

THE ♦ BRIDGE

The Magazine of Eta Kappa Nu

SPRING 2007

New Directions for Educating Engineers

FEATURES

*Engineering Education in
the Changing World*

*What Your Favorite EE Prof
Never Told You about Life
in the Real World*

*Engineering as a Liberal Art:
Taking a Broad View*

*First Person: How I Came to Be
a Pioneer in the Convergence of
Hollywood and the Internet*



www.hkn.org

LETTER FROM THE PRESIDENT

J. David Irwin | Xi Chapter Member

Dear HKN members,

It is a pleasure for me to update our readers on a couple of important projects that are currently under way. I am pleased to announce that HKN and IEEE have signed a memorandum of understanding (MOU) in which the two organizations pledge to work together for the benefit of their memberships. One of the projects resulting from this MOU is the effort on behalf of the IEEE to help HKN update our membership roles. Very soon the IEEE will send an e-mail to all members in the United States requesting a minimal amount of information if they were elected to HKN at some time in the past. The procedure will be simple and effortless, requiring only that the member click on an icon that will take them directly to the data site.

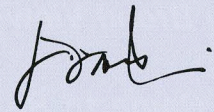
The Board of Governors is examining some proposed changes to our constitution. This effort, being drafted by Past President Karl Martersteck, is aimed at making the organization more responsive to the needs of our members and providing the flexibility for HKN to go global. In that regard, we are working with several Canadian universities that have expressed an interest in developing HKN chapters. In addition to this international initiative, we are installing some new U.S. chapters and working closely with a number of dormant chapters to revive and strengthen them.

I am deeply appreciative of the financial support that has been provided to HKN by numerous members and friends. This financial support plays a significant role in HKN's development activities and allows HKN to provide enhanced services to members such as the November 2006 Student Leadership Conference hosted by Purdue's Beta chapter. Students attended this two-day program free of charge.

Those wishing to contribute to the 2006–2007 fundraising campaign will find a donation envelope conveniently enclosed in this issue. Your contributions to HKN, a 501(c) 3 organization, are tax-deductible.

Finally, I believe that through the dedication of the Board of Governors and the fine efforts of numerous volunteers, we continue to make solid progress as we strive to enhance the value of HKN membership. If you would like to become an active part of this outstanding organization and help us strengthen it, we would be most pleased to hear from you.

Warm regards,



LETTER FROM THE EDITOR

Barry J. Sullivan | Beta Omicron Chapter Member

The pastoral image of the university campus evokes an air of detachment from the frantic pace and pressures of the real world. This image stands in sharp contrast with the demands placed on engineering educators to keep pace with the rapidly evolving needs of the industries that will employ their students.

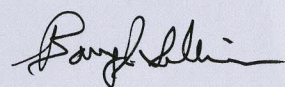
We have collected perspectives from both ends of engineering education value chain for this issue of *THE BRIDGE*. Representing the educators are articles from two university deans describing new approaches to preparing students for engineering careers. We also present two articles from former students relating their work experience to their education.

Leah Jamieson, dean of engineering at Purdue University, observes how changing contexts will affect engineering careers and outlines proposed responses. She suggests that these responses can also address the challenge of attracting and retaining a diverse engineering student body. Following her article, Geoffrey Burr, the 1991 HKN Outstanding Student Award recipient, demonstrates that education continues after graduation as he shares important lessons learned during his career.

Vincent Poor, Princeton University's dean of engineering, promotes technical literacy for all students, making the case for engineering as a liberal art. Recognizing that many engineering graduates follow nontraditional career paths supports this case. Ray Arthur Wang, recipient of the HKN Outstanding Student Award in 1999, tells how he brought seemingly divergent interests in art and engineering together in his experience as a pioneering filmmaker.

My e-mail address, where your comments are always welcome, is editor@hkn.org. Do we have yours? If not, you can update your information on the Eta Kappa Nu Web site at www.hkn.org/updateinfo.

Warm regards,



Eta Kappa Nu

*The Electrical and Computer
Engineering Honor Society*

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Eta Kappa Nu (HKN) was founded by Maurice L. Carr at the University of Illinois on October 28, 1904, to encourage excellence in education for the benefit of the public. HKN fosters excellence by recognizing those students and professionals who have conferred honor upon engineering education through distinguished scholarship, activities, leadership, and exemplary character as students in electrical or computer engineering or by their professional attainments.

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THE BRIDGE

The Magazine of Eta Kappa Nu

features

6 Engineering Education in the Changing World

Engineers face a rapidly changing world, demanding corresponding changes in their education. The engineering curriculum requires sweeping changes to equip students with the attributes and skills they will need to launch successful careers.

8 What Your Favorite EE Prof Never Told You about Life in the Real World

They say that experience is the best teacher. A veteran engineer shares lessons learned from a teacher with plenty of problems to solve but no answer key.

12 Engineering as a Liberal Art: Taking a Broad View

Can the technically illiterate be considered truly educated in today's world? Engineering educators must support the goal of technical literacy by making courses on technology accessible to non-engineering students.

14 First Person: How I Came to Be a Pioneer in the Convergence of Hollywood and the Internet

A degree in electrical engineering can launch a career in many directions, some far removed from traditional engineering pursuits. An engineering background proves valuable in realizing a filmmaker's vision.

departments

5 2006 Leadership Conference

18 2007 Leadership Conference

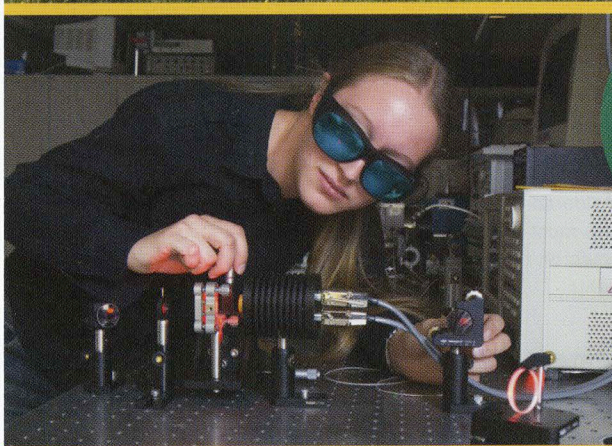
award winners

10 HKN Presents Awards

16 HKN Welcomes New Eminent Members



Discover



Electrical & Computer ENGINEERING

The Department of Electrical and Computer Engineering can connect you with world-class research and proven people in an unbeatable setting.

