



Celebrating 125 Years of Engineering the Future

Pittsburgh Section Bulletin

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Celebrating 125 Years of Engineering the Future



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All announcements for publication in a particular month's bulletin are due to the Editor by the 20th of the previous month. The accuracy of the published material is not guaranteed. If there is any error, please bring it to the Editor's attention. The Section's web site www.ewh.ieee.org/r2/pittsburgh has past issues of the bulletin and lots of other useful information

- **Twigg's Tidbits**

There are no tidbits this month.

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Dr. Rin Burke

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Life Member – Chair: Bob Grimes, P.E.
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Women In Engineering – Chair: Dr. Rin Burke
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Committees

Consultants Network

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- ***Scanning Electron Microscopy for Industrial Problem Solving And EMC History - "The first two Thousand Years"***

Speaker: Dr. Karen Harris, RJ Lee Group
Date: Thursday, November 5, 2009
Time: Social - Dinner 6:00 PM, Program 7:00 PM
Place: Westinghouse Energy Center, Monroeville PA
Cost: No charge
RSVP: **by November 3, 2009 to:** Dr. Rin Burke, rinburke@gmail.com or 814-397-7058;
Mike Oliver, emi@majr.com or 814-573-2812;
Organizers: IEEE Women in Engineering (WIE), Affinity Group -and- Electromagnetic Compatibility Society (EMCS)

1st Presentation Abstract; Sponsored by The IEEE Women in Engineering (WIE) Group: Scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS) is a versatile tool that can be applied to address a variety of industrial and manufacturing challenges. Many people are familiar with the topographical images an SEM can produce, however this is only one of many modes in which the SEM can operate to provide information on a sample. A combination of backscattered electron imaging, secondary electron imaging, and X-ray spectroscopy provides tremendous analytical capability for investigating material microstructures, fracture surfaces, microelectronic failures, and particle size and morphology. By placing the SEM under computer control and using automated image analysis techniques, data can be collected on large populations (particle analysis or steel inclusion analysis are examples), or used to identify and characterize a small population within a larger sample (heavy metals in soils or gunshot residue analysis for example). This technique, termed computer-controlled SEM (CCSEM) allows for quantification of feature size, shape and composition in a rapid manner. X-ray imaging using energy dispersive spectroscopy is another way to collect a large amount of information on a sample with minimal operator involvement. Once parameters are established, the instrument is placed under computer control to collect an EDS spectrum for each pixel of the image. X-ray images created from the data show the collocation of elemental composition with various morphological features. This method can be helpful in understanding concentration gradients in a cross section through a surface, the impact of material defects in a failure analysis, or the identification and location of different phases in a complex material or device. Field emission sources for SEMs provide improved resolution and increased source brightness with the corresponding ability to conduct more surface-specific characterization by using lower accelerating voltages. Additional flexibility for accommodating a variety of samples for SEM analysis can be provided by options for large sample chambers and variable pressure (low vacuum) operation. Application of these capabilities to the characterization of a variety of industrial materials and environmental particulate will be discussed.



About the speaker: Dr. Karen Harris received her Ph.D. in Materials Science and Engineering from the State University of New York at Stony Brook where she used transmission electron microscopy to study the effects of stress and diffusion on thin film microstructures. After graduate school, she had a postdoctoral position at the National High Magnetic Field Laboratory in Tallahassee, FL applying scanning electron microscopy and orientation imaging microscopy to investigate microstructures in NiAl alloys. Following that, she used SEM to characterize microelectronics processing-related defects to assist in product development. Dr. Harris joined RJ Lee Group in 2003, assisting clients with SEM characterization, investigating processing issues, and performing defect analysis using various materials characterization techniques. She is currently the manager of the Materials & Environmental Services Group at RJLG's headquarters facility in Monroeville, PA, where she is responsible for coordinating sample preparation and analysis to address client's requests and support litigation and consulting

projects.

