Test and Instrument Systems Instrument-Computer Interface Subcommittee	Michael Stora, mjshome@optonline.net Robert Cram, robertcr@mdhost.cse.tek.com
TC-9	Sensor Technology	Kang Lee, Kang.Lee@nist.gov
TC-10	Waveform Generation Measurement and Analysis Waveform Recorder Subcommittee A/D Converters Subcommittee D/A Converters Subcommittee Pulse Techniques Subcommittee (SCOPT) Subcommittee on Probe Standards (SCOPS)	Thomas Linnenbrink, toml@hittite.com Bill Boyer, wbboyer@sandia.gov Steve Tilden, tilden_steve@ti.com Steve Tilden, tilden_steve@ti.com Nick Paulter, paulter@nist.gov Robert Graham, rmgraha@sandia.gov
TC-11	SCC-20 (ATLAS) Coordinators	Joseph J. Stanco, j.stanco@ieee.org Mark Kaufman, mark.kaufman@navy.mil
TC-13	Wireless & Telecommunications in Measurements	Reiner Thoma, reiner.thomae@tu-ilmenau.de
TC-15	Virtual Systems in Measurements	Emil Petriu, petriu@site.uottawa.ca
TC-16	Laser and Optical Systems in Measurements	Thierry Bosch, Thierry.Bosch@enseeiht.fr
TC-17	Materials in Measurements	Jacob Scharcanski, jacobs@inf.ufrgs.br
TC-18	Environmental Measurements	Michael Gard, mgard@ditchwitch.com Gabriele D'Antona, gabriele.dantona@polimi.it
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TC-25	Medical and Biological Measurements	Marco Parvis, marco.parvis@polito.it
TC-26	Radar Cross-Section Measurements	Mark Yeary, yeary@ieee.org
TC-27	Human Computer Interface and Interaction	Mel Siegel, mws@cmu.edu Peter Wide, peter.wide@tech.oru.se
TC-28	Instrumentation for Robotics and Automation	Emil Petriu, petriu@site.uottawa.ca Mel Siegel, mws@cmu.edu
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TC-33	Characterization of Electrical HF and Optical Non-Linear Components	Marc Vanden Boshe, marc.vanden_bossche@nmdg.be Yves Rolain, yves.rolain@vub.ac.be
TC-34	Nanotechnology in Instrumentation and Measurement	open
TC-35	Netcentric Operations Interoperability	open
TC-36	Industrial Inspection	Zheng Liu, zhengliu@nrc-cnrc.gc.ca David Forsyth, dforsyth@tri-austin.com
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"Open" positions indicate that TC chairs are needed.

Membership Notes

Jorge Fernández Daher

June 2008

I started as Vice President of Membership in January 2008. It is a great pleasure to have been elected and it represents a great challenge to me that I am willing to undertake. I would like to strengthen the relationship the membership committee started with our Chapter Chairs over the last two years and find new ideas that will help develop our Society.

One new program we developed is a funding program to promote technical activities in the Chapters. It is having good results. Last year we also established the Outstanding Chapter Award that will be given yearly. The Germany Chapter was the winner for 2006. I would like to encourage all of our members to participate and suggest new ideas so that our Society can better serve your needs.

In this issue, we start highlighting the activities of a chapter so we can share in what others are doing. In this issue, the Germany Chapter presents its activities since its creation in 2004. Please contact me at j.daher@ieee.org.

New Chapter

We are very pleased to welcome a new Chapter in the Long Island Section; Chapter chair, Nickolaos Golas (golas@telephonics.com). We look forward to working together to fulfill our members' needs. Recently, we have seen an increase in the number of chapters and we are very excited about it. You can create a new chapter in your section by filling out the forms at http://www.ieee.org/web/geo_activities/units/forms_petitions/socchap_form.html .

I&M Society Annual Outstanding Chapter Award

It is a pleasure to announce that our Society has recently developed the Outstanding Chapter Award. This award consists in a Certificate and cash award of US\$ 1000. The criteria adopted are based on membership increase; membership advancement/Senior member increase; and technical or societal activities. At the end of 2007, we received proposals from chapters for the 2006 award. The award was given to the Germany Chapter Chair and all the officers for their great job. We congratulate you!

We encourage Chapters to participate in the award for this year. All Chapters interested in the Award need to fill in the form and follow the guidelines found on the IMS website. Please contact me with any questions.

Jorge

Specific Chapter Activity

Since its foundation in late 2004, the German Chapter of the Instrumentation and Measurement Society, Germany Section, has set out to broaden activities according to the Chapter's aims to:

- establish a platform for IM Society members for knowledge exchange with industries and research institutes,
- enhance its membership to co-operate closely with the IM Society and the IEEE network, and
- to promote the formation of networks and interest groups for joint activities and research projects.