Cutting-Edge Research and Facilities - Standing apart from other departments, our electrical and computer engineering program was awarded two Engineering Research Centers by the National Science Foundation.

Highly Reputable Faculty - A higher percentage of our faculty are Fellows of the IEEE than most of the "top 10" ECE departments in the country.

Fort Collins: "The Best Place to Live" - An outdoor lover's paradise, Fort Collins was recently named America's "Best Place to Live" by Money Magazine and one of "Ten New American Dream Towns" by Outside Magazine.

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and a free department DVD:**

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State
University**

2006 Leadership Conference



On November 3-4, 2006, Beta chapter at Purdue University hosted nearly 70 HKN members from across the United States for a student leadership conference. The conference theme was "HKN Discusses Leadership Skills for Your Future." Students participated in a variety of activities throughout the weekend, including team projects, keynotes from distinguished HKN alumni, a tour of the state-of-the-art Birck Nanotechnology Center, a career development workshop, and a chapter development workshop.

Thirteen chapters were represented from across the Midwest and as far away as New York, Oklahoma, and Texas. All HKN student members, not just chapter officers, were encouraged to attend to develop leadership skills that will be beneficial to their future careers.

The conference opened Friday evening with a pizza party for students to mingle and get to know one another. Saturday was a day full of activities. Dr. Stephen Goodnick, Epsilon Beta faculty advisor, HKN board member, and vice president for research at Arizona State University, presented the morning keynote address.

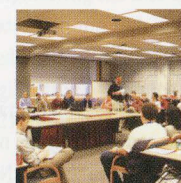
After the lecture, students broke into groups of four for the team projects. Each team of students received a bag of "junk"—a funnel, rubber bands, dowel rods, foam, men's briefs, plastic fishing lures, paper clips, duct tape, Velcro—and competed to design a ping-pong ball launcher that sent the ball the furthest and straightest. This was one of the highlights of the conference. Students enjoyed meeting HKN members from other schools and working together to accomplish the task in a short amount of time.

After Tellabs Chairman Michael Birck gave his luncheon-keynote, he accompanied the group on a tour of the Birck Nanotechnology Center, a state-of-the-art facility on Purdue's campus. Everyone was impressed at the technological advances being made there on a daily basis. Some students even commented that they would consider graduate school if they could participate in similar research opportunities.

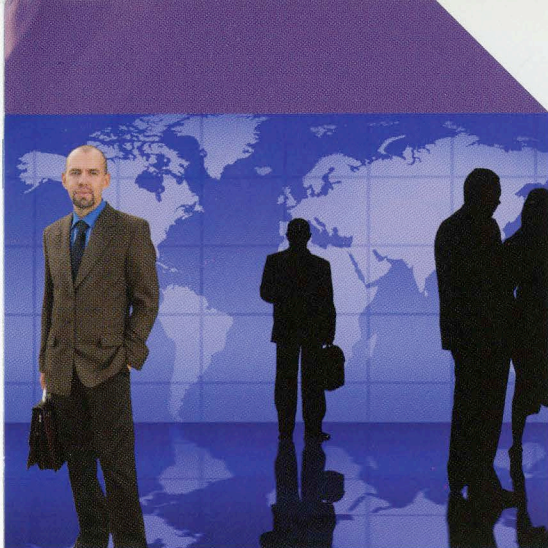
The afternoon consisted of a career development workshop, sponsored by Purdue's career placement office, and a chapter development panel, where five outstanding chapter award-winning presidents shared their insights on chapter management, activity ideas, and recruiting.

Dr. Leah Jamieson, IEEE president and John A. Edwardson Dean of Engineering at Purdue University, gave the dinner keynote address about future opportunities for engineering graduates. Dr. Thomas Talavage, Beta faculty advisor, accepted the 2005 C. Holmes MacDonald Outstanding Teaching Award.

The conference was a huge success, and students were enthusiastic about participating. They were able to share what they had learned about leadership and chapter development with their peers at home.



2006



Engineering Education in the Changing World

By Leah Jamieson

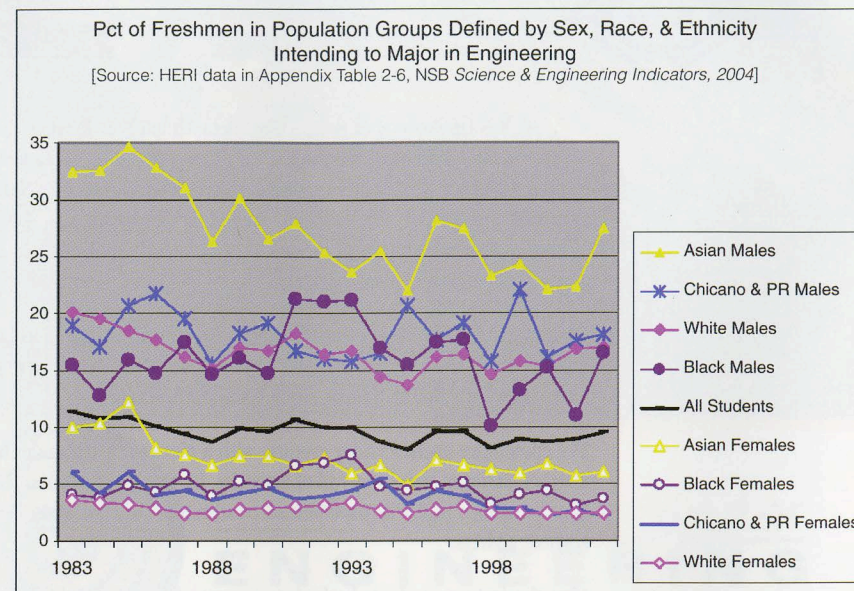


Figure 1 U.S. Trends in Engineering Enrollment

This article is based on an address delivered at DesignCon 2007 in Santa Clara, California, on January 31, 2007.

The world is changing in many ways. We continually ask ourselves whether our graduates are going to have the attributes and skills they will need for careers over the next 40 years. Some of the drivers for change are new technologies that are emerging at an incredible pace. In particular, the continued importance of multidisciplinary technologies is increasing the need to be able to communicate across disciplines in order to have effective system-level designs.