2nd Presentation Abstract; Sponsored by The IEEE Electromagnetic Compatibility Society: The history of EMC (Electromagnetic Compatibility) begins very early in human history. This extraordinary video begins with the first battery through developments of the first published works of electricity and magnetism of William Gilbert. Discoveries and inventions are then discussed from the works of: Pieter Van Musschenbroek, Benjamin Franklin, Alessandro Volta, Hans Oersted, Georg Ohm, Andre-Marie Ampere, Michael Faraday, Joseph Henry, Samuel Morse, Gustav Kirchoff, James Maxwell, Elisha Gray, and Alexander Graham Bell. It continues with the development of the International Electric Congress in 1881 and inventions of Tesla and Westinghouse, and the discovery of electromagnetic waves in 1888 and the 1902 Marconi wireless station. Other inventions and organizations such as the IEEE EMC Society are presented that were formed in the 20th century, along with the first integrated circuit, Sputnik, CB radio, and the personal computer with future trends in electromagnetic compatibility and hardware.

DIRECTIONS TO WESTINGHOUSE ENERGY CENTER

From Pittsburgh take Interstate 376 East (Parkway East). Take Exit 14A to Monroeville. Cross Business Rt 22 at the traffic light and proceed on Rt 48 South (Moss Side Blvd) approx ½ mile (two traffic lights). The 2nd traffic light is at a 4-way intersection with an Exxon station on the right. Turn left onto Northern Pike. Proceed approx 0.2 miles and turn right at the 1st traffic light onto Westinghouse Dr. Travel 0.7 miles (past the guard stand) to the 3 flags where the building's main entrance is located. Parking in the evening will be plentiful. Use the main entrance and check with the security guards inside. You will be directed to the proper room for your meeting.

From the PA Turnpike, take Exit 57 (Monroeville). After the toll plaza, get in the left lane to get on Business Rt 22 West. At the first light, turn left onto Rt 48 South (Moss Side Blvd) and follow the above directions.

- ***Growth of III-Nitride Thin Films and Structures***

Speaker: Prof. Dimitris Korakakis, West Virginia University
Date: Monday, November 9, 2009
Time: Talk 5:00 PM
Place: room G102 of Engineering Science Building at WVU
Organizers: Upper Mon Subsection and West Virginia University, for more information, contact Natalia Schmid at natalias@csee.wvu.edu, or David Graham at David.Graham@mail.wvu.edu

Abstract: III-Nitride based semiconductors are of significant interest for the fabrication of optoelectronic devices, such as Light Emitting Diodes (LEDs) and Laser Diodes (LDs), primarily due to the ability to engineer the emission across the visible spectrum and into the Ultra Violet (UV) regime by adjusting the molar concentration. Furthermore, due to the piezoelectric, electronic, and mechanical properties, III-Nitride materials are well suited for Micro-Electro Mechanical Systems (MEMs) or Nano-Electro Mechanical Systems (NEMs). In this work, the growth and characterization of III-Nitride thin films and structures via Metal Organic Vapor Phase Epitaxy (MOVPE) will be presented.

Within the III-Nitride material system, Aluminum Gallium Nitride ($\text{Al}_x\text{Ga}_{1-x}\text{N}$) alloys are the most promising for UV device fabrication due to the wide, direct band gap, while Indium Nitride ($\text{In}_x\text{Ga}_{1-x}\text{N}$) films are well suited for visible emission. The growth of high quality $\text{Al}_x\text{Ga}_{1-x}\text{N}$ alloys via MOVPE is challenging due to the large sticking coefficient of the Al species compared to that of Ga and also the high reactivity of Al precursors¹. As a result, films are often characterized by large dislocation densities, cracks, and poor conductivity. Likewise, material growth issues arise in $\text{In}_x\text{Ga}_{1-x}\text{N}$ films due to the large lattice mismatch and low miscibility between InN and GaN^2 . The growth of $\text{Al}_x\text{Ga}_{1-x}\text{N}$ and $\text{In}_x\text{Ga}_{1-x}\text{N}$ films and the techniques used to improve quality will be discussed. In particular, digital alloy growth of $\text{Al}_x\text{Ga}_{1-x}\text{N}$ has been investigated as a viable means of growing high quality ternary alloys via MOVPE. Digital alloy growth consists of layers of binary or ternary alloys with a period thickness of a few monolayers¹. The influence of the growth parameters on the film properties will be presented. Additionally, the influence of growth parameters on the V-defect formation in $\text{In}_x\text{Ga}_{1-x}\text{N}$ will be discussed.