Each year, up to four Technical Meetings, as well as full-day seminars, are being organized to inform about the newest developments in relevant emerging fields. Emphasis is laid on the fields of sensor technologies, smart sensors and signal processing. In 2006 and 2007, workshop topics varied from measurement uncertainty and multi-dimensional sensor signal processing to material testing and sensors in automotives, 3D optical sensors or applications of haptic technologies. Active members initiated and organized these manifold activities along with the chapter board.

Emphasizing the international aspect of chapter activities, distinguished lecturers from abroad are being invited (in 2006 and 2007 from Canada, Switzerland and USA). Several activities, like a course lecture on measurement uncertainty for EE postgraduate students at Bundeswehr University Munich, given by Dr. Karl Ruhm from the ETH Zurich Metrology Education Center, and the organization of a Special Session on Multi-Sensors at IMTC 2005 in Ottawa, Canada, thankfully gained financial support from the IEEE I&M Society.

In 2006, the new seminar series "New Developments in Instrumentation and Measurement" was initiated in order to establish a well-recognizable platform of knowledge exchange and education. Seminars within this series are intended to be open to all interested. They are announced as Chapter events to the German I&M Chapter members and their co-workers, to interested scientists from the host site (scientific institutes, universities or industry)

and outside. The seminars take place in different parts of Germany to facilitate participation for colleagues and students from different regions.

The activities of the Chapter Board are focused on sharing novel ideas and strategies for strengthening the I&M Chapter. In order to promote the formation of networks and interest groups, a well-received Contact Forum was organized on the biennial; the largest sensor conference in Germany “Sensors and Measurement Systems” held March 13-14, 2006 in Freiburg. At the same event, an I&M Chapter “Best Paper” Award was promoted and funded for the first time. The awarding ceremony was held during the conference banquet.

At the 2007 IMTC conference in Warsaw, Poland, the German Chapter together with the I&M Chapters in Croatia and Italy launched the idea of an “Annual Regional Workshop Networking I&M Chapters”. The location of the workshops will change every year and will not be limited to countries where I&M chapters already exist. It is projected that these workshops lead to more chapter activities, the acquisition of new members, and the formation of new chapters within the I&M Society.

The Chapter work is very important for both members and IEEE. All I&M Chapter activities are aimed to bring added values to its members, to activate members and to attract new members, to trigger subsequent I&M chapter meetings and seminars and, last not least, to strengthen the local branch of IEEE. You can visit the Germany Chapter web site at:

<http://smarhome.unibw-muenchen.de/IMC/>

Submitted by Prof. Olfa Kanoun and Dr. Heinrich Ruser

Column Summaries

My Favorite Experiment

John Witzel

Spelunkers, how deep are you? *(Summary)*

“Ever wonder how deep that cave goes? Or if you are a rocketeer, where your model was at zero velocity? A simple experiment using the weight of the air can answer both these questions and more. Measuring pressure change and relating it to depth is the principle behind this experiment, although lowering the earth’s natural noise floor is the key to its successful application.”

The column describes the measurements that need to be taken, the science you need to know and the equipment to do it. You can even find out how far your son or daughter climbed today by adding the sensor to their backpack.

*The first paragraph of this summary
is taken from the column.*

Instrumentation Notes

Yoel Ainhoren, Shlomo Engelberg,
and Shai Friedman

The Cocktail Party Problem *(Summary)*

“Consider a cocktail party with many people attending and many conversations going on simultaneously. If we recorded the sound from somewhere in the room, we would find that we had recorded many conversations at once, and it would be very difficult to tell what was being said by any given person. The problem of taking such a recording, or several such recordings, and separating out the different speakers is known as the **cocktail party problem**.

The generalization of this problem to separating out different independent components of a signal without making use of any specific knowledge of the component signals is known as **blind source separation**. The ability to take a recording in which many people are speaking and to create separate tracks that contain what was said by each person is of great interest to industry and government.

We have tested many of the currently available methods of blind source separation and did not find a truly successful solution to the cocktail party problem. This column describes some of the methods we examined and the tests we performed.”

*This summary is the first
three paragraphs of the column.*

New Products

Bob Goldberg

(Summary)

Oscilloscopes for PCI, PXI, VXI, & LAN Run at 4 Gigasample Rate, by ZTEC Instruments

The new ZT4610 series of digital storage oscilloscopes with high speed software interface.

www.ztechinstruments.com

Microwave Analog Signal Generator with fast switching speeds by Agilent Technologies

It provides frequency coverage to 20, 32 or 40 GHz, well suited for EW, radar, military communications and broadband wireless access applications.

www.agilent.com/find/N5183A.

Multi-Channel Signal Conditioner with Individual Input Ground Isolation

Eliminates ground loops, well suited for applications where a very low noise floor is required

www.endevco.com

Economical Sensors for Switch Point Detection by TURCK

PK pressure sensors for switch point detection for air and inert gas applications: pneumatic and robotic

www.turck.com

Family of Hall-Effect Sensors Integrates Microcontroller and Digital Interfaces by

Micronas; the HAL 28xy series for automotive and mechatronic applications

www.micronas.com

Hand-Held, Two Channel Data Recorder System with Integral Printer by Astro-Med

The Dash 2EZ+, a two- channel, hand-held data acquisition system with integral chart recorder

mtgroup@astromed.com.

