

The Florida West Coast Section of the IEEE

Serving over 2,300 members in Charlotte,
Citrus, DeSoto, Hardee, Hernando,
Hillsborough, Lee, Manatee, Pasco, Pinellas,
Polk, and Sarasota Counties



THE

SUNCOAST

SIGNAL

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

<http://www.ieee.org/fwcs>

Volume 49 - No. 6

June 2006

Inside this Signal...

Page 2

Editor's Column
LightningMaster
ISI

Page 3

A to Z Substation Design

Page 4

What's In It for Me?
Siliconexion, Inc.
Great Seminar on UL

Page 5

41st Annual IEEE Industry
Applications Society
A Day of a DSP Engineer

Page 6

Students to Go to IMS 2006
Commodore Computer
Computational Intelligence

Page 7

TISP
Teachers Needed
Did You Miss It?

Page 8

IEEE-USA—
Feynman/Nanotech

Page 9

Brain Teaser Challenge
GE Donation Matching
IEEE Benefits



Dinner Meeting with

Distinguished Speaker—Professor Larry Bernstein

Trustworthy Software Systems

Date Tuesday June 6, 2006

Time 6 pm; Dinner 6:45; Talk 7 pm

Location Johnny Carino's Italian
Restaurant 1102 N. Dale Mabry
Highway, Tampa.

Cost \$10 IEEE Members, \$20 Non-
(Includes dinner, desert and Drinks)

RSVP <http://time2meet.com/fwcs-meetings/>

Questions Jim Lumia at 813-832-3501 or
JLumia@ieee.org

Much software engineering focuses on cost and schedule, especially schedule. A shift is needed. The software engineer must make judgments or tradeoffs among the features the software provides, the time it will take to produce the software, the cost of producing the software, how easy it is to use and how reliable it is. Too often performance and functional technical requirements become an issue once the software is deployed. Rarely is trustworthiness considered. Not only must software designers consider how the software will perform they must account for consequences of failures. System requirements must encompass trustworthiness.

Trustworthy software is stable software. It is sufficiently fault-tolerant, not crashing at minor flaws, and will shut down in an orderly way in the face of major trauma. The National Institute of Standards and Technology defines trustworthiness as "software that can and must be trusted to work dependably in some critical function." Failure to do so may have catastrophic results, such as serious injury, lost of life or property, business failure or breach of security. Some examples include software used in safety systems of nuclear power plants, transportation systems, medical devices, electronic banking, automatic manufacturing, and military systems.

This talk presents principles of requirements for trustworthy software for intensive systems of systems. The theme is a process for obtaining a quantitative and feasible set of software feature requirements. The approach is to deduce a Measurable Operational Value from a customer prospectus, establish feature sets, set priorities using a simplified quality function deployment approach, validate the feature packages with prototypes, and extend the prototypes to models.

See Bernstein p. 3



2005 IEEE EXECUTIVE COMMITTEE FLORIDA WEST COAST SECTION

CHAIR: Angela Alexander
Honeywell, 727-539-2331
Angela.alexander@ieee.org

VICE CHAIR: Jim Anderson
813-417-8854
jim.anderson@ieee.org

SECRETARY: Jules Joslow,
941-351-4812 joslow@ieee.org

TREASURER: Ralph Painter,
Tampa Electric Co. (813) 228-4685
rdpainter@ieee.org

SIGNAL EDITOR: Dr. Paul Schnitzler,
USF PS&A (813)-974-5584 paulschn@ieee.org

AWARDS: Richard Beatie, PE
r.beatie@ieee.org

BYLAWS: Richard Beatie, PE, Consultant
(813)-289-0252 r.beatie@ieee.org

EDUCATION: Dr. Rudolf E. Henning and Zhen Tong
(813) 974-4782 or (727) 328-8777 (Ext: 333)
henning@eng.usf.edu or tong@ieee.org

PACE: Scott Haynes, Honeywell
(727)-539-3358, scott.haynes@ieee.org
Richard Martino, Consultant
(727) 536-1776, richard@richardmartino.com

MEMBERSHIP: Tom Blair, TECO Energy,
813-228-1111 (ext: 34407) tom_blair@ieee.org

STUDENT BRANCH CO-ADVISORS:
Dr. Paul Schnitzler, USF PS&A
(813)-974-5584 pauls@eng.usf.edu
Dr. Chris Ferekides, USF, (813)-974-5737
fereked@eng.usf.edu
Dr. Srinivas Katkoori, USF, (813)-974-5737
katkoori@ieee.org