In addition, the growth of III-Nitride structures will be presented. This will include the growth of AlN/GaN Distributed Bragg Reflectors (DBRs) and AlN suspended structures. Indium has been used as a surfactant during the growth of AlN/GaN DBRs and been shown to reduce the crack length per square millimeter by a factor of two. Finally, the growth of AlN suspended structures fabricated using a sacrificial silicon oxide layer will be presented. In this work infrared absorption spectra of polycrystalline and crystalline AlN films through micro-Fourier Transform Infrared Spectroscopy (FTIR) transmission techniques has been investigated.

1. M. E. Hawkrige, Z. Liliental-Weber, H. Jin Kim, S. Choi, D. Yoo, J. Ryou, and R. Dupuis. Appl. Phys. Lett. **94**, 071905 (2009).
2. F. A. Ponce, S. Srinivasan, A. Bell, L. Geng, R. Liu, M. Stevens, J. Cai, H. Omiya, H. Marui, S. Tanaka, Phys. Status Solidi C **7** (2003).

Dimitris Korakakis is an Associate Professor in the Lane department of Computer Science and Electrical Engineering (LCSEE) at West Virginia University (WVU). He is also a Resident Institute Fellow of the Institute of Advanced Energy Studies, a collaborative effort amongst West Virginia University, the University of Pittsburgh, Carnegie Mellon University and the Department of Energy National Energy Technology Laboratory. Dr Korakakis obtained his B.S. degree in Theoretical Physics from Queen Mary College, University of London (1986), his M.S. degree in Manufacturing Engineering from Boston University (1994), and his Ph.D. degree in Electrical Engineering from Boston University (1998).

His area of research interests are wide band gap semiconductors, growth and device structures, piezoelectric materials and MEMS/NEMS devices, organic electronics, biosensors and gas sensor devices. He is the lead faculty in the department's efforts to involve undergraduate students in authentic research and the National Science Foundation funded Nanotechnology Undergraduate Education award to WVU extends these efforts across most Science, Technology, Engineering, and Mathematics (STEM) disciplines within the University. The relevant ongoing studies in his laboratory include: the piezoelectric response of AlN thin films, the development of $\text{In}_x\text{Ga}_{1-x}\text{N}$ MQW based emitters and photodetectors and the development of GaN based opto-electronic devices and structures.

- ***Leadership ≠ Management***

Speaker: Dr. Richard A. Thompson, Telecom Program, University of Pittsburgh
Date: Monday, November 16, 2009
Time: Pizza and other refreshments at 6:00, Talk at 7:00 PM
Place: Room 722, Benedum Hall, 3700 O'Hara St., Oakland campus, University of Pittsburgh.
Organizers: Communications Society Chapter and GOLD Affinity Group. Reservations are recommended so we can estimate the food. Contact Jason Harchick, jharchick@ieee.org, or Philip Cox, p.e.cox@ieee.org.

Abstract: – This talk describes how *administration*, *management*, and *leadership* are similar, and different. After illustrating the complexity, and importance, of their difference, the three terms' conventional definitions are given, and clarified. The observed confusion, especially in Wikipedia, is discussed.

Then, 40 stated characteristics are shown to be microscopic examples of five macroscopic traits of good leadership: *vision*, *passion*, *charisma*, *morality*, and *people-orientation*. Finally, based on these five traits plus the “Golden Rule,” the “One Minute Manager,” “Dogsled Leadership,” and personal experience, six simple rules for leadership (and life) are stated.