Silicon Diode Array Improves Communication Line Protection from ESD and Other Overvoltage Threats by Littelfuse, Inc. The SP72x Series of SCR Diode Arrays provide

overvoltage protection of microprocessor/logic inputs, data bus lines, analog device inputs, and many other voltage clamp applications

www.littelfuse.com.

Radio Access Network Infrastructure Testing by Aeroflex

The TM500 LTE test mobile addresses the challenges of 3G Long Term Evolution network infrastructure development test and rollout and provides complete visibility into even the lowest layers of the radio modem

www.aeroflex.com

Accurate, Low Cost General Purpose Temperature Sensor by Spectrum Sensors & Controls
Monitors air temperatures or ideal for standard controllers or data loggers

www.SpecSensors.com

Copper Flex Assembly from Molex Incorporated and Neoconix

Low-profile contact interface integrates Molex Copper Flex with Neoconix's HD&S PC Beam interposer for flex-to-PCBA applications

www.molex.com/product/flexinterposer.html

Enclosures Meet Increased Safety Requirements for Hazardous Location by Hoffman

ATEX-certified ZONEX™ Enclosures, designed for use in potentially hazardous locations

www.hoffmanonline.com

High Dynamic Range USB Power Meters Perform to 26.5 GHz by Satori Technology

The ST265USB are complete miniature RF & Microwave Power Meters.

www.satori-technology.com/products.htm

Optical Return Loss (ORL) Module for Multiple Application Test System (MATS) by Yokogawa Corporation of America

This module measures optical return loss while simultaneously measuring insertion loss (IL).

www.yokogawa.com.

Article Summaries

The Measurement of Oxygen Saturation in Arterial and Venous Blood

Meir Nitzan and Haim Taitelbaum

(Summary)

The oxygen concentration of a person's blood offers significant information relating to their overall health for conditions dealing with the heart, lungs, and blood. Unfortunately, a common non-invasive *and* reliable measurement technique for oxygen levels in blood has yet to be decided upon in the medical community. This article examines the accuracy and technicalities of known methods to provoke in its readers an informed opinion on the topic, and also points out areas in need of improvement. Some methods described are Pulse Oximetry and multiple cases involving spectroscopy.

This summary was written by Caitlin Woody

The Tangent Galvanometer of Johan Jacob Nervander

Jukka Venermo and Ari Sihvola

(Summary)

How far has technology come in the past 200 years? Can first generation instruments prove themselves still useful, and maybe even compare to their present day reconstructions? Two engineers tested these questions using the Tangent Galvanometer as their subject, first invented by John Jacob Nervander in 1834. The experiment was in celebration of Nervander's 200th birthday, and concludes with surprising results! Read on to learn about the history of galvanometry and its contributors, as well as a background on Nervander, one of the lesser-known fathers of the science.

This summary was written by Caitlin Woody

Tutorial 14: Multisensor Data Fusion

David Macii, Andrea. Boni, Mariolino De Cecco and Dario Petri

(Summary)

You're driving 60 mph down the highway, worrying about the time crunch you're in to get to your destination. You check the clock one more time and without a warning, the driver to your front-left swirves into your lane and you're suddenly headed for a collision. You're reflexes can't act fast enough and it is up to your car to decide what to do. Do airbags deploy? Does your

car take over your manual control of the wheel? Of the breaks? In a split second, your car makes the decision to veer right and avoids the accident for you.

Thanks to data fusion technology, scenerios such as this one will be possible in the near future. Multisensor data fusion, the communication of sensors throughout a system to arrive at one deduction, is expected to have a significant impact on automovitve safety. “This tutorial provides readers with a basic overview of data fusion terminology, models, and algorithms with the help of some examples related to next-generation car safety and driver assistance systems.”

This summary was written by Caitlin Woody

Tutorial 15: Control Theory, Part I

Shlomo Engelberg

(Summary)

“Control theory is the branch of engineering that tries to answer questions like “given a system configured in a particular fashion, will the system behave reasonably?” That is, control theory deals with **analyzing systems**. [It] also tries to answer the question “given a system with (negative) feedback, what can I add to my system to see to it that my system will meet its specifications?” That is, control theory deals with **designing systems**, too.”

In this article, Engelberg offers an overview of control theory including past use and understanding, how it is utilized in instrumentation and measurement, and particularly its connection to negative feedback. Negative feedback is broadly examined to demonstrate its key role in analyzing and designing systems with proper regard, and also the cons that result from incorrect use of negative feedback. This work is the introduction to a series by Engelberg that investigates the mathematical theory of control.

*This summary was written by Caitlin Woody;
the quotations are from the article*