STUDENT BRANCH MENTOR: Jim Howard
Lakeland Electric (863) 834-6506
j.howard@ieee.org (H) (813) 876-1748

STUDENT BRANCH:
Aaron Meltzer, IEEE; runner_25@yahoo.com
Upavan Gupta, IEEECS
(813)-974-1348, ugupta@csee.usf.edu

PES/IAS CHAPTER: Ghaff Khazami
(813) 960-0990 gkhazami@megaway.com

MTT/AP/ED CHAPTER: Ken A. O' Connor
kenoconnor@ieee.org

COMP/AESS CHAPTER: James S. Lumia
(813) 832-3501, jlumia@ieee.org

SP/COMM CHAPTER: Hüseyin Arslan
USF (813) 974-3940
arslan@eng.usf.edu

LIFE MEMBER AFFINITY GROUP: Jules Joslow
941-351-4812 joslow@ieee.org

GOLD: Kristy Baksh, knbaksh@gmail.com
Dennis Trask, d.trask@ieee.org (813) 366-4201

WEB PAGE: <http://www.ieee.org/fwcs>

WEB MASTER: Jim Anderson, jim.anderson@ieee.org

THE SUNCOAST SIGNAL is published monthly by the Florida West Coast Section (FWCS) of the Institute of Electrical and Electronics Engineers, Inc. (IEEE). THE SUNCOAST SIGNAL is sent each month to members of the IEEE on Florida's West Coast. Annual subscription is included in the IEEE membership dues. The opinions expressed, as well as the technical accuracy of authors, advertisers or speakers published in this newsletter are those of the individual authors, advertisers, and speakers. Therefore, no endorsement by the IEEE, its officers, or its members is made or implied.

All material for THE SUNCOAST SIGNAL is due in electronic form by 1st Friday after the 1st Tuesday of the month preceding the issue month. Address all correspondence to:

Dr. Paul Schnitzler, P S & A USF
30612 Nickerson Loop, Wesley Chapel, FL 33543
Telephone: (813) 994-2297; (813) 974-5584
E-MAIL: paulschn@ieee.org
The Signal, Copyright 2006

Editor's Column

We live in an era of the very high: very high capacity, very high data-rates, very high density, very high availability—very high everything. Think power, communications, nanotechnology, software; all of these and more are highlighted in current and future FWCS activities. Even this month, a distinguished speaker will talk about trustworthy software systems, and, while not exceptionally high power, learn how to get power through better substation design, from our own Ghaff Khazami

And don't miss the article (p. 8) on one of the most fascinating physicists of our time, Richard Feynman, and his presaging of nanotechnology. He was talking in 1959 on how "the entire contents of the Encyclopedia Britannica" might be stored on the head of a pin!

Read the Suncoast Signal and go to these stimulating meetings. This is your organization; support your technology chapter! —PS



(Advertisements)



Richard E. Beatie, P.E.
Regional Sales Manager

1351 N. Arcturus Ave. (33765) (800) 749-6800 Voice
Post Office Box 6017 (727) 580-3598 Cell
Clearwater, FL 33758-6017 (727) 499-0138 Fax
www.lightningmaster.com
RBeatie@LightningMaster.com





INTERSECURITIES, INC.

1212 Highland Avenue S #2

(801) 469-8043 Fax
(727) 515-3439 Mobile
ssingh@isimail.com

Branch Office: 611 Druid Rd. East, Suite #103, Clearwater, FL 33756 (727) 450-1625
Member NASD, SIPC and Registered Investment Advisor

Satendra "SP" Singh
Registered Representative
Investment Advisor Representative

Call me
for your retirement planning and investment needs.

ISI can help with

- 401K's
- IRA's
- Roth IRA's
- college funding 529 Plans
- life insurance

to meet group and individual needs. My engineering background of over 30 years qualifies me to understand engineers and to help them with their financial planning and investment needs. Note, health insurance is not a service of ISI. IEEE member since 1969.

LD20552-01/06



A to Z Substation Design

A meeting with the FECA Engineers Conference

Speaker: Ghaff Khazami, PE Chair. PES/IAS Chapter, FWCS
Date & Time: June 8, 2006, 8:15 AM – 1:45 PM
Location: FECA Engineers Conference
Sheraton Sand Key Resort, 1160 Gulf Blvd, Clearwater, FL 33767 727-595-1611
RSVP: Ray Trusik rtrusik@fecacom 850-877-6166 Ext. 5. Fax to: (850) 656-5485
Cost : IEEE Members \$100 Non members \$150
PDH: 4 Continuing Education Hours for Engineers will be provided by IEEE EXP00015.