About the Speaker: Dr. Richard A. Thompson has been a Professor of Telecommunications at the University of Pittsburgh since 1989, after 20 years at AT&T's Bell Laboratories. He was the Chair of Pitt's Telecom Program for 16 years, has a secondary appointment in Pitt's EE Department, and is affiliated with Pitt's undergraduate Photonics Program. His BS and MS degrees, each in EE, are from Lafayette College and Columbia, respectively. His PhD, in Computer Science, is from the University of Connecticut. Besides peripheral research interests in human-computer interaction and probabilistic automata (with application in statistical packet dependence), Dr. Thompson's principal research area is

communications switching, especially photonic switching and Voice over IP. Dr. Thompson is a former chair of the IEEE Comsoc Technical Committee on Switching and Routing. He has over 90 research publications, including two textbooks: Telephone Switching Systems and The Physical layer of Communications Systems. He is a founding board member of the International Telecommunications Education and Research Association and received ITERA's Research Career Award in 2007.

• *Energy Harvesting*

Speaker: Marlin H. Mickle, Swanson School of Engineering, University of Pittsburgh
Date: Thursday, November 12, 2009
Time: Social 6:30 PM, Program 7:00 PM
Place: Westinghouse Energy Center, see directions on page 4
RSVP: Andy Tomaswick, shadrax48@gmail.com by November 5, 2009
Organizers: Power & Energy Society/Industrial Applications Society.

Abstract: Energy harvesting (EH) invokes interest for obvious reasons dealing with the major energy requirements of society - macro scale EH. At a much smaller scale, EH makes things work by providing function to systems where no maintenance and no "physical" connection are fundamental requirements.

A Pittsburgh original, the crystal set, provides a simple example of energy harvesting that had its roots in a "wireless" telephone. Today, that same technological concept powers millions of devices that rely solely on radio frequency (RF) energy harvesting. It is interesting to note that this activity keeps alive Tesla's idea of transporting energy wirelessly although at a scale many orders of magnitude smaller, i.e., micro (μ) EH or nano (n) EH implementations.

The same topical combinations of energy forms are seen at the μ EH levels. This presentation will include the current concepts and forms of μ EH in terms of: direct use, energy pools, combinations of RF and mechanical forms along with conservation.

The design of efficient devices and systems at the μ EH scale is perhaps more critical, and certainly more challenging, than at the macro scale. As in the crystal set, the RF provides both energy (power) and communication in the same waveform. Situations require microprocessors operating on less than 100 nano watts providing interesting computer architecture challenges. Currently, it is possible to remotely power a network of communicating COTS microchips using only a wireless RF source.

Biography: Marlin H. Mickle is currently Nickolas A. DeCecco Professor in the School of Engineering of the University of Pittsburgh. He holds appointments as Professor of Electrical and Computer Engineering (Primary), Professor of Computer Engineering, Professor of Telecommunications, and Professor of Industrial Engineering. He is the Executive Director of the RFID Center of Excellence. He received the B.S.E.E., M.S.E.E., and the Ph.D. degrees from the University of Pittsburgh in 1961, 1963, and 1967. He is the 1988 Recipient of the Systems Research and Cybernetics Award of the International Institute for Advanced Studies in Systems Research and Cybernetics, Carnegie Science Center Award for Excellence in Corporate Innovation, 2005, Life

Fellow of the IEEE, Pitt Innovation Award, 2005, 2006, 2007,2008 and 2009, Faculty Honor Roll 2001, Honorable Mention 2004 Carnegie Science Center Award, with Mary Besterfield Sacre, Bopaya Bidanda, Michael R. Lovell, Larry Shuman and Rakibar Chaterjee (Katz).