The rate of technological change is unprecedented and continues to accelerate. Globalization is on everyone's mind. There are also workforce issues that we are trying to understand. Interest in engineering careers among U.S. high school students is down 18 percent since 1991. What are the workforce implications of our slow progress on diversity? We are seeing engineering students working in fields other than engineering. Are we preparing them for careers outside engineering? And last, but certainly far from least, what issues are raised from offshoring?

Enrollment Trends

Figure 1 shows some national trends in enrollment. The black line shows the percentage of U.S. freshmen intending to major in engineering between 1983 and 2003; the colored lines are breakdowns by race, ethnicity,

and sex. We see a gradual decline in interest in engineering majors in the United States. All of the lines below the black line are the patterns for women in engineering, and all of them have a downward slope. The only lines with upward slopes are Asian males, and there is a fair amount of jumping around regarding African-American males, with some years high and others low.

There is a general sense that engineering is not as attractive in the United States as it used to be. We are trying to understand not only our role as educators in that perception, but also the role of industry. There are some global trends in the engineering market. There is an explosion in the engineering workforce in China, a potentially growing workforce in India, and a stable or shrinking workforce in the United States.

All of these factors—globalization, the workforce, and the pace of change in technology—have spurred conversations in sectors that consider engineering

education. Probably the voices that have been the most coherent, and certainly the most reputable, are coming from the U.S. National Academy of Engineering (NAE) in a companion pair of reports: The Engineer of 2020 and Educating the Engineer of 2020. The first volume sets out visions of what engineering will be for this century, and the second specifically addresses the implications for engineering education.

Changing Career Contexts

The first phase of the NAE study, completed between 2002 and 2004, looked at the contexts—particularly the technological, societal, global, and professional contexts—in which engineering will be practiced. Due to different population demographics throughout the world, the technological contexts are pulling in opposite directions: technology for an aging population in the

developed world, and technology for a young population in the developing world. Solutions will be interdisciplinary, and complex systems perspectives are going to be essential for successful products in the future.

The discussions on the societal and professional contexts are more wide-ranging. With an accelerating global economy, market opportunities will continue to grow in many parts of the world. There needs to be more interaction between engineering and public policy. We know this is true in telecommunications, but it will also be the case in energy, health care, and security. How issues such as safety and reliability are funded, and which regulations are adopted and which are not, are the concerns of public policy.

There is a need for a global perspective of social contexts, perhaps even thinking about where engineering fits into the notion of liberal education. In the 19th and 20th centuries, liberal education meant liberal arts. Where does engineering fit into the liberal education for the 21st century?

Changes in Education

From these contexts, the NAE report went on to identify a relatively small set of attributes, some of which are very familiar—communication, teamwork, business management skills, and ethical standards. The report also adds traits such as practical ingenuity, creativity, dynamism, agility, resilience, and flexibility. No one I know in engineering education is ready to give up on the notions of technical depth and technical breadth. And so we are faced with the question of how we do all this. We have increasing lists of things that apparently are going to be critical for our success, but where is the time to do it?

The second volume of the NAE report, Educating the Engineer of 2020, makes two very specific recommendations. The first is that the bachelor's degree should be considered a

pre-engineering or engineering training degree, that is, a four-year bachelor's degree is in some ways analogous to a pre-law or a pre-med degree. The second recommendation is that accreditation should extend to include the master's degree so that the master's degree becomes a professional degree in engineering.

An alternative proposal is to turn the curriculum inside out. The challenge is that we still need to teach engineering, but now we need to teach this other stuff, and I contend that most of that "other stuff" is hard to teach in a traditional classroom. The 20th-century curricula had engineering science at the core, and it probably included a design course—perhaps the best place to learn all of these other attributes. A possibility for the 21st century is to put the engineering experience at the core and wrap the engineering science around that core in support of learning how to design, solve problems, and do more open-ended engineering, even as an undergraduate.

Experiential education includes things such as co-op and internship experiences and service learning. It includes the notion of creating design teams that work in partnership with not-for-profits. Undergraduate research and study-abroad programs are essentially ways of learning by doing rather than learning by listening.

Finally, I would like to come back to the diversity issue. Will different approaches to engineering education affect who becomes an engineer?

For example, in some of the experiential programs, such as international experiences and study-abroad engineering programs, the participation of women is more than twice as high as the participation of men. In some cases, the participation of women is three or four times the participation of men in fields where 10 percent of the students are women.

International experiences are incredibly attractive to women. In service learning—projects that tie engineering to the community—two to three times as many women participate as compared to the base populations in their fields. So this notion of engineering in context—a very design-centered, experiential-centered curriculum—may give us different stories to tell elementary and high school students about what engineering and engineering curricula is like. There may be some implications between how we are teaching engineering and the question of who wants to be an engineer.

Conclusion

I think the last unanswered question is whether or not we have the courage to make such sweeping changes in education. It is a large system; we have talked about curriculum and thinking about it differently. Do we have the courage to change? Do you want us to change?



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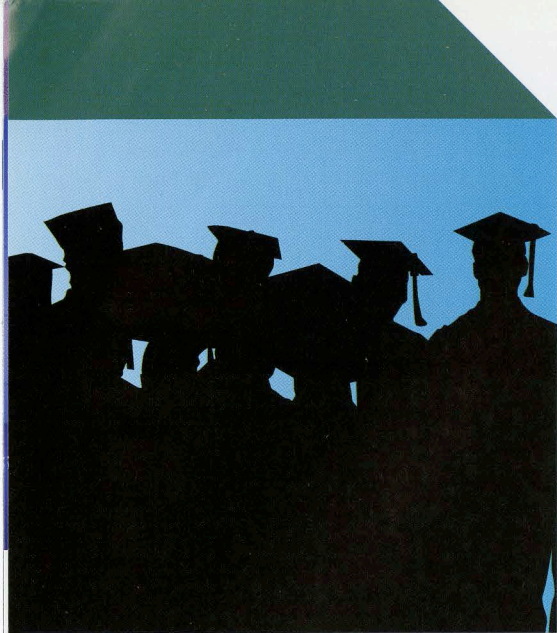
ABOUT THE AUTHOR



Leah Jamieson

John A. Edwardson Dean of Engineering, Purdue University
IEEE 2007 President and CEO
Beta chapter – Purdue University

Dr. Jamieson received her S.B. degree in mathematics from MIT and her Ph.D. degree from the Department of Electrical Engineering and Computer Science at Princeton University. She joined Purdue in 1976 and currently serves as Ransburg Distinguished Professor of Electrical and Computer Engineering. She is co-founder and past director of Engineering Projects in Community Service (EPICS), an engineering design program that operates in a service-learning context. She is a fellow of both the IEEE and the IEC and a member of the U.S. National Academy of Engineering.