For more information look for the Florida West Coast Section of the IEEE at <http://www.ieee.org/fwcs>

This seminar is intended for power Utility Engineers, Operations & Maintenance Personnel. It will provide a step by step process to complete the design and construction of a Transmission and Distribution Substations.

The speaker will provide a comprehensive presentation based the latest information on the following:

- Design Standards
- Environmental Regulations And Permitting
- Substation Automation And Communication Interfacing
- Bus Configuration Design
- Equipment Selection
- Protection Schemes
- Metering Requirements
- Update on the latest Energy Policy
- Substation Operating Instructions and Documentation

Also an update on the latest energy policy related to system documentation, data gathering in the new and existing substations.

Speaker:



Ghaff Khazami is a Senior Member of IEEE, PES/IAS Chairman for FWCS of IEEE and Vice president of Megaway Inc. Consulting Engineers in Tampa. He is a Professional Engineer registered in the States of Florida and Wisconsin. Ghaff is an alumnus of the University of South Florida with over twenty five years experience in the Power Utilities Industry, specializing in Consulting and Design of Substations, Transmission Lines, System Protection and Power System Analysis. Ghaff is a retiree from a G&T Company, Seminole Electric Cooperative Inc; and has been involved in numerous Substation and Transmission projects as a Manager and Consultant.

For directions see <http://www.sheratonsandkey.com/Directions.asp>



Bernstein cont.

Larry Bernstein is the Industry Research Professor of Software Engineering at Stevens Institute of Technology, Hoboken, NJ. He is Director of the Quantitative Software Engineering Program and teaches Quantitative Software Engineering.

His recent book is Trustworthy Systems Through Quantitative Software Engineering. He was a 35-year distinguished executive at Bell Laboratories managing large software projects and his systems are used worldwide. He now heads his own consulting firm and is an IEEE Fellow and an ACM Fellow. Larry is also a board member of the Center for National Software Studies and a director of the NJ Center for Software Engineering

Dinner: A dinner choice of 6 entrees with salad, beverage and desert will be served for a special price of \$10 for members and \$20 for non members. See the meeting web site for details.

Join IEEE and your meal is free! Email JLumia@ieee.org for details.

Don't miss this special event with Professor Bernstein. Please register early for this meeting at: <http://time2meet.com/fwcs-meetings/>

For more information or special menu requests, contact Jim Lumia, Computer Society and AESS Chairman, at 813-832-3501 or JLumia@ieee.org

What's In It for Me? The 3 Phases of IEEE Membership

I've been doing a lot of thinking lately about why I keep paying my \$200+ annual membership fees to belong to the IEEE. You can get a pretty nice iPod for that amount of money and so my thinking has been centered around trying to answer the question of what I am getting out of my membership (those iPods sure are pretty...)

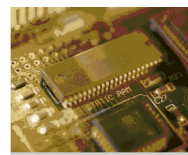
What I have come to understand is that there are three distinctly different phases to an IEEE membership. Depending on where you are in your career and what your personal goals are determines what phase you are currently in. The current value of belonging to IEEE differs depending on which phase you are in. I'm a Marketing guy at heart and so of course I've given these phases names: Get, Grow, and Give.

When we first join the IEEE we enter the Get phase. It truly is all about us – what can the IEEE do for me, me, me. It turns out that it can do quite a bit: reading the Spectrum magazine is what we all do and it keeps us up-to-date on major engineering developments. If you've joined a Chapter then you are also kept up on developments in those areas that you have chosen to specialize in. The Get phase is basically a one-way feed from the IEEE to you.

Many of us stay in the Get phase forever. However, some move on to the Grow phase. In this phase, we start to participate in IEEE activities such as local EXCOM meetings, Chapter events, and perhaps even attending some IEEE conferences. We do this for a variety of reasons, but one of the most important ones is to do that professional networking that we've read so much about but never seem to find the time to do. This phase is a two way connection, the IEEE is still providing a big feed to you, but you are now providing value back to the IEEE.

The final phase is the Give phase. This seems to occur most often when Engineers retire. Searching for something to do and unwilling to discard a lifetime of learning a difficult skill, these IEEE members start to volunteer their time. A lot of time gets spent working to make sure that the schools and universities are able to turn out the next generation of engineers. The IEEE provides lots of awards and recognitions for the members who give so much of their time and talents. The phase is still two way; however, the big feed is now from you to the IEEE with the smaller feed being from the IEEE to you.