He is currently active in the areas of energy harvesting and high technology RF and sensor applications. He is co-author and co-editor of over 20 books. In addition, Marlin H. Mickle has over 200 publications in refereed journals, conference proceedings, etc. He currently holds 17 patents including a magnetically levitated gyro, a gyro optical sensor, energy harvesting and antennas on a CMOS chip and 4 additional patents to be issued.

Marlin H. Mickle is a member of the Scientific, Product or Technical Advisory Boards of Mobile Aspects, Pgh., PA, SmartWear Technologies, San Diego, and ClearCount, Inc. He has been the Advisor or Co-Advisor of four teams selected by the NCHIA for March Madness for the Mind displayed at the Smithsonian in Washington, D.C. (3 times) and at the Boston Museum of Science.

- ***Report on 2009 Electronics Packaging Expo and Conference***

INAUGURAL MEETING
PITTSBURGH CHAPTER OF COMPONENTS, PACKAGING, AND MANUFACTURING
TECHNOLOGY/ELECTRON DEVICES SOCIETIES

Speaker: Louis Hart, Compunetics

Date: 18 November 2009

Time: Social - Dinner 6:30 PM, Program 7:00 PM

Place: Westinghouse Energy Center, Monroeville PA, see directions on page 4

Cost: No charge

Reservations: by 11 November to Louis Hart, lhart@compunetics.com or 412-858-1272

Organizers: Components, Packaging, and Manufacturing Technology Society with Electron Devices Society

Abstract: The IPC APEX EXPO in Las Vegas is a trade show and conference covering a multitude of topics in electronic assembly. Technical sessions dealt with subject ranging from lead-free reliability and rework, printed circuit board manufacturing using ink-jet technology, cleaning techniques, and entry materials for drilling circuit boards. Standards development meetings addressed solder flux specifications, high-frequency circuit board testing, materials for embedding passive components, and numerous other areas. Louis will give a high-level overview of the expo and the many interesting tidbits of technology he observed.

Biography: Louis Hart received a Ph. D. in physics from Duke University. He has worked on amorphous semiconductors for the Duke Materials Science department, electronic component reliability and quality for IBM, and in printed circuit board fabrication along with electronic assembly at Compunetics in Monroeville. He has also taught physics, astronomy, and geology at West Liberty State College. For several years, he was responsible for blade quality at the Schick razor plant in Milford, CT.

• ***Robust Biometrics for Tracking and Surveillance***

Speaker: Harry Wechsler, Department of Computer Science, George Mason University
Date: Monday, November 30, 2009
Time: Talk 5:00 PM
Place: room G102 of Engineering Science Building at WVU
Organizers: Upper Mon Subsection and West Virginia University, for more information, contact Natalia Schmid at natalias@csee.wvu.edu, David Graham at David.Graham@mail.wvu.edu

Abstract: Challenges related to an expanded biometric processing space that involves less than perfect sensors, missing information, and/or corrupt data are the main subjects of interest in this talk. Robust designs of biometric systems are proposed to address the above challenges using layered categorization, adaptive and pro-active training strategies, and data fusion. Scale space and recognition-by-parts support layered categorization, semi-supervised learning, transduction support adaptive and pro-active strategies, and boosting and non-linear mappings support multi-level and multi-layer data fusion. Predictive quality-based fusion approaches to multimodal and multialgorithm data are introduced. Few results in support of the developed robust biometrics are demonstrated. Lecture concludes with promising venues for future R&D.

Bullet Points:

- Biometrics and Forensics
- Robustness: Sensors, Missing Information, and Corrupt Data
- Metrics and Open Set Protocols
- Recognition-by-Parts
- Information Theory and Statistical Learning
- Model Selection and Prediction
- Multi-Level Fusion: Feature, Score, and Decision
- Multi-Layer Fusion: Modality, Quality, and Method
- Ensemble and Voting Methods
- Performance Evaluation and Error Analysis
- Data Management