What Your Favorite EE Prof Never Told You about Life in the Real World

by Geoffrey Burr

I know what you are saying to yourself. “Oh no, not another dry and boring column by some toothless Eta Kappa Nu relic!” On the contrary, this column is meant to be chock-full of useful tidbits on surviving as a working engineer after school—and besides, it is my hair, not my teeth, that I seem to have misplaced somewhere.

Indeed, if your engineering education is anything like mine, you are spending countless hours in vast auditoriums listening to your professors drone on about electromagnetics or circuits or transistors or some other apparently useful stuff. (If your education is really like mine, you have been sitting in the back row reading the student newspaper instead of paying diligent attention—perhaps this is why I still cannot recall the difference between a D and a JK flip-flop.)

That is not to say you can blow off that lecture on semiconductor processing—you might very well need that information later; or more accurately, you might need to dimly recall that such knowledge exists, so that you have a fighting chance to look it up efficiently when you desperately need it. The reason you should attend your engineering classes is that you will never have time to play catch-up later.

Unfortunately, however, the most useful information that is possessed, and used day-to-day, by an engineer who has been out of school for a decade or so is not taught in any classroom. Most of it, sad to say, is simple common sense. Fortunately, however, you are holding this article—a fount of wisdom on such matters (at least according to the author). So, in all seriousness (but with tongue planted firmly in cheek just in case), here are some things I wish I had known 15 years ago when I got my undergraduate EE degree.

It's All about Communication

One of the most important aspects to being an engineer is—you guessed it—communication. There is no point to having the greatest engineering invention since the wireless remote if you cannot convince anyone else to allow/help/fund you to build it.

One of the tricks to communicating is simply to put yourself in your audience's shoes. You are asking this other person to invest his or her most valuable possession—time—in listening to (or reading) what you have to say. Use this time wisely—treat it as the precious commodity that it is. For instance, if you are giving a prepared talk with PowerPoint slides, invest sufficient time to make the slides incredibly clear and organized, so much so that the final talk almost gives itself.

Be Ready to Tell Your Story off the Cuff

But you will not always have time to prepare and practice, so you should get comfortable with organizing your thoughts well enough that you can make your case in three to five minutes or less, “off the cuff” as it were. I have heard many stories of business deals that came about simply because someone happened to be on an elevator with the right person of great influence at the right time and was able to use this opportunity wisely.

A second trick, which goes along with the first, is to tell a story. When I give a talk, I want to get straight to the details, the nitty-gritty.

But I realize now that my audience, even if it is full of world-class researchers from exactly my same sub-sub-field, is not going to appreciate or even follow what I say unless I cast it as part of a story that makes sense to them. Why was that algorithm important? How did we come to build such-and-such a system? What effect might our nano-device potentially have on the audience members and on the world at large?

Impact as a Currency

When you are a student, your job is clear—learn lots and get good grades.

And in some engineering jobs, success is equally easy to define: design a successful (e.g., revenue-producing) product X for your company. Either it works and you sell products or it does not. But in a lot of engineering careers, including mine, the definition of success is not always so crystal-clear. A good year for me is one where I have written some critical papers, filed some important patents, presented well-received publications, and even attracted some coverage for my company in the mainstream press. Did my colleagues and I create a product that produces revenue that year? Probably not. But did my research lay the groundwork for future products? Did we establish our research group, and thus our company, as the leaders in the field we are working in? When people ask themselves which companies are the most technologically advanced, which ones are demonstrating today that they will be able to deliver the information technology products of the future, do they name my company? If so, then my colleagues and I are having an impact on our company and the world at large. In many ways, you can gauge the quality of work in a lot of professions this way—good work makes an impact; lousy work does not.

The Importance of Trust

Aha! I hear you say. Why bother with the nasty grunt work to actually produce a solid engineering result? Why not just get really really good at communication—you can simply claim great accomplishments and use superior salesmanship to skip straight to the accolades! I have bad news for you here—this never works in the long run. In a world of peer review and competing companies and research groups, when the importance of the technical accomplishment increases, so does the level of scrutiny. You may be able to make a big splash for a few months, but as with the recent cloning scandal in

South Korea, you will be found out, and your reputation will be irretrievably destroyed. No one will ever trust you again.

Trust is an absolutely critical component of your engineering career. (Regrettably, this may not be apparent from your experiences in engineering school, where sometimes it seems that the all-encompassing pursuit of good grades justifies any and all depravations.) In the real world, however, things go much better if you have a level of mutual trust with your boss and co-workers. Your boss is going to ask you to design/check/verify/measure/produce something and is going to need to trust that you are going to get it done, and that you are going to do it correctly. If you lose that trust, then you may very well find yourself in the unemployment line.

(A Healthy Dose of) Paranoia Can Be Your Friend

But, you say, if trust is so important then maybe we are better off doing nothing at all, lest we risk making an honest mistake? Here is where a healthy dose of paranoia while you are doing your engineering work is

not such a bad thing. Be suspicious of your own experimental results—check and double-check to make sure you can trust the results. When things just do not seem to be working right, ask yourself what it is that you are assuming, perhaps even implicitly, and then go check that these assumptions are correct.

Conclusion

One of the most important things to learn about the real world is that the problems have not been designed to be easy. When you are in engineering school, pretty much every test question you have ever been given has been designed to be solved in, say, 15 to 20 minutes. Out in the real world, however, there are a whole bunch of engineering problems for which the answer is not only not yet known to anyone, there may not even be an answer. Sometimes the “right” answer is to conclude that something is either impossible or impractical, and the right course of action is to stop wasting time on it. I hope these ruminations have been (at least somewhat) useful to you. I would love to chat more, but I've got to go and look for those dentures now ...