We all grow and change over the course of our career and our lives. Our membership in the IEEE also changes with us. The opportunity to Get, Grow, and Give is what makes the membership worth its annual fee. An iPod sure would be nice to have, but it won't last for a lifetime—it only has two phases: on/off. My IEEE membership offers me so much more... —JA



Siliconexion, Inc.

FPGA Design and Verification Experts

Siliconexion offers robust, on-time electronic design consulting services by experienced senior level professionals.

Applications Include:

Telecommunications / Data Communications
Aerospace and Military
Embedded Computer Systems

Services Include:

FPGA / CPLD Design and Verification
ASIC to FPGA Conversions
Training for FPGA Design, VHDL, Test Benches
Digital and Analog Board-level Hardware Design
Embedded Systems Software Development
High Speed Signal Integrity Analysis

Cost Effective sub-system or turnkey product development

Phone: 727 596-1990

**E-mail: info@siliconexion.com
www.siliconexion.com**



Great Seminar on UL Listings

On Friday, April 21, Seminole Electric hosted IEEE for a seminar on what is a third party listing and what it means. The class was taught by Mr. Paul D. Evers who made a presentation of the history of third party certifications and described the various listings available and what they do and do not cover. There was a demonstration of online research resources available at www.ul.org. In addition to the PDH certificate for the seminar, non IEEE members received a ½ year membership in IEEE. —TB





The 41st Annual Meeting of the IEEE Industry Applications Society

Tampa Marriott Waterside Hotel—October 8-12, 2006

The technical program for the 2006 IAS Annual Meeting includes exciting technical paper presentations, panel discussions, and vendor presentations spanning a very broad range of industrial applications including lighting, mining, metals, appliances, electric machines, power electronics and drives, power systems, and many others. These presentation forums will focus on product applications, industry standards, manufacturing and production strategies and techniques, and research advances. In addition, we will have special dedicated sessions targeting display technologies, automotive application, and appliances. We will also have special targeted sessions where manufacturers and vendors are discussing specific applications of products to solve application problems.

We anticipate approximately 65 conference sessions in these different industry application areas and a partial list of the tentative session titles is shown below. Each session usually lasts 4 hours and there are multiple sessions occurring in parallel. Because we will adhere to the schedule as it ultimately appears in the final program, it will be possible (and very common!) for attendees to freely move between sessions to attend discussions and presentations that are of interest. Group-level and one-on-one interactions between the conference attendees, discussion leaders, and presenters are strongly encouraged and time is specifically allocated for these discussions during each session and during break periods.

While this list of sessions is tentative at this time, it gives you an idea of the technical application areas that will be discussed so that you can begin to make your travel plans. We will update this information as we move closer to the conference and the complete program should be available by mid-summer. Please monitor the conference web site for any updates.

Partial List of Conference Sessions

Special Focus Sessions

Display Technology
Automotive Drives & Systems
Automotive Generators & Actuators
Motor drive Systems in Appliances
Energy Conversion in Appliances

Products & Services Sessions

Power Electronic Devices & Components
Industrial Power Semiconductor Devices

Technical Paper Sessions

Power & Energy Systems
Intelligent Controls
Advanced Controls
Industrial Controls
Motion Control Systems
Primary Metals
Semiconductor Models
Devices in Power Converters

Thermal Models
Power Modules and Integration
SiC Devices and Applications
EMI and High Frequency Effects
Induction Machine Drives
PM Machine Drives
Traction Drives
Special Application Drives
PM Sensorless Drives
Safety and Productivity
High-Power Rectifiers and Drives
Industrial Power Systems Reliability
Industrial Power Systems Design
Industrial Power Systems Analysis
Industrial Power System Protection
Power Quality
Induction Motors
Permanent Magnet Motors
PM Motor Design Optimization

System Diagnostics
Linear Machines
Interior Permanent Magnet Motors
Reluctance Machines
Large Machines and Generators
Active Power Filters
Multilevel Converters
Design & Control of Power Converters
DC/DC Converters
Alternative Energy Applications
PWM and Control Techniques
Customer/Utility Interface
Soft Switching and Resonant Converters
Control Applications
Ballasts for Fluorescent Lamps
Ballasts for HID lamps #1
Light Sources
Light Emitting Diodes



Day in the Life of a DSP Engineer with LTC Engineering —Great Student Service

On Tuesday, April 18, a presentation by LTC Engineering Associates of Sarasota, Florida was hosted jointly by the University of South Florida and the IEEE Communications Society, Computer Society and the Aerospace and Electronic Systems Society. This very informative seminar was conducted by Rene Hernandez and Nathan Tillman from LTC. The talk targeted those approaching graduation and wondering what happens upon entering the workforce. Topics included such things as projects tackled by a DSP engineer working in the area of communications, and the tools used to get the job

done. Visit the LTC website for more information about their organization and capabilities <http://www.LTCeng.com>.