Harry Wechsler received the PhD degree in computer science from the University of California, Irvine, in 1975. Currently, he is a professor of computer science and director for the Center of Distributed and Intelligent Computation at George Mason University (GMU). His research in the field of intelligent systems focuses on active learning, biometrics, computational vision, data mining, data streaming, image and signal processing, machine learning and pattern recognition, and statistical learning theory using transduction and semi-supervised learning. The range of applications covers biometrics for data fusion, face recognition, gait analysis, performance evaluation and error analysis; learning for change, malware detection, and outlier detection; and video processing and surveillance. He organized and directed the NATO Advanced Study Institute (ASI) on “Face Recognition: From Theory to Applications” (Stirling, UK, 1997), and was the principal co – editor for its seminal proceedings published by Springer (1998). His book on *Reliable Face Recognition Methods*, which breaks new ground in applied modern pattern recognition and biometrics, was published by Springer in 2007. Dr. Wechsler directed at GMU the design and development of FERET, which has become the

standard facial data base used for benchmark studies and experimentation. He was elected an IEEE Fellow in 1992 for “contributions to spatial/spectral image representations and neural networks and their theoretical integration and application to human and machine perception” and an IAPR (International Association of Pattern Recognition) Fellow in 1998. He was granted (together with his former doctoral students) three patents by US Patent Office (USPO) on fractal image compression using quad-q-learning (licensed in 2006), on feature based classification (for face recognition), and on open set recognition using transduction. Three additional patents, (1) on data stream change detector, (2) on adaptive and robust correlation filters (for robust recognition), and (3) on selective (co)training from labeled and unlabeled exemplars, have been filed with USPO and are now pending.

- ***Nominees for Pittsburgh Section Officers***

At the monthly meeting of the Pittsburgh Section Executive Committee on Oct. 15th, the members present accepted the following nominations for 2010 officers from the Nominating Committee:

Chair – Joe Cioletti
Treasurer – Dr. Louis Hart
Vice Chair – Robert Brooks
Secretary – Dr. Rin Burke

Since no other nominations had been proposed, the Executive Committee unanimously accepted the slate as the 2010 officers. Please congratulate them.

- ***Employment Survey***

The USA Employment and Career Services Committee would like to hear the hot button issues of our members. The Pittsburgh Section encourages you to participate in this survey.

http://www.surveymonkey.com/s.aspx?sm=rJoau26ct4T_2fxnNMI7WTAQ_3d_3d

- ***Future City Pittsburgh Volunteers Needed***

The Pittsburgh Region is beginning its eleventh year in the National Future City Competition. The number of middle schools that have registered in the Pittsburgh Regional Competition has grown each year. The Competition's growth is testimony to the program's unique capacity to challenge students to learn and test new concepts related to engineering and city planning, to apply the mathematics and science they have already learned, to explore their imaginations about what our Cities will be like in the future, and to build an example of the result using ingenuity and their own hands. It has proven to be an excellent introduction of the engineering profession to middle school students.

Another important facet of the Pittsburgh Regional Future City Competition that has allowed it to expand is the associated growth of a cadre of dedicated volunteers. Without volunteers, there would be no competition. Please, volunteer as a Presentation Aide or Judge. During November and December, judges will review the SimCity files, narratives, and essays. On Saturday, January 16, 2010, the Pittsburgh Regional Competition will be held at the Carnegie Music Hall in Oakland. Based

on past experience we anticipate that we will need more than 140 volunteers to fill the positions of Essay Judges, Disk Judges, Registrars, Model Movers, Room Manager/Timers, Score Keepers, Special Awards Judges, Presentation Judges, Exhibit Area Control Volunteers, Still and Video Camera Operators, and Public Relations Coordinators. Orientation Meetings for Presentation Aides and Judges will be held as needed in early January, with the goal of identifying all volunteers and making assignments by January 2, 2010.