For more on this topic, visit
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ABOUT THE AUTHOR



Geoffrey W. Burr

Research Staff Member, IBM Almaden Research Center
Zeta Pi chapter – University of New York at Buffalo

Dr. Burr received his B.S. in electrical engineering (EE) and B.A. in Greek classics from the State University of New York at Buffalo in 1991. That year Eta Kappa Nu selected him as the Alton B. Zerby Outstanding EE Student in the U.S. He received his M.S. and Ph.D. in electrical engineering from the California Institute of Technology in 1993 and 1996, respectively. Although he worked for a number of years in volume holographic data storage and optical information processing, Dr. Burr's current research interests include nanophotonics, numerical modeling for design optimization, and phase-change nonvolatile memory.

HKN Presents Awards

C. Holmes MacDonald Outstanding Teaching Award

2005



The C. Holmes MacDonald Outstanding Teaching Award recognizes young electrical and computer engineering professors who have demonstrated, early in their careers, special dedication and creativity in their teaching responsibilities.

Dr. Thomas M. Talavage

Associate Professor of Electrical and Computer Engineering
Purdue University

Talavage accepted the Outstanding Teaching Award during the student conference at Purdue University on November 4, 2006. He is the faculty advisor for the Beta chapter at Purdue University. His research group seeks to improve the quality of life for users of auditory neuroprostheses through improvement of hardware and speech signal representations, based on the outcomes of fMRI experiments as well as computational and behavioral models, representing both normal and impaired hearing conditions.



Outstanding Electrical and Computer Engineering Student Award

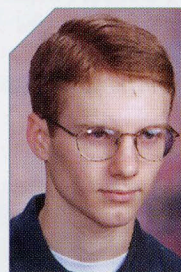
2006

The Alton B. Zerby and Carl T. Koerner Outstanding Electrical and Computer Engineering Student Award recognizes outstanding scholastic excellence and high moral character, coupled with demonstrated exemplary service to classmates, university, community, and country. This program is administered by the Los Angeles Area Alumni chapter. A jury of distinguished engineers selects the recipient.

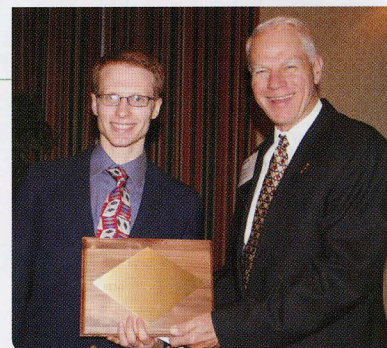
For more on the award and a list of past winners, visit www.hkn.org/awards/oeces.html.

2006 AWARD RECIPIENT

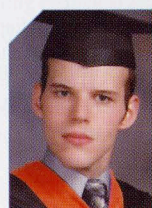
Benjamin Moss, University of Missouri, Rolla



Moss received his award at the 2007 Annual Meeting of the Electrical and Computer Engineering Department Heads Association in St. Augustine, Florida. Dr. Dave Irwin, HKN president, presented the plaque and certificate. Moss graduated in 2006 with B.S. degrees in EE, CS, and CE. As a research assistant at UMR, he designed and implemented a Palm Pilot database of skin disorders, symptoms, and drug interactions. He also worked for three years in UMR's Electromagnetic Compatibility Laboratory. He placed second with another UMR student in the 2005 IEEE International EMC Student Design Competition. He enjoys running, traveling, Boy Scouts, rebuilding cars, and learning the German language.



Honorable Mentions



Ryan Thibodeaux
Vanderbilt University



Renee L. Ecklund
Kansas State University

Finalists

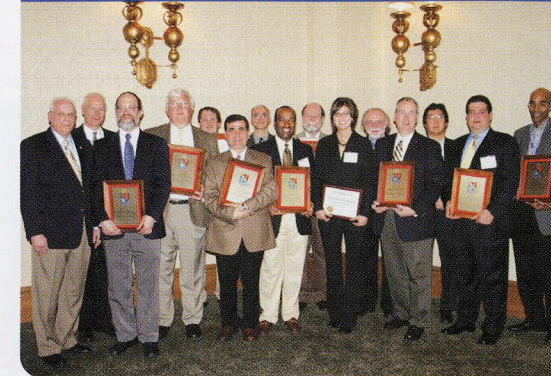
James C. McClintock
Oklahoma State University

David T. Kao
University of Illinois,
Urbana-Champaign

Outstanding Chapter Awards

Outstanding Chapter Awards

2005-2006



At the 2007 Annual Meeting of the Electrical and Computer Engineering Department Heads Association (ECEDHA), 15 Outstanding Chapters were recognized and their department heads received plaques on behalf of their chapters. A private reception was held before the awards banquet for the honorees and Eta Kappa Nu board of governors. Alan Lefkow, chair of the OCA Committee, presented each department head with a plaque.

Fifteen winners is a new record for HKN. The award criteria was changed two years ago to accommodate large and small schools and to allow every chapter the opportunity to win. Chapters must submit an Annual Chapter Report to be considered for the award.

2005-2006 CHAPTER AWARD RECIPIENTS

Alpha University of Illinois, Urbana-Champaign
Beta Purdue University
Beta Chi South Dakota School of Mines and Technology
Beta Epsilon University of Michigan
Beta Eta North Carolina State University
Beta Mu Georgia Institute of Technology
Beta Omicron Marquette University
Delta Omega University of Hawaii, Manoa

Gamma Chi New Mexico State University
Gamma Theta University of Missouri, Rolla
Iota Epsilon University of Hartford
Iota Gamma University of California, Los Angeles
Kappa Delta Florida International University
Mu University of California, Berkeley
Theta Epsilon Kettering University

Call for nominations

Do you know someone who should be recognized for their contributions to HKN or ECE?
Nominate him or her for an Eta Kappa Nu award!



C. Holmes MacDonald Outstanding Teaching Award

- > Presented each year to an outstanding professor under age 36
- > Send a letter of nomination to HKN headquarters
- > Nominations due May 1, 2007

Outstanding Young Electrical and Computer Engineer

- > Presented annually to an outstanding young professional who has made significant contributions to ECE
- > Nominee must be under age 35
- > Nomination forms are available at www.hkn.org
- > Nominations due June 1, 2007

Outstanding Electrical and Computer Engineering Student

- > Presented to a graduating senior
- > Nomination forms available at www.hkn.org
- > Nominations due June 30, 2007

Distinguished Service Award

- > Presented to an individual who has contributed significantly over their lifetime to Eta Kappa Nu
- > Nomination form available at www.hkn.org

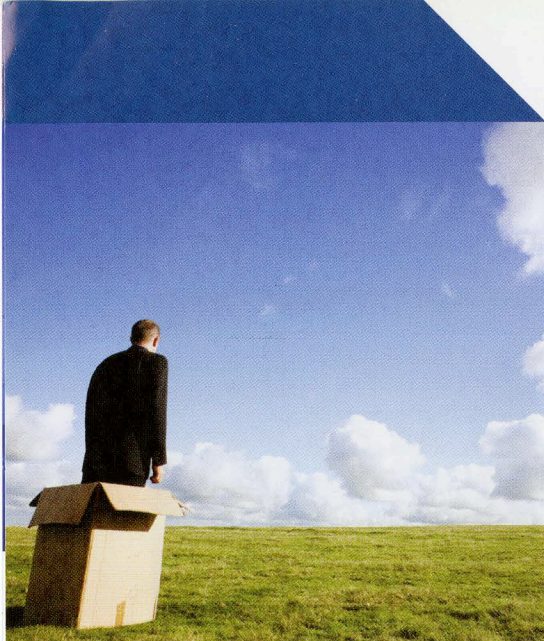
Vladimir Karapetoff Outstanding Technical Achievement Award

- > Presented annually to an individual who has distinguished himself/herself through an invention, development, or discovery in the field of electrical or computer technology
- > Send a letter of nomination to HKN headquarters

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Engineering as a Liberal Art: Taking a Broad View

by H. Vincent Poor

Educating Leaders for a Technological Age

It is useful to step back for a moment and look at the larger picture of universities and their role in society. The role of educational institutions – which has been more or less constant since classical times – has been to engage the next generation, to bring them along intellectually and to help them move into leadership positions. Of course, times change and the subject matter that we teach certainly changes. Today more than ever, any leader must be comfortable thinking about scientific and technological subjects: What are the basic principles behind current developments? How have technology and society shaped each other at key moments through history?

At Princeton, although my colleagues and I on the engineering faculty spend most of our time teaching engineering students, more than 60 percent of the University's students outside the engineering school take at least one engineering course. This includes students majoring in philosophy and classics, economics and public policy – essentially all majors. These students recognize the need to know something about technology regardless of what career they think they might pursue in the future. We would like to bring that percentage closer to 100. Even more ambitiously, we would like for each student to take more than one engineering course during their four years, ideally one a year.

How can we push toward those numbers? Here I think carrots work better than sticks, because mandatory distribution requirements can only go so far in generating student interest. At Princeton, all students are required to satisfy requirements for “quantitative reasoning” and “science and technology,” but those requirements can be met in a variety of ways and do not, by themselves, guarantee the kind of intellectual engagement for which we are aiming. Besides, we are really doing our job only when students take our courses because they want to, not because they have to.

A key to engaging students is to make sure courses are relevant to real issues in students' lives. Professor Robert Socolow, one of our experts on climate change, teaches “Energy for a Greenhouse-Constrained World” in which students receive an inside look at technical issues that are at the forefront of today's public policy agenda. A course I developed, “The Wireless Revolution,” led students through the technical, social, political and economic issues arising in the field of wireless communications during the very years when cell phone use overtook landline traffic.

For students curious about the world around them, these courses are a natural draw, and they illustrate the fundamental role of technology in a context that makes the lessons stick.

Supporting Change

Such courses require both institutional and national support. Universities should create incentives for faculty members to put their ideas into action when they conceive of interesting subject matter. They also must find ways to sustain such courses when their originators move on to other projects. Princeton created its Center for Innovation in Engineering Education to support existing courses that have broad appeal and to encourage new ones. The center also serves as a focal point for publicizing such courses, which tend to get lost in individual departmental course lists, so that undergraduates can easily see their choices and know that the University values the courses.

The National Academy of Engineering is increasingly providing support to educational initiatives, including ones that reach beyond conventional engineering students.



In 2005, the NAE selected Princeton's David Billington for its Walter Robb Engineering Education Senior Fellowship, which allowed him to improve and expand the instructional materials for his popular course, “Engineering in the Modern World.” That course explores how engineering and its products – from automobiles to computers – have influenced society and how political and cultural forces have affected engineering. I believe that this kind of support at the national level is critical to advancing technological literacy.

Benefits for Engineers

Drawing non-engineers to our courses also benefits engineering students. Engineering schools everywhere are increasingly aware of the need to instill their students with an understanding of teamwork and how to work across disciplines. In business, government or any real-world situation outside the academy, engineers must collaborate with non-engineers. Some of the courses that have been most successful at drawing a broad participation are ones that create teams of engineers and non-engineers, and the benefits accrue in both directions.

That brings me back to my general point about universities and leadership. At Princeton, we view our undergraduate engineering education as part of a liberal arts curriculum, even for those majoring in engineering. The philosophy behind this view is that what we are really teaching undergraduate engineers is analytical thinking and problem solving. They are learning, of course, domain-specific knowledge about a particular branch of engineering. But we realize that the real professional training for an engineer is at the graduate level or on the job in these days of specialization. At the undergraduate level, we are really teaching students a way of thinking, a way of looking at problems that goes beyond engineering as a discipline. If they want to practice engineering these are important skills, but these are also important skills for anyone who expects to lead others in making a positive difference in the world.

Conclusion

When I meet young students, I assure them that, contrary to stereotypes, engineering is one of the most exciting areas for anyone who wants to engage with others in solving real problems, to lead and to serve society. As engineering educators, we must take a broad view of our teaching and use our unique perspective to give full expression to that promise.



For more on this topic, visit www.hkn.org/bridge

ABOUT THE AUTHOR



H. Vincent Poor

Dean, School of Engineering and Applied Science, and Michael Henry Strater University Professor of Electrical Engineering, Princeton University
Xi chapter – Auburn University

Dr. Poor has been an advocate for the widespread teaching of the technical, economic, political and social aspects of technology to academically diverse audiences. He was the founding director of Princeton's Center for Innovation in Engineering Education, which has the fostering of such pedagogy as one of its primary goals. Dr. Poor is a member of the National Academy of Engineering and is a Fellow of the American Academy of Arts and Sciences and the IEEE. Recent recognition of his work includes a Guggenheim Fellowship and the IEEE Education Medal. He served as Xi chapter vice president in 1972.

High-quality
Internet distribution



On December 31, 2006, I had the good fortune of finding myself at Dhoom '07, one of the Silicon Valley's Top 10 New Year's Eve parties, according to the San Jose Mercury News. But then it dawned upon me that I wasn't there just to party. I was there to announce to all the party guests that the award-winning supernatural thriller *Carma* would soon be streaming into film history as the first feature film to launch exclusively on the Internet via a revolutionary DVD-quality pay-per-view streaming system.



First Person: How I Came to Be a Pioneer in the Convergence of Hollywood and the Internet

by Ray Arthur Wang

As a past winner of the HKN Outstanding ECE Student Award, I hope to provide some insight into the way high technology is shaping the entertainment industry, specifically Hollywood. Ironically, my involvement in the *Carma* Internet release is from the artistic side rather than the technological side. I have recently become a self-taught filmmaker, even though I am still a practicing electrical engineer, as Employee No. 1 for Las Vegas-based network security startup Remnant Labs, co-founded by Eric Lin, one of the executive producers for *Carma*.

Engineering versus Art

By my senior year in high school, I was destined to study electrical engineering and computer science (EECS) because of my general interest and skill in physics and mathematics, and the fact that EECS was increasingly becoming the career of choice Asian parents had in mind for their children, especially the boys. Up to then, I had a pretty stereotypical upbringing for an Asian American male—trained in classical piano, off to UC Berkeley to study EECS, the list goes on. Throughout my undergraduate years, I enjoyed many aspects of my EECS education, but I also realized that I had an even stronger inclination toward art, which Asian parents traditionally consider off-limits in terms of a possible career option.

A winner of numerous major piano competitions, I eventually made time, after a two-and-a-half year hiatus, for concerts again. Meanwhile, it was time to find an undergraduate research project, and in an ambitious attempt to combine the EECS and music careers, I went to the Center for New Music and Audio Technologies. Learning quickly that interdisciplinary research in EECS and music did not satisfy my interests in either of the fields,

I found intrigue instead in wireless communications. And I found harmony and balance in my life by keeping my careers separate.

Two years away from defending my dissertation on "Cross-Layer Interaction in Cellular Ad Hoc Networks" at Stanford, I found myself drawn to art again, this time in drama. This was bound to happen since I believe everybody has imagined being an actor at some point. Everybody also enjoys movies. I quickly found a new talent in acting but became increasingly disappointed about the portrayal of the Asian American males in mainstream cinema, or the lack thereof. Not only do Asian American males lack representation in mainstream movies on the level of Lucy Liu, we are often confused with Asian males like Jackie Chan, who speak broken English and are pigeonholed into limited roles such as martial artists, among other stereotypes.

Career Callings

It was the first time since becoming an electrical engineer that I had time to think about my place in American society and confront my desire to break out of my own stereotypical existence. This higher calling made me realize that in order to have any chance at fixing the Asian American male problem, the best way was to write, produce, and/or direct my own material. Becoming increasingly aware of other social problems in the world, I founded Raw Power Productions, Inc., in 2004 with one main mission: social change, especially in regards to but not limited to racial discrimination. Since movies are the most satisfying and accessible form of art and entertainment in the present day,

I felt that making movies, both thought-provoking and appealing to the mainstream, is the best bet for effecting social change. As an example, *Carma* may be a supernatural thriller, but it is also subtle social commentary. Featuring Academy Award nominee Karen Black and having been compared favorably to the work of Quentin Tarantino, David Lynch, and Alfred Hitchcock, my feature directorial debut *Carma* has come to represent a milestone in a new era of completely digital filmmaking, as it was created from start to finish entirely digitally. I wrote on a Palm Pilot, shot with a Panasonic digital video camera, edited on a Macintosh notebook computer, and am now having *Carma* distributed online through DVD-quality streaming technology developed by Silicon Valley start-up FastMovie.TV, founded by the multi-talented Viktor.

Art and Engineering

Along the way, my engineering background turned out to be one of the greatest assets a filmmaker could have. The very rigorous training and approach to problem solving from the engineering world translated to an unparalleled level of discipline in the filmmaking process. Despite traditional distribution offers, my deep technology background was the reason I instead took a chance with the daring Internet distribution deal, which was initiated by Anand Chandrasekaran, *Carma* executive producer and co-founder of Aeroprise, a leading mobile enterprise company, and Jayashree Patil, Founder and President of *Nirvana Woman* magazine, the premiere fashion/lifestyle magazine for South Asian Americans.

Prior to our launch, film distribution has scarcely changed since the film industry began in the 1920s. Traditional distribution requires a costly 35mm film print be made and sent to every theater where the film is screened.

"Marketing costs alone," says Chandrasekaran, "often exceed the cost of making the film. The average film costs more than \$2 million to distribute regardless of its production budget. High-quality Internet distribution and viral marketing via affiliate programs like *Carma*'s can lower the upfront distribution costs to almost zero, making it possible for more filmmakers to have their work seen." Making the process of releasing independent films faster and more democratic, Internet distribution promises to dramatically revolutionize the way films are viewed.



Figure 1 Screen capture of the official Web site of *Carma*, written, produced, and directed by former HKN Outstanding ECE Student Award winner Ray Arthur Wang.

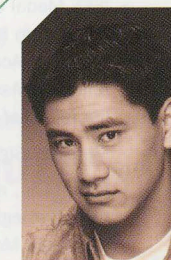
Pictured at the top is Tigger Oci, and at the bottom (left to right) are Peter Kiszka, Monika Lynn, Bob May, Justin McBaine, RAW, Alexis Brigham, the Ferrari 360 Spider (with Dane Andrew, Jennifer Heill, and Victor Ko), and Peter Kiszka again.

Conclusion

In the end, it was karma that *Carma*'s release would be of an interdisciplinary nature, successful this time around with the fields of filmmaking and engineering brought together seamlessly. The process helped me realize that engineering is at my core and is something I will never let go of. Do I ever wish I had a film degree rather than an electrical engineering degree? Not a chance. I have been fortunate to balance my careers successfully, but three can be too much, and I have been cutting back on the piano. On the other hand, two careers seem manageable, so I plan to continue being both a filmmaker and an electrical engineer.

For more on this topic, visit
www.hkn.org/bridge

ABOUT THE AUTHOR



Ray Arthur Wang
1999 HKN Outstanding Electrical and
Computer Engineering Student Award Recipient
Mu chapter – University of California – Berkeley

Ray Arthur Wang received a Ph.D. and M.S. from Stanford University in electrical engineering and a B.S. from UC Berkeley in electrical engineering and computer science with minor in music. With an invitation to the Sundance Producer's Conference under his belt, Ray made history as a filmmaker recently when his debut full-length supernatural thriller *Carma* became the first feature in film history to be distributed exclusively over the Internet via a revolutionary DVD-quality pay-per-view streaming system. Watch *Carma* on the official site of Raw Power Productions (www.rawpp.com).

Two New Eminent Members Inducted

Eta Kappa Nu confers Eminent Member status, the society's highest level of membership, on those select few whose contributions and attainments in the field of electrical and computer engineering have resulted in significant benefits to humankind.

EMINENT MEMBER

Presented October 2006



Abe M. Zarem

Abe M. Zarem established his technical leadership early in his career, most notably with the development of the "Zarem camera," a high-speed camera with no moving parts. He went on to engage in an extraordinarily broad spectrum of academic, civic, industrial, governmental, and professional management activities encompassing many fields of endeavor. He has served as special advisor on technology transfer and the application of scientific research to the king of Spain and the vice president of the United States, along with many other industrial, academic, and national leaders. Dr. Zarem's talent as visionary executive is evident in the design of the "world's first practical ion engine" by his company, Electro-Optical Systems, a model of which now resides in the Smithsonian Institute. Over the past two decades, he has continued his very active role as a strategic business development advisor, fulfilling his lifelong goal "to identify talent and to challenge it to greater achievements."

Zarem at a Glance

- > Distinguished senior advisor for neuroscience technology transfer, Brain Research Institute, University of California at Los Angeles
- > Founder of Electro-Optical Systems (acquired by Xerox) and Xerox Development Corporation
- > HKN Outstanding Young Electrical Engineer Award, Caltech Distinguished Alumni Award, National Academy of Engineering, IIT Hall of Fame, fellow of the IEEE and AIAA
- > Member, Delta chapter
- > B.S. in electrical engineering from Illinois Institute of Technology (IIT); Ph.D. from the California Institute of Technology (Caltech)

EMINENT MEMBER

Presented February 2007



James D. Meindl

If James Meindl was ever told "those who can, do; those who can't, teach," he didn't listen. He has shown what he can do with a record of technical accomplishments that includes micropower integrated circuits for portable military equipment, low-power integrated circuits and sensors for a portable electronic reading aid for the blind, miniature wireless radio telemetry systems for biomedical research, and non-invasive ultrasonic imaging and blood-flow measurement systems. To teach others to do as well, he has founded and directed research centers at Stanford and Georgia Tech. Even while serving as provost at Rensselaer Polytechnic Institute, he found time to supervise two graduate students. Dr. Meindl's dedication to teaching has amplified his ability to "do," producing a legacy of more than 80 doctoral students who will extend his impact on microelectronics for years to come.

Meindl at a Glance

- > Joseph M. Pettit Professor of Microelectronics; director, Microelectronics Research Center, Georgia Institute of Technology
- > Senior vice president for academic affairs and provost, Rensselaer Polytechnic Institute (1986-1993)
- > John M. Fluke Professor of Electrical Engineering, Stanford University (1967-1986)
- > IEEE Medal of Honor, SRC Aristotle Award, IEEE Third Millennium Medal, National Academy of Engineering, American Academy of Arts and Sciences, fellow of the American Association for the Advancement of Science, life fellow of the IEEE
- > Member, Sigma chapter
- > B.S., M.S., and Ph.D. in electrical engineering from Carnegie Institute of Technology (Carnegie Mellon University)



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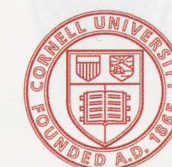
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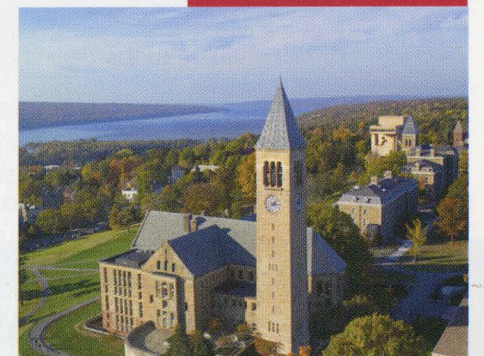


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2007 Student Leadership Conference

Leadership for a New Century

University of Missouri, Rolla | November 2-3, 2007

Gamma Theta chapter at the University of Missouri, Rolla will host the 2007 HKN Student Leadership Conference November 2-3, 2007. Students, please mark your calendars for this exciting weekend that will include presentations from distinguished speakers, team projects, a chapter development panel, and the chance to meet HKN members from chapters around the region. This year's theme is "Leadership for a New Century."

The weekend will begin with a welcome activity Friday evening, November 2, and then continue all day Saturday, November 3. You are welcome to participate in Gamma Theta's fall induction ceremony on Sunday morning as well.

Gamma Theta has set up a Web site for this conference, www.umsr.edu/~hknconf, so check often for details. Details will also be posted on the headquarters' web site, www.hkn.org, as they become available.

Registration will open in September 2007 and will be limited to 100 participants. All current HKN student members are welcome. So whether you are a new inductee or a chapter officer, mark your calendar now and plan to attend.

Last year's conference at Purdue was a huge success, and we look forward to the same enthusiasm at the University of Missouri, Rolla. Thanks to the generosity of our alumni members, this conference will be offered to participants at no charge. We appreciate their support in helping to develop the future leaders in ECE.



Members of Gamma Theta pose with Leah Jamieson. They are the hosts of the 2007 conference.



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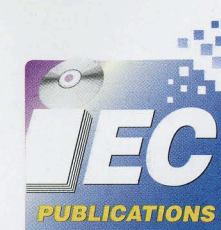
Various publications on topics such as telecommunications, satellite communications, VoIP, and wireless LANs are available to HKN members at an extremely reduced rate!

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