The FWCS of SP/COM Joint Chapter, Computer Society and AESS are grateful to LTC Engineering Associates for providing this service to the local IEEE. The local IEEE also thanks Jeremy Ludes, Dr Ravi Sankar and Dr. Huseyin Arslan for coordinated the event at USF. For those that missed this presentation please check the monthly Signal for a similar presentation coming up this Fall.
—JL/DC

IEEE Students Are Fund Raising for IMS 2006 Conference

The International Microwave Symposium—2006 (11 Jun – 16 Jun 2006) is an excellent opportunity for Electrical Engineering students to represent the FWCS Section and USF at this distinguished event.

This is also an opportunity for IEEE student members to attend workshops, panel discussions and technical sessions presenting the latest results in international microwave research; meet with representatives from companies and organizations with microwave related products and interests; meet and interact with fellow students working in related fields; take in all the information presented in the technical and poster sessions to share with other students back at the University of South Florida; and meet leaders in the field from both academia and industry.

Three USF IEEE student members would like to attend but are unable to afford the cost. The three EE graduate students are Suzette Presas, Diana Aristizabal, and Bojana Zivanovic. Perhaps you or your organization can help these three students attend this year. Please contact: Paul Schnitzler paulschn@ieee.org

Funds Needed

Hotel: \$150/day for 6 days= \$900

for one room to be shared by three students

Registration: \$100 per student *Plane Ticket:* \$300 each

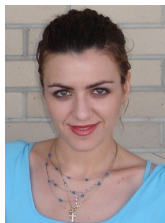
Food: \$40/day for 6 days= \$240 per student



Suzette Presas



Diana Aristizabal



Bojana Zivanovic



FWC Chapter—Computational Intelligence Society

The IEEE Computational Intelligence Society (CIS) was formed to bring together people with interests in neural networks, fuzzy systems and evolutionary computing. “Mimicking nature for problem solving” characterizes the paradigms represented by this society, which itself evolved not long ago from the IEEE Neural Network Society. Researchers and practitioners from many fields have found the techniques and ideas that have come out of these nature-inspired approaches to computing to be useful in their own work, even if they would not consider themselves to be in the “computational intelligence field.”

“Rise and Demise of Commodore Computer” Meeting Was a Hit!

A real treat was received by the Life, Computer Society, and Section members that attended the April 17 luncheon meeting featuring the history of the Commodore Computer. Tom Hyltin, a member of the Commodore team and IEEE Life Fellow, traced the interesting life of Jack Tramiel, the founder of Commodore. Jack was an immigrant from Poland. Arriving after WWII, he enrolled in an IBM electric typewriter school. After serving in the U.S. Army, he started his own successful typewriter repair business. And when PCs first hit the market, he started Commodore and enjoyed success. There were thirty million sold! But for various reasons, Commodore did not keep up with the rapidly changing world of PCs and the company declined rapidly.

Tom showed photos of the people and equipment involved. He also had one picture of the early Microsoft staff when there were only eleven people, including a very young Bill Gates. Those people are very comfortable these days. So is Jack, by the way! If you missed this meeting and would like some Commodore history, go to

<http://www.skillreactor.org/cgi-bin/index.pl?jtramiel>.

Be sure to read the SIGNAL for the notice of the next Life Members meeting. If you have an interesting story to tell, please contact Jules Joslow (joslow@ieee.org). —JJ/JL



Tom Hyltin (left) explaining some Commodore details

It's time to provide a recurring opportunity for people interested in these developing areas of computing to get together, to hear about new developments and work in the field, and to discuss their own work with researchers and users who may have similar or very different perspectives from their own. Cross-pollination of knowledge can be a very good thing, and we hope to provide a fertile ground for ideas.

Interested? Send an e-mail to armitage@lakeland.usf.edu, and we'll get back to you with further information. If you are a current CIS member, please mention that in your e-mail, as we need a specified minimum number of CIS members to form the Chapter.

Teacher in Service Program Update

The FWCS Teacher In Service Program has been moving ahead with gusto. The initial events have been in-classroom programs that are intended to attract the actual in-service sessions.

After the first Teacher In Service Presentation held at Northeast High School (NEHI Pinellas county), teacher Felix McCauley e-mailed his gratitude:

"The kids still have not come down from your IEEE Motor Controller presentation this past Tuesday. As expected, it was the high point of this semester. It is difficult to determine the long-range impact such an experience can have on kids; however, the immediate response has been quite overwhelming.

"I hope you will continue your superb contribution within the Pinellas County School system. If i can assist you in any way, please let me know."

He continued in a note to Bob Orlopp of the Pinellas County Schools

"I wanted to fill you in on the IEEE "Motor Controller" presentation Sean Denny and his colleagues made for our NEHI Physics II class earlier this week. Sean was accompanied by Scott Haynes, a Guidance System Reliability Engineer at Honeywell and Tom Blair, the featured speaker and an engineer specializing in Power Generation at TECO. Tom is a superb instructor and brought a trunk-load of hardware to support his "very hands-on" instruction. Tom covered wave transformation and cycling in a manner that would be very difficult for even the most effectively equipped high school lab to replicate. Both Scott and Sean contributed to the presentation and fielded the students' many questions."

Sean and his team are to be commended for this work. For additional information on this program, contact Sean Denny at Venner20@aol.com.



Tom Blair at Northeast High School

Life Members as Teachers

The Alternative Teaching Certificate Program at Manatee Community College in Bradenton, Florida is part of a state backed initiative to get more qualified teachers into the classrooms. It focuses on the critical shortage areas of math, science, reading and special education. We have had a few retired engineers in the program, and they make excellent teachers! Our next training cohort begins May 10th. We will also have a cohort starting on August 22nd.

This program is designed to take people with little or no teaching background and give them all the courses necessary to become permanently certified in the state of Florida. The classes include Classroom Management, Technology, Diversity, etc.

The classrooms in Florida desperately need qualified math and science teachers, and we believe that many retired engineering professionals will find the challenge and rewards of teaching to be quite a fulfilling career change for them.

If you have any questions about our program please contact Vick Vercauteren ACP Recruiter/Advisor Manatee Community College 5840 26th Street West Bradenton, Florida 34207 (941)-752-5411

Email: vercauv@mccfl.edu www.mccfl.edu/teachered



Did You Miss It?

The PE/IA FWCS Chapter had a very informative meeting on Tuesday, April 18th at TECO Hall. George Matzke from Gulfstream Gas provided a great update on the gas situation for Florida and included the projections of availability of gas for the state in the upcoming years. Some of the interesting questions George answered for the group included:

Are there operating oil wells in Florida? (Answer is yes – surprised?)

Are there only two gas transmission suppliers supplying all of Florida?

When will the two gas lines supplying the natural gas for Florida reach capacity?

What are the operating differences between the two gas suppliers in the state?

How is the gas collected from the many wells throughout the Gulf of Mexico for inclusion in the pipeline?

What affects did the Hurricanes have on the operation of the Gulfstream pipeline?

Are the two major gas suppliers for the state of Florida tied together in any way?

Why can't we have large supplies of gas stored in Florida as they do in other areas of the US?

George answered these and many other questions with his very enlightening presentation.

Your PE/IA Officers are doing their best to bring you informative and interesting meetings, so please be sure to attend and show your support for their hard work on your behalf. —JH

There's Plenty of Room at the Bottom: Richard Feynman's Big Dream for Small Things

by Kim Breitfelder

May 2006 <http://www.todaysengineer.org/2006/May/history.asp>

[On occasion, we will publish an article that is interesting and off-beat. Here is this month's entry. —the Editor]

The field of nanotechnology is in its infancy, but that doesn't mean it doesn't have a heritage. And although nanotechnology's destination is widely debated and largely uncertain, looking back at its historical roots — although relatively shallow — helps us get a better grasp on what nanotechnology is, why it's important now, and how it will change the world in the future.

The story of nanotechnology (technology smaller than a nanometer, or one billionth of a meter) begins in the 1950s and 1960s, when most engineers were thinking big, not small. In an era of big cars, big bombs, big buildings, and big plans for sending people into outer space, the electronics industry began its ongoing love affair with making things small. The invention of the transistor in 1947 and the first integrated circuits in the late 1950s launched an era of electronics miniaturization.

It was within that context that, on 29 December 1959, physicist Richard Feynman delivered a public lecture, "There's Plenty of Room at the Bottom." While few took notice at the time, Feynman's words are believed to have inspired the new field of nanotechnology. Delivered at the meeting of a local California chapter of the American Physical Society, the talk opened with Feynman announcing that he had identified what might someday be considered an entirely new field — but not a field of technology. Although he called it a field of physics — the study of matter — he went on to describe what might more accurately be called a field of science-based engineering.

In his lecture, Feynman described something very curious: potentially writing an enormous amount of text, perhaps the entire contents of the Encyclopedia Britannica, in a space about the size of the head of a pin. He described how this could be done using techniques available to engineers in 1959. He further surmised that all the information in every book in a library could theoretically be converted to digital information and "stored" as "bits" consisting of particles of just a few atoms each, built in two different shapes to represent 0s and 1s. This would pack much more information into an even smaller space, and Feynman believed that the entire contents of the world's great libraries could fit in something the size of a dust mite. If information could be condensed, Feynman then argued, so too could the information machine, the computer. Perhaps not aware that the integrated circuit had been invented earlier that year, Feynman suggested that tiny computers could be made by fabricating all the necessary wires and components using chemical techniques, to form a small, solid "block" containing all the necessary electronics.

But Feynman saw even more interesting possibilities, not only in microelectronics but also in micromachines. What if, he speculated, it were possible to construct tiny machines specially designed to perform some simple surgical operation inside the body? Medicine would be revolutionized. In addition to micromachines, Feynman also believed that constructing useful things could be done at the atomic level, by manipulating individual atoms to arrange them however the engineer or scientist wanted. Then, he reasoned, compounds and chemicals for drugs or other purposes could be easily manufactured, limited only by the imagination of the chemist. Feynman closed with a challenge to engineers to carry out some of the tasks he had mentioned, specifically reducing printed information to a size that could only be read with an electron microscope, and making a functional electric motor no larger than 1/64th of an inch square.

A few months later, *Engineering and Science* magazine published an account of the Feynman's lecture. Despite the article and the fact that some of his predictions for tiny computers were being realized in the form of digital integrated circuits, Feynman's talk remained largely forgotten for the next two decades. In the 1980s, physicist K. Eric Drexler rediscovered the Feynman article, and he expanded on Feynman's limited vision of tiny drills and lathes, microscopic toy automobiles, pin-head encyclopedias, miniaturized computer circuits, and customized chemicals. Drexler called his broader approach "nanotechnology," but credited Feynman with the inspiration.

Feynman's hypotheses and predictions have often been misconstrued as a sort of vision of the future, but his proposal was brief, vague and founded on the technologies of the late 1950s. Nonetheless, he deserves credit for recognizing one of the most important technological trends of the late 20th century, one that promises to make the 21st century very interesting.

This article is adapted from the IEEE Virtual Museum exhibit, *Small is Big: The Coming Nanotechnology Revolution*. To see the full exhibit, visit www.ieee.org/museum.

IEEE-USA is an organizational unit of the Institute of Electrical and Electronics Engineers, Inc. created in 1973 to support the career and public policy interests of IEEE's U.S. members. IEEE-USA's mission as outlined in the IEEE Bylaws is to recommend policies and implement programs specifically intended to serve and benefit the members, the profession, and the public in the United States in appropriate professional areas of economic, ethical, legislative, social and technology policy concern. The vision is to serve the IEEE United States member by being the technical professional's best resource for achieving life long career vitality and by providing an effective voice on policies that promote U.S. prosperity.

Brain Teaser Challenge Column

—By Butch Shadwell

May BTC Last month our demented doodler was drawing "... an inverting Schmidt Trigger built around a linear comparator. His design used three resistors and a three terminal comparator. The input impedance was equal to the open terminal input of the comparator. The design changed state at 1/3 and 2/3 of Vdd. Describe the circuit configuration and calculate the resistor values. Let's limit the feedback current to 1 mA, and Vdd is 5 vdc."

First you need to know that a Schmitt trigger is a circuit that takes a slow moving analog voltage and makes it produce a logic level voltage switching quickly at a predetermined set point. Due to the non-inverting feedback, these circuits exhibit a form of hysteresis that moves the switch point in the opposite direction from the direction of the input signal change, as the signal crosses the previous switch point. I hope that's clear?? Anyway, if you draw this circuit, the function should be obvious. First the input signal goes to the inverting input of the comparator. No other connections are needed to this node. The switch point is determined by the voltage on the non-inverting input terminal. As specified above, this voltage must move between 1.67vdc and 3.34vdc as the output of the comparator changes state between 0vdc and 5vdc. In this design, the output of the comparator is connected to the non-inverting input through a feedback resistor, Rf. Then that input is also connected through a resistor (Rr) to a voltage reference. Since the two switchpoints are symmetric around Vdd/2, we can use two resistors of the same value in series, tied between ground and Vdd, to produce a voltage reference. The parallel resistance of these two resistors is the Thevenin source impedance of the reference voltage, or Rr as described above. So if you connect that voltage reference to the non-inverting input, you have a voltage divider that changes the switch point voltage as the output changes state. Since I stated that the feedback current would be 1 mA, we know the value of Rf. The voltage across Rf is set at 1/3 of Vdd at both output states, so Rf must be 1.67 Kohms. The value of Rr = $(V_{dd}/2 - V_{dd}/3) / 1 \text{ mA} = 830 \text{ ohms}$, the parallel resistance of the two voltage divider resistors. So, it turns out that all three resistors are the same value, 1.67 Kohms (within 1%). But I bet you already knew that.

June BTC I live in Jacksonville, Florida in the USA. Once again, hurricane season is almost here and it's time we get everything ready. Two years ago we lost power at our house for over a week. A good friend loaned us a generator, but for the three days leading up to that point, life was hard. We bought a generator last year in anticipation that it could

GE Donation Matching

General Electric Company to Match Gifts to the IEEE Foundation – The IEEE Foundation is pleased to announce that the GE Foundation has agreed to extend the charitable giving of General Electric employees and retirees by matching their gifts to the IEEE Foundation. The process is simple! All a GE employee or retiree needs to do to designate the IEEE Foundation as a matching gift recipient, is to register with the GE Foundation Matching Gift website at www.gefoundation.com/matchinggifts. To see the full list of companies that match gifts to the IEEE Foundation visit us on the web at www.ieeefoundation.org.



IEEE Benefits? One engineer's view

For me, the important benefits have been:

- 1) travel coverage
- 2) COMPUTER Magazine
- 3) Training Seminars
- 4) Networking Opportunities (in both the technical and the job hunting sense of the word)

Objections that I've dealt with over the last decade (many of which no longer apply!!)

- My company will not pay for dues
- IEEE membership is too expensive
- I have no time to read the publications

By the way, if you have been unemployed and can no longer afford the dues, the IEEE will help you out. Check out on the IEEE website for the various ways your dues may be reduced.

—Sean Denny



happen again, but it did not. The fact is that in the last 40 years I can only remember the power failing for a whole day once before. I guess it may seem strange to buy a generator to only really need it once every 20 years, but on the second or third day without power the logic gets a lot clearer.

This machine requires an oil change every 50 hours, and the system has a definite life span where after so many hours of use it will no longer be operable. Trying to keep things in perspective, if my new generator uses 5 gallons of gasoline in 12 hours while driving 5000 watts of household loads, then what is my cost per kilowatt-hour for emergency electrical energy? For this calculation we will ignore the oil change costs and the depreciation of the system. Regular gas in my neighborhood is running about \$2.75 per gallon. I'm pretty sure I can get a better price from the Jacksonville Electric Authority.

Reply to Butch Shadwell at b.shadwell@ieee.org (email), 904-223-4510 (fax), 904-223-4465 (v), 3308 Queen Palm Dr., Jacksonville, FL 32250-2328

June 2006 Calendar of Events (For more information see P. 1 *Inside this Signal...*)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
28	29	30	31	1	2	3
4	5	6 5:30 pm: <i>IEEE FWCS ExCom</i> <hr/> 6:00 pm: <i>Comp. S/W Security P 1</i>	7	8 8:150 am: <i>A-Z Substation Design Clearwater P 3</i>	9	10
11	12	13	14	15	16	17,
18	19	20	21	24	23	24
25	26	27	28	29	30	1

Institute of Electrical and
Electronics Engineers, Inc.
Florida West Coast Section
3133 W. Paris
Tampa, Florida 33614



IEEE/IAS Annual Meeting Oct. 2006 Tampa!

NON PROFIT ORG U.S. POSTAGE PAID TAMPA, FL. PERMIT No. 1197

DATE SENSITIVE MATERIAL. DO NOT DELAY

Change of address? IEEE Web Contact Update <http://www.ieee.org/membership/coa.html>

Or send address changes including your name, IEEE Member number and all pertinent information to:

IEEE, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331 or call (800) 678-4333

Or fax your address changes to (732) 562-5445