Please add Your Name to Our 2009-2010 Volunteers List. We welcome the help of anyone who is interested in volunteering his or her time. To qualify as a Presentation Judge, you must have judged before or have attended a Judge Orientation Meeting. If you are interested in registering as a volunteer for the 2010 Future City Competition please take a minute and fill out the VOLUNTEER REGISTRATION FORM at: http://www.futurecitypittsburgh.org/futcityvolunteer_form.htm.

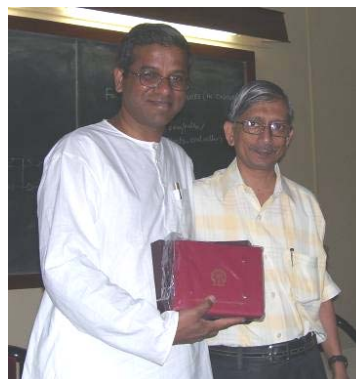
Volunteers will be contacted in November for SimCity judging, mid-December for essay judging, and early January for competition day assignments. If you have any questions, call Bill Pruss at (412) 651-5304 or Keith Jensen at (412) 303-2960. If you wish to learn more about the program and roles of volunteers, take a look at our website's homepage: <http://www.futurecitypittsburgh.org/>

- ***Distinguished Lecturer Travels***

Local IEEE Senior Member and Distinguished Lecturer Dr. Kalyan Sen traveled to India in October on a book-tour to promote his newly published book titled "Introduction to FACTS Controllers: Theory, Modeling, and Applications." He gave two seminars at the Indian Institute of Technology in Kharagpur and in New Delhi. The book can be previewed at the following link: [Search inside this book](#)



Attendees at the Indian Institute of Technology – Kharagpur



Prof. A. K. Sinha (right) presenting a memento



Attendees at the Indian Institute of Technology – New Delhi



Mr. V. K. Dutt (left) presenting a memento

2009 Calendar – Meetings of IEEE Pittsburgh Section

	Jan	Feb	Mar	Apr	May	June	July	August	Sept	Oct	Nov	Dec
<u>Executive Committee</u>	15 TBD	19 Panera Bread, Wilkins Twp	19 TBD	16 Spaghetti Warehouse	21 Panera Bread, Wilkins Twp	18 – Great China Buffet Allison Park	16 Panera Bread, Wilkins Twp	20 – Great China Buffet Allison Park	17 - 6:00 PM, Pitt Greensburg	15 WVU	19 Panera Bread, Wilkins Twp	
<u>Section</u>		21 Engineers Week		8, 29 X-Prize	28 History Dinner				12 Picnic, Boyce Park	23, 24 TISP Workshop		
<u>Communications</u>		13 Digital TV	25 UltraCMOS		18 Networks						16 Leadership	
<u>Computer</u>		21 - Robot Car Race		21 Voice RFID				4 PSP/TSP				
<u>EMBS</u>			18, 25 Control Theory									
<u>EMCS</u>					18 Maxwell's Eq.						5 History	
<u>PES/IAS</u>	27 – Pitt P&E	18 Ampere	12 – PC Boards 26 – Opt. Transformers 31 - Adcom	2 Climate 9 PE License	7 Roller Coasters 26 Elec. Contacts	11 Myers Briggs 25 Essential Tech	9 Concept Models 17 Pirates	13 Tour 27 Energy	8 Power Injection from Fuel Cell	29 Power Transformers	12 Energy Harvest	8 AdCom
<u>Magnetics</u>	12 – Disk Drives											
<u>Robotics</u>		UPG Career Days										
<u>CPMT/ED</u>											18 Report	
<u>Social Impl Technology</u>						19 FBI Tour			10 CFL Legislation			
<u>Upper Mon</u>		16 – 4PM Software Eng. WVU							10 CFL Legislation		9 Nitrides 30 Biometrics	
<u>Women in Eng'ing</u>									12 Picnic, Boyce Park		5 Microscopy	
<u>Life Mem.</u>		13 Digital TV										
<u>GOLD</u>		25 Social		9 PE License							16 Leadership	
<u>PACE</u>						19 FBI Tour						
<u>Student Act</u>												