ENGINEERING EDUCATION IN 2000

Edwin C. Jones, Jr.*
e.c.jones@ieee.org

At one time this writer expected to retire in 1999 and thus to be interested in but not involved with engineering education in 2000. Recent changes in the retirement law mean that he now hopes to be in the classroom, and actively trying to balance his own views with those of students, industry, and society. What will those challenges be? What will our responses be?

When a good engineering design philosophy is applied to engineering education, the curriculum and educational structure developed maximizes the quality of the educational experience and process, subject to the constraints of societal pressures, student interests, industry desires, and faculty views. Students have always had strong influence on the curriculum, and the modern "students as adult consumers" trend will probably continue. This seems to be a responsible trend, for students do want a quality education. Today, when industry reports back to our campuses, they tell us that their main concern with the graduate is that new engineer's inability to communicate, either in written or spoken language. In contrast, they are satisfied with the graduate's technical capability and ability to continue learning. This is a substantial change from the past. Industry desires in the future will add interdisciplinarity to the need for communications, learning, and technical skills. Society is putting certain constraints on the engineering program. Society is wondering why the technological leadership in the United States is not advancing so rapidly as that in other parts of the world. Society is asking the engineer to look at the impact of engineering work and to ensure that the positive results far outweigh the societal costs. In its taxpaying role, society is now pressuring engineering faculty to be more "productive" but, of course, this has not yet been defined, let alone turned into a measurable quantity. The faculty, as always, has a responsibility to consider all of these inputs and to add to them its own views to produce a program and curriculum that will be manageable, feasible, and responsive.

One of this author's former teachers describes three kinds of learning that must take place in an engineering program. (Bloom, in a more detailed analysis of learning objectives, defines six.) The first is characterized as "memory work" or "knowledge accumulation." The student and the graduate engineer must have a substantial data bank ready for instant use. Little "rote memory" is involved, but repeated

Edwin C. Jones, Jr., circa "the late 1980's

work with realistic situations leads to a useful knowledge base. The second is an ability to solve "closed problems." This phrase describes analysis-type problems that usually have a single "correct" answer, and it represents a skill that must be mastered by students and graduate engineers alike. The "engineering approach" is developed by application of knowledge to variations of previously solved problems. The engineer on the job has, in practice, "open ended" problems to solve, the third type. These involve design and decision-making. To solve these the engineer uses the knowledge and analysis skills, applying them repetitively until the best solution that meets all of the constraints emerges.

The engineering faculty today spends a great deal of time teaching the first two kinds of skills. These tend to be the types of problems that lend themselves to computer-aided instruction, which will be extensively employed. Mastery teaching will be common, and it could be that grades will no longer be given for these two types of learning. It is expected, however, that the faculty will remain in continuous supervision of the process. Most of the instructional programs will have finite lives —the computer programs could easily include an "erase yourself" command when predetermined conditions are met. The increased use of the computer will, perhaps surprisingly, leave more time for

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student-faculty interaction. Most of this will occur in the "open-ended" or design courses, where the emphasis will be on decision making. The details may change, but evaluation will be a very important part of these courses.

There is much talk today about how rapidly knowledge becomes obsolete. This does not happen to the fundamental ideas upon which our profession is built. Rather, it is the knowledge of particular technologies and applications that are suitable and appropriate for today's task. This means that the role of continuing education will be primarily to make available to the engineer information regarding the latest and the most appropriate technological developments. Presumably in the year 2000, every faculty member, every professional engineer, and most if not all students, will have some kind of computer controlled learning center in the home or in the office at which to gather specific information about latest products and technologies. Manufacturer's catalogs, for example, may well become nearly obsolete. But because the fundamentals will change only very slowly, the role of these in the engineering curriculum will continue to be fully as important as it is today. If it is possible to spend more faculty time in the decision-making process, this will lead, it seems, to substantial interdisciplinarity in engineering study. Engineers will still be identified as electrical, or chemical, or civil engineers, but will work more closely with students and faculty in other disciplines than is now possible. The interdisciplinary approach will extend to and include the social sciences, the humanities, and the natural sciences. Professionals in many disciplines will need to develop ways to work together to meet society's demands on all. Among other things, this means that the engineering faculty will have a responsibility to work with faculty in other disciplines to develop their understanding of the engineering processes, just as engineers are now expected to be aware of the types of operations that go' on in other disciplines.

This suggests an expanded role for the social sciences and the humanities in engineering education. Some time ago one writer observed that engineers have learned to use the physical sciences and mathematics very efficiently in the engineering curriculum, but have not found effective ways to bring the social sciences and the humanities into the engineering profession. Their importance is realized but much learning yet remains. It does seem to this writer that much progress will be made in this area in the next twenty years. Among other things, this will lead to more consideration of a wide variety of non-technical factors in our engineering designs. The principal non-technical factor used today is economic, with some consideration of political constraints. Cultural and societal constraints are rarely considered. Ways will be found to include these; this will call for some very sophisticated engineering and thus a great deal of responsibility on the engineering faculty.

Teaching in 2000, when today's students are helping their children choose colleges, will continue to be an exciting, challenging, and worthwhile profession. This writer looks forward to being in the classroom at that time.

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This paper originally appeared in The Iowa Engineer, a student publication in the College of Engineering at Iowa State University. (Unfortunately the publication no longer appears.) Some of the predictions are acceptably close, others are way off. But it was fun to re-read the paper, courtesy of a colleague, Professor George Burnet, and perhaps some readers will enjoy it also. The author retired in 2001, but still goes to campus on a regular basis.

February 1, 1979

Get Ready For On-Line Learning Modules From EAB

By James M. Tien
IEEE Vice-President for Educational Activities

Early in 2003, the IEEE Educational Activities Board (EAB) brought together a Task Force of volunteers – **Antonio Bastos**, **Ted Bickart**, **Tariq Durrani**, **Lyle Feisel**, **Charles Hickman**, **Tom Jahns** (Chair), and **Friedolf Smits** – and staff leaders – **Jonathan Dahl**, **Matt Loeb**, and **Barbara Stoler** – to determine how IEEE could meet the critical industry need of providing continuing education for its working professionals. Indeed, this need was clearly detailed in a 2001 EAB study; it was also a recommendation of the 2002 IEEE Sections Congress and, if met, would be responsive to two of 2003 IEEE President Adler's goals – to produce new "products and services" and to build "bridges to industry."

After considerable deliberation and discussion, the EAB Task Force launched a "proof of concept" initiative to test the feasibility of creating on-line education or learning modules by adding instructional design to selected tutorials and short courses that are annually offered at the hundreds of conferences organized by the IEEE Societies, Councils, and Standards. It is important to note that these offerings are attended by conference registrants who actually pay another one to several hundred dollars to attend a tutorial or short course. Further, the offerings constitute the only remaining intellectual property (IP) that are not being packaged and widely distributed by the IEEE for the benefit of the engineering profession, including our own members. The 2003 initiative also tested the delivery of these modules on the IEEE Xplore platform. Furthermore, the development of a preliminary business model was undertaken to assess the financial viability of marketing such an Xplore-enabled learning library (XELL) to industry and to our own members, all of whom are clamoring for web-based educational material that can be accessed at anytime and from anywhere.

On-line learning modules will bridge the gap between IEEE-sponsored conferences and industry's need to provide timely and cutting-edge learning experiences to their technical staff. With significant educational input, we can leverage presentations that once went only to a privileged, one-time audience into modules that can be widely distributed. Our goal is to act as liaison between industry and the IEEE Technical Societies. We must be responsive to the needs of those working engineers whose travel and time have been restricted by the new business realities.

In the 2001 EAB study, corporate training and engineering departments were canvassed to see what they might want from the IEEE. The one consistent refrain from corporations was that they and their employees want materials with the imprimatur of the IEEE. The IEEE enjoys a reputation for presenting reliable reports on cutting edge topics in its electronic library of publications. As a result, the EAB Task Force reasoned that if there could be a way to capture and deliver educational content from the conferences in the same manner, corporations would then be helped greatly in keeping their engineers up-to-date on critical new developments. Additionally, the concept of anytime, anywhere delivery would already be a reality if the IEEE Xplore platform could be employed to distribute the learning modules.

To move from concept to product, the EAB decided to produce four prototypes. These were to be interactive, easily navigable and allow for self-testing so as to gauge the level of comprehension. In addition, several corporations were interviewed to determine end-user needs and abilities. Some preliminary marketing data were gathered to begin the development of an eventual business plan. Four IEEE Societies – Computer, Electron Devices, Engineering Management and Lasers and Electro-Optics – were selected from several who volunteered to be a part of the initiative. Together, we identified four topics from the previous year's conference material that seemed best suited to reflect the breadth, depth and relevance of the recently available tutorials and short courses. The prototypes ranged from managing innovation to computer security. The identification of Subject Matter Experts (SMEs) who actually delivered the material at the conferences was critical to the process. Their content, along with their willingness to work with the instructional designers, would make or break the initiative. With the cooperation of the society leadership and the engagement of committed SMEs, the prototypes have been successfully completed.

The production of four one-hour modules in less than six months proves:

- that we can move quickly from concept to final module, while maintaining the freshness of the subject matter;
- that we can make an educational product from conference tutorials and short courses, while employing instructional design and development techniques that underscore learning objectives and assessment criteria; and
- that an on-line, Xplore-delivered format can be utilized, while ensuring an easy-to-use and a financially viable approach.

Task Force volunteers have also taken the modules to corporations that previously had expressed an interest in the initiative. Several companies representing such areas as aerospace, medical technologies, computer hardware and software were contacted. The companies were of the caliber of a Boeing, an Abbott Labs, or an IBM. The feedback we sought was on two levels. The first was on the module itself, the second concerned pricing and subscription type. We welcomed feedback from a wide range of industry that represented the diversity of IEEE's current corporate subscribers, which in turn reflected the range of companies that employ our members. The industry feedback has been heartening and our proof of concept effort has been quite successful.

Each step taken by EAB has been measured and rigorous. As eager as we may be to try what promises to be an exciting new dimension in delivering continuing education and in enhancing IEEE's global value, we must be prudent. Before launching XELL, the Task Force has three more hurdles to overcome: fashioning a tight business plan, obtaining the cooperation of all the IEEE technical units and the selected SMEs, and producing in 2004 some 30 learning modules – reflecting the best of over 800 tutorials and short courses delivered at the more than 300, 2003 IEEE conferences.

At this point we have been working with IEEE marketing to detail the business plan so that the initiative can withstand the realities of the marketplace, beginning in 2005. We must be confident that the costs will be covered and that positive net revenues will be forthcoming to the technical societies whose cooperation, support and IP are at the core of XELL.

Never has there been a better time to launch an IEEE Xplore-enabled learning library. We're well on our way. Time to get ready for what IEEE EAB will be making available to help working professionals meet their need for continuing education.

James M. Tien
j.tien@ieee.org

From the Electrical and Computer Engineering Department Heads Association (ECEDHA)

Agents of Change: Achieving Diversity in Electrical and Computer Engineering Research and Education

Stephen Goodnick, ECEDHA President
David L. Soldan, ECEDHA Past President

In our last column, we highlighted some of the ongoing initiatives that ECEDHA has engaged in over the past year. In this issue's column, we highlight one of those initiatives, that of improving the diversity of students and faculty in Electrical and Computer Engineering Research and Education.

The lack of representation by women and minorities in science and engineering professions relative to U.S. society as a whole is well documented, however the problem is particularly acute for Electrical and Computer Engineering education. Based on statistics compiled by ASEE in 2002, the fraction of women in tenured/tenure track academic positions in ECE is only 8% of the total, while African American and Hispanic tenure track faculty account for 5.1% of all faculty (compared to about 25% of the US population as a whole in the latter case). While the percentages improve somewhat as one moves from faculty to graduate students, and from graduate students to undergraduates, the picture that emerges is of a continually narrowing pipeline of women and underrepresented minority students entering ECE, and continuing on for advanced degrees and academic positions. Given that ECE represents the largest engineering discipline in terms of student and faculty numbers, this lack of participation by more than half the population has major social as well as workforce consequences.

In June 2003, the National Science Foundation (NSF) sponsored a two day workshop with ECEDHA entitled "Agents of Change: Achieving Diversity in Electrical and Computer Engineering Research and Education." The workshop was organized by **James Momoh** and **Vasundara Varadan** of NSF's Electrical and Communications Systems (ECS) directorate. The purpose of the workshop was to bring together the chairs, deans and faculty members representing Electrical and Computer Engineering programs in the U.S. to share best practices and discuss innovative strategies to significantly enhance the diversity of the student and faculty bodies. The vision of diversity articulated at the workshop focused on the need to develop a welcoming and nurturing climate in educational institutions for women and underrepresented minority groups in Electrical and Computer Engineering. As

Stephen Goodnick

"Agents of Change," the workshop participants were invited to help formulate a national agenda and action plans for recruitment and retention of faculty members, graduate, undergraduate, and K-12 students.

The first day of the workshop featured presentations by a number of distinguished speakers. These speakers addressed a wide range of topics related to diversity in Electrical and Computer Engineering research and education. Several shared personal experiences. Following the presentations by the plenary and topical speakers, the workshop participants organized into breakout groups to address best practices and needs for achieving diversity in four different focus areas. The first group, led by Dr. **Jose Zayas-Castro** and Dr. **Pamela Leigh Mack**, addressed recruitment, retention and graduation of K-12 and undergraduate students in ECE. The second group, led by Dr. **James Johnson** and Dr. **Steven Marcus**, addressed the same with respect to underrepresented faculty in ECE. A third group, led by Dr. **David Soldan** and Dr. **Chris DeMarco**, focused on recruitment and retention of underrepresented groups into ECE graduate programs. Finally, the fourth group led by Dr. **Ronald Walters** and Dr. **Mark Smith** discussed the future of affirmative action, and its impact on achieving diversity in engineering programs.

There were several recommendations for further action by NSF, ECEDHA, and universities resulting from these breakout sessions. These recommendations pertain to two distinct goals that emerged from the discussion:

1. Increase the number of under represented minorities (URM) and women entering bachelor's level programs in Electrical and Computer Engineering.
2. Retention of URM and women in ECE programs in the pipeline to graduate school and academic positions.

A number of recommendations were made to NSF to help address these goals. Action items to increase the number of URM and women entering bachelor level programs include:

- Develop programs through engineering schools that educate secondary teachers and counselors on engineering as a career as well as support of Engineering Curriculum in K-12 education. Some programs already exist, but more active participation with ECE programs is needed.
- Develop an engineering school program that addresses two-year college students with a focus on recruitment and retention of URMs to complete ECE degrees in 4year colleges and universities.

Recommendations to NSF to recruit, and retain more URM and women into graduate and academic positions include:

- Faculty centered fellowships based on success in URM and women mentorship for proactive use in recruitment of underrepresented students into research positions.
- Funding for visiting graduate student fellowships from HBCU/HSI to major research universities.
- Fund partnerships/faculty exchange and sabbaticals programs with HBCU/HSI.
- Funding of senior faculty/junior faculty partnerships as well as unique and successful mentoring programs to become national models.

- Provide incentives to professors to enlist undergraduate women and minority students in research through REU and similar programs. Fund REU-like supplements to minority institution faculty for undergraduate research experiences.
- Fund short-term visiting faculty positions for newly minted minority PhDs to help prepare them for tenure track appointments. Conceptually, this suggestion is very close to the Faculty Fellowship program currently being developed by the NSF.

For ECEDHA, the following immediate action items were proposed and being followed up on:

- Include material in the ECEDHA New Chairs workshop on hiring, mentoring, and retention of new faculty. Include information on specific issues related to faculty diversity.
- Establish a clearinghouse of best practices in the recruitment and retention of URM and women students and faculty. Specific examples that address admission standards, expectations, retention and mentoring should be included.
- Hold a session at the 2004 ECEDHA Annual Meeting to present and discuss the outcomes of the Agents of Change Workshop, and develop further action items.

Mark Smith of Purdue will lead a session at our 2004 Annual Meeting to discuss results of this workshop and recommendations for universities in more detail. The ECEDHA leadership strongly encourages its members and the schools they represent to support these recommendations and become **AGENTS OF CHANGE!**

Steve Goodnick, stephen.goodnick@asu.edu
Dave Soldan, soldan@ksu.edu

From the Chair of the IEEE Accreditation Policy Council

Mario Gonzalez
m.Gonzalez@ieee.org

I'm writing this article in my new role as chair of the Accreditation Policy Committee (APC). This committee reports to the IEEE Vice-President for Educational Activities and coordinates the activities of three IEEE committees involved in accreditation: the Committee on Engineering Accreditation Activities (CEAA), the Committee on Technology Accreditation Activities (CTAA), and the Committee on Global Accreditation Activities (CGAA).

The most recent meeting of APC was held during the second week in January in Virginia Beach, Virginia. (Disclaimer: Virginia Beach in January is not the same as a beach in Hawaii any time of the year. The temperature was in the single digits at the time of our first meeting on the morning of January 11. In fact, during the three days of the meeting I never saw the beach!)

Instead of writing a summary of the meeting, what I will do here instead is to highlight some observations and questions that arose as a result of discussions that took place during the meeting. The remarks that follow are based not only on my own observations and beliefs, but also on suggestions provided by several colleagues who responded to my request for ideas for this article.

The first subject I wish to highlight is the accreditation process itself—defined and refined by ABET constituent societies only after long and thoughtful deliberations; training of evaluators and team chairs; the amount of work done by the entire team before, during, and after the visit; editing and reediting performed by team chairs, editors, and commission chairs;

Draft Statements and Due Process Procedures that allow institutions to respond to shortcomings identified during the visit and identify corrective actions taken since the end of the visit; more editing by the aforementioned contributors; approval by commissions after accreditation recommendations are approved in open session; and, finally, approval by the ABET Board of Directors. We should all be proud of the democratic manner in which this process is conducted even as we recognize that mechanisms are in place to make changes that reflect the constant evolution of the world in which we live, learn, and work. In other words, the accreditation process is driven by the need for continuous improvement, the same imperative that should motivate changes in our engineering programs.

At least as impressive, however, is the fact that accreditation is driven by volunteers: from industry, government, and academe. Over the years, friends and family members who are not engineers have asked me, "Why do you do this? Why do you invest all this time and energy without compensation?" The answer, of course, is that we do it because all of us, regardless of engineering discipline, professional affiliation, or geographic location are driven by one common goal: the improvement of engineering education. Now, when I talk to my classes about the internationalization of engineering practice, the central role of engineers in our collective and continuing efforts to improve the quality of life for all humans and in such magnificent achievements as the landing of two functional programmed explorers on the surface of Mars, it is much easier for me to relate the ABET criteria to their program of study and to the need for continuous improvement in an increasingly complex world.

I think it is safe to say that by the end of the next round of visits this fall, most, if not all, engineering programs will have experienced an EC-2000 visit. Some institutions have already had a second EC-2000 visit! This brings me to the second subject of discussion: Why are we doing this? That is, why do we subject ourselves to EC-2000 visits? Frankly, the preparation for an ABET visit is long-term, continuous, and not without a significant investment in people time, assessment, and evaluation. Whenever a faculty colleague asks me, "Why are we doing this?"—involving our constituents, asking if we're meeting our objectives and outcomes, closing the loop and making improvements—I say that we should be doing these things even if ABET didn't exist! How else are going to determine if our students have acquired the abilities, skills, and attitudes they should have at the time of graduation and several years after they've left us? How else can we determine if we're doing the job we set out to do?

In seeking advice for this article, several colleagues responded with their response to the question, "Why are we doing this?" Here's what some of them said:

- With respect to peer review: "It is almost certain to be beneficial to have a review by knowledgeable, unbiased persons from outside your own institution, who use a consistent set of reasonable criteria against which to form judgments and recommendations."

- "One obvious benefit of accreditation is that it assures some level of consistency in similar programs across the country." This colleague also reminded me that whenever anyone of us makes a statement or writes an article such as this one, although we may not necessarily convey an official IEEE position, we certainly do not convey an official ABET position.

- "…accreditation by a central body such as ABET is the only way to meet expectations with respect to consistency of knowledge and quality of the education of program graduates."

These statements support both the concept of accreditation and the way we perform engineering accreditation through ABET. At the same time, one contributor quoted above also goes on to say: "I think that too much emphasis is put on the written criteria and too little emphasis on the need for a wise, considered implementation of the criteria on each visit." This cautionary remark recognizes that the current approach to engineering accreditation is evolving. I believe that with time and more experience, more of us will have the wisdom to do a better job of addressing the real intent of the criteria.

In response to concerns and questions raised by some constituencies, IEEE has proposed changes to the criteria, changes that were approved on first reading by the ABET Board of Directors in November. Changes to Criteria, 2, 3, and 4 "will bring about greater understanding of expectations on the part of program faculties and, especially, a simplification of the major design experience while still expecting students to deal with conflicting constraints in design. "

The final subject examined here is related to the "Why are we doing this?" question and perhaps is even more fundamental: "How do we know that what we are doing [i. e., the accreditation process using EC2000 criteria as opposed to the old "topics" criteria] really leads to the graduation of better engineers?" This question (and the preceding "Why" question) are usually followed by one or more of the following statements: "My students get better every year." "Even in tough economic times employers still seek our graduates. That must mean we're doing something right." "Our graduates are succeeding in the best graduate programs in the country." The implication, of course, is that ABET and EC2000 notwithstanding, engineering programs across the country are producing outstanding young men and women who will become productive citizens and engineers by working in government or industry or by adding to their educational resume. The implication is valid. But the question remains, and ABET, cognizant of the importance of providing an objective and affirmative response "has initiated a longitudinal study to compare quantitatively the abilities and successes of the EC2000 criteria." [See the November, 2003 issue of *The Interface* for an excellent article by **Jerry Yeargan** on the development of the ABET EC2000 Criteria model.] I am confident that this long-term study will provide very positive results, and as noted in Jerry Yeargan's article, ABET will provide periodic progress results.

Before closing, I'd like to touch on a few more items that came up at the joint meeting in January and may serve as subjects for future reports.

- International accreditation. Many countries have created or are creating their own accreditation models with significant contributions from ABET and members of ABET societies.

- The use of web-based materials for training of program evaluators.
- The most appropriate level of education to enter practice in electrical and computer engineering.
- Standards. The IEEE Standards in Education Task Force (SETF), paralleling an ongoing ANSI project, is looking at the integration of standards in engineering practice into engineering programs of study.

If you are not already an IEEE program evaluator, I encourage you to get involved. An excellent way to get started is to read the article "IEEE and Accreditation" at:
http://www.ieee.org/organizations/eab/apc/accreditation_ieee.htm

Mario Gonzalez
m.gonzalez@ieee.org

From the Chair of the IEEE Committee on Engineering Accreditation Activities

Kenneth Cooper
k.cooper@ieee.org

Once again the IEEE has had a very successful year supporting accreditation activities. Our Program Evaluators supported over one hundred program visits again this past year and they performed very well.

The results from this year's visits continue to indicate issues with criterion 2 and criterion 3 of EC 2000. The recommended accreditation actions when leaving campus featured a lower percentage of NGR/VE actions this year than last. The recommendations for actions other than NGR/VE were dominated by issues with criterion 2 and criterion 3.

The primary objective of the Committee on Engineering Accreditation Activities (CEAA) is to recruit, train, mentor, and evaluate Program Evaluators capable of performing high quality, consistent program evaluations. Evaluation of the performance of the Program Evaluators is done by review of the report materials submitted after the program visit and input from Team Chairs and those responsible for the program visited. Issues and lessons learned from this evaluation of program visit results are factored into the CEAA training and mentoring programs.

In reviewing visit report material over the past few years, the CEAA members felt that some additional information would be helpful. This was because of the lack of details on the report forms and the exit statement and the issues identified with criterion 2 and criterion 3 of EC 2000. To respond to this need, Program Evaluators were asked to provide the following additional information this past year.

- A brief description of the primary factors that led to the recommended accreditation action.
- A comment on the consistency of criteria interpretation by members of the visit team and how differences were resolved.
- A comment on the collaboration between IEEE members on the visit, if applicable.

This request was responded to reasonably well by the Program Evaluators. The additional information provided to support the recommended accreditation action was extremely helpful in understanding the actions and provided significant insight into how criteria compliance was being judged on the visit. The information provided indicates that criteria compliance was not evaluated consistently between visits. A white paper on interpreting and meeting criterion 3 was available to support last years visits but there were indications that it was not used by all visit teams.

Data provided indicate that criteria interpretation on individual teams was very consistent. In those cases where there were issues, the Team Chairs provided the guidance required to reach resolution.

The collaboration between IEEE members on visit teams was reported as very good. This was very good news to CEAA for several reasons. First and foremost, our Visit Assignment Coordinator, Bill Sayle, works very hard at getting the appropriate Program Evaluators for each program visit. Secondly, there is usually significant overlap between the programs at an institution and good collaboration between the visitors makes it easier for the institution as well as the individual program evaluations.

Overall, I would say that the request for the additional information from the Program Evaluators was successful in supporting the objectives of CEAA. I am sure a similar request will be made to support the next visit cycle. I hope that this explanation of what was trying to be accomplished and the results will encourage the Program Evaluators to respond to the request for the next visit cycle.

Ken Cooper
kenneth.cooper@srs.gov

From the President of the IEEE Education Society

REFLECTIONS ON THE YEAR 2003

David V. Kerns, Jr.
d.kerns@ieee.org

This past year, the *Education Society* has had noteworthy successes and some areas for concern. As we leave 2003 behind, I'd like to remind of you of some of the achievements of our Society and also highlight some areas for growth in the New Year.

Primarily through the efforts of **Burks Oakley**, we have now officially established a new Education Society Award, the *Mac Van Valkenburg Early Career Teaching Award.* This award is to recognize members of the IEEE Education Society who have made outstanding contributions to teaching unusually early in their professional careers. Full-time (or equivalent) faculty who are within the first ten years following receipt of their Ph.D. (or other appropriate terminal degree), and have had a minimum of two academic years of appointment as a faculty member, are eligible to be nominated. The creation of this award is an initiative to attract younger members into the IEEE and the Education Society, and to appropriately recognize exceptional teaching. The details for nominating a candidate appear on our new website. We plan to make the first award at the next FIE Awards Banquet.

And speaking of the new website, if you haven't looked lately at the Education Society website, take time to browse at: www.ieee.org; click on technical societies and then on Education Society. **Rob Reilly** has done a fantastic job in totally restructuring our website and including links to relevant documentation and other important resources. We are now able to use the website as a tool to communicate activities of the Society worldwide. If you have information you think should be posted, contact Rob directly at: reilly@media.mit.edu

At the beginning of last year the Education Society had almost 4000 members; however, like most IEEE societies, during the past year our membership has decreased, in our case about 10%. This is cause for some concern and certainly for an increased need to explore providing real and enhanced value to our members and to build more enthusiasm for the Society. A member survey indicated that most members joined the education society for the publications. We sincerely thank **David Conner**, **Bill Sayle**, **Jerry Conner**, and all the staff and associate editors that have made our publications valuable to our members. On the other hand, half of our members report never having heard of the *FIE conference*. We also have some work to do.

Growth in membership has occurred in certain areas, particularly internationally. The formation of new Education Society Chapters around the world is particularly exciting, and the leadership of Chapter Chair, Rob Reilly has really helped.

There were several chapters born in 2003: Argentina, France and Romania. The South Brazil Chapter completed approvals to renew its Chapter status. The paperwork for a chapter in Spain has been approved by the Spain IEEE Section and is on its way to IEEE headquarters and the Education Society President for final approval. There is serious chapter formation activity in Taiwan, Trinadad & Tobago, Germany, and in Egypt.

Richardo Veiga has done a terrific job in forming the Argentina Chapter and is in the process of organizing a schedule of activities. The Chair of the new France Chapter is **Veronique Perdereau**, Veronique did a tremendous job getting the chapter in-place and she is looking forward to very productive chapter meetings. The Romania Chapter also came into existence; its chair is **Gabriel Dima**. Gabriel is to be commended for his efforts in forming the chapter. Like Veronique and Richardo, Gabriel is organizing a schedule of technical meetings in Romania.

The Education Society Chapter in the South Brazil IEEE Section required updating of records and renewal. **Claudio da Rocha Brito**, the chair, and **Melany Ciampi**, the vice chair, expended a good deal of time and effort to re-establish this chapter and develop a full schedule of technical meetings.

There are several IEEE members that Rob is working with to form new Education Society chapters throughout other parts of the world. These folks all have gone beyond the planning stage, and have completed forms and are gathering signatures. In Egypt, Dr. **Ahmed Zobaa** is the prime mover behind the chapter formation effort. In Germany **Michael Berger** is organizing a chapter formation effort, and in Taiwan this effort is being led by **Juing-Huei Su**. In Spain, **Manuel Castro** has more than enough signatures on a chapter formation petition; and the petition is moving forward. In Trinadad & Tobago Professor **Alvin Lutchman** is the central figure in forming a chapter as well as forming an IEEE section.

Trond Clausen of Norway, the Committee Vice Chair, is actively contacting all Education Society members in selected sections to explore the possibility of establishing chapters there. We are also exploring various ways of supporting the growth of new chapters, financially and otherwise.

As many of you know, I have long advocated for the Education Society to become more involved in international conferences; 2003 has seen some progress. We have asked **Victor Schutz** to serve as Meetings Chair for the Society, and to place a special emphasis on meetings outside the USA. Plans made in 2003 are providing some excellent conference opportunities in 2004.

Our positive association with **Federico Flückiger**, IGIP President, has led to our technical co-sponsorship of a conference in Fribourg, Switzerland, the 33rd IGIP Symposium, *"Local Identity – Global Awareness"* to highlight international aspects of engineering education. This meeting will be September 27 to October 1, 2004. We are very pleased that Federico has attended our AdCom meetings, and I believe will help build important links for our Society to Europe.

Our Society will also be providing technical co-sponsorship to *ITHET2004*, the 5th International Conference on Information Technology Based Higher Education and Training, May 31 to June 2, 2004 in Istanbul, Turkey. We are grateful for the continuing collaboration with the general chair, **Okyay Kaynak**, and this year's program chairs, **Yavuz Akpynar** and **Marion Hagler**.

Our Education Society colleagues in Brazil have organized *WCETE'2004* – the World Conference on Engineering and Technology Education. This meeting will be March 14 – 17, 2004 in Guaruja / Santos, Brazil. General chair **Claudio da Rocha Brito** and Program chair, **Melany M. Ciampi** have organized very successful conferences in the past, and the program for this meeting looks very exciting. We are very pleased and thankful for their continuing effort to promote dialog on engineering education, and represent the Education Society in Brazil and the region.

The activities of the Nordic Chapter should certainly be noted. Trond Clausen, **Flemming Fink**, **Mats Daniels** and others have organized workshops, conferences, and invigorated the activities of the Education Society throughout Scandinavia. I had the pleasure of attending a workshop in Aalborg, Denmark, last March and found the open discussion of cultural differences and similarities stimulating and valuable.

Before leaving conferences, (returning to the USA) we gratefully acknowledge the work of the *FIE 2003* team. The Education Society Co-sponsored a very successful FIE Conference in Boulder Colorado. The general co-chairs were **Melinda Piket-May**, **James Avery** and **James C. Sherman**; the Education Society Co-Program Chair was **Jeff Froyd**. Thank you and all those who helped for an exceptional FIE conference.

There are many others who should be thanked, but time or space doesn't permit. I look forward to working with the other officers, **Dan Litynski**, **Joseph Hughes**, **Rod Soukup**, and the members of the Society in the coming year to further our common goals. Please feel free to write or email me with your ideas. Our focus must continue on strengthening our membership, and reaching out to members in new ways to improve the value we provide.

David V. Kerns, Jr.
d.kerns@ieee.org

From the Chair of the ASEE ECE Division

S. H. Mousavinezhad
hossein.mousavinezhad@ieee.org
2002-2003 ASEE ECE Division Chair

As we finish review of more than 100 papers for the upcoming *ASEE Annual Conference in Salt Lake City*, I would like to ask readers of *The Interface* to mark their calendars for many important, informative, technical and educational events/sessions planned for this year's annual conference.

Sessions planned for the conference in Salt Lake City include our breakfast business meeting (1132, Mon. June 21, 7:00 a.m.), teaching and learning with technology (TLT, panel discussion, session 2232, Tues. June 22, 8:30 a.m.), and BSEE (BSECE) brainstorming. Paper sessions are: UG research & new direc-tions, new trends in ECE education, ECE online courses, labs, and programs, accreditation and related issues in ECE, course and curriculum innovations in ECE, ECE capstone and engineering practice, ECE laboratory development and innovations, pre-college and ECE education, and ECE education & engineering mathematics. We also have sessions for IEEE Education Society meetings and an ECE poster session. **Paul Devgan**, 2004 program chair is working hard and with help from other ECE division officers and many reviewers we hope that we will continue to have excellent educational/research programs for the membership.

I also want to mention again the importance of your active participation in ASEE and IEEE activities. Soon I will send out a call for nominations through the *ASEE listserv* and ask you to

IEEE Education Society Business Meeting in Nashville, June 2003.

ECE Division Officers (R-L): S. Burns, H. Mousavinezhad, S. Devgan, and S. Udpa. This was taken during business meeting in Nashville, June, 2003.

nominate a colleague (including yourself) to stand for election during our business meeting in Salt Lake City for the position of Division Secretary/Treasurer. This is an important position and we need someone with leadership, academic and research experience in the fields of electrical/computer engineering and related areas. The strong candidate is also a person with substantial track records of service in IEEE, ASEE and other related organizations. As universities and industry go through many changes and with many organizations facing economic and budget hard times, we need a strong individual to take office as secretary/treasurer who becomes Division vice chair and chair in the subsequent two years. The ECE Division is one of the most active divisions within ASEE and includes specializations (in addition to electrical/computer engineering) of biomedical engineering, electro information technology, software engineering and real-time systems, nanotechnology, and microelectromechanical systems.

Another related item is the *eit* (electro/information technology) conference we started in Chicago in 2000. Happy to report that eit04 conference will be hosted by Milwaukee School of Engineering, June 3-5, 2004 (for eit04, please contact Dr. **Russ Meier**, meier@msoe.edu). Future eit conferences are planned for Lincoln, Nebraska (2005), E. Lansing, Michigan (2006) and Windsor, Canada (2007). We have also started a Web site for the ECE Division, our thanks to Dr. **Victor Nelson** of Auburn for setting up this site.

ASEE ECE Division Web site:
www.eng.auburn.edu/ece/ASEE_ECE_Division
Thank you,

S. Hossein Mousavinezhad,
past chair, ECE Division,
listserv manager
hossein.mousavinezhad@ieee.org

So Where Is the "Real World?"

Mani Mina
Department of Electrical and Computer Engineering
Iowa State University
mmina@iastate.edu

This happens to me almost every term that I teach. I get very excited about some aspect of electrical engineering (complex numbers, Maxwell's equations, physics of devices, . .). Then, right at the moment of my excitement, while I am talking about the beauty of the utilization of the concepts, there is always "the" question: "So, do we really need to know these in the real world!!!!????" In this short article I would like to address a couple of important items related to this question.

Many of my colleagues do not like this type of questioning. I personally don't mind it. While it can be the most anticlimactic moment of the lecture, over the years I have learned to love such challenges. In my opinion, the students are questioning their education, determining their needs, and challenging the status quo of their field. These are great steps in becoming self-learners and that is what the whole education system is all about. Indeed the question can show that the students are trying to look into the future and see what they really need to learn. These are all great and wonderful attempts and we should have our hats off to those types of questions. However, sometimes the problem with this particular question is that the students, in a few cases, are not really trying to know what to learn, but trying not to learn what they have to. My experience shows that the students' curiosity is the best asset for educating the class about many important and related issues.

I also believe that there are two important messages in the questions. First, we would like to study only what we absolutely have to know (based on a very narrow vision of what the "real world" is). Second, the university is not a part of the "real world." As the reader can see, when such questions arise I have to take

many tangents in the lectures to explain important items that need to be addressed. In this article I will address these two major issues, hoping that many of the readers will let me know what they think.

1. What should we learn and what should we not learn?

During my years as a student, I also had many similar questions. However, at that time we did not even imagine posing a question like this. Perhaps we trusted that the system (our faculty and external departmental advisory board) knew what the students needed to study and know. While it was hard for us to see the reason for learning the abstract, and maybe theoretical, subjects, we believed that if other engineers needed to know them, so did we. I also remember that some of my colleagues, only in our study sessions, would say, "I am going to be an experimentalist, therefore I do not need to know all of the detailed theoretical understanding. I will not need that in my future career." That sounded logical at the time to many people. However, I always believed that we all should know what are considered the fundamentals of our trade—even if they are esoteric, even if they are hard, and even if my co-op position did not use them and many of my co-op colleagues told me they were not important. My experience shows that those who do not learn in school will need to learn later in order to advance their careers. Sometimes when we are students, we only focus on our very limited perspective of the discipline that we are studying. No one really knows what they need to know in the future, the best bet is to become a self learner and practice as much as you can. Perhaps the following example will also provide a helpful point of view.

Let us imagine that we are in the first year of medical school. Medical students also take many classes and labs. They go

through rotations to get practical experience. They keep learning, reading, thinking, and relearning while in rotation and later while practicing medicine. One of the tough classes they have to take in the first year is molecular pharmacology and biochemistry. What do you think will happen if, during a biochemistry lecture, a confident and "cool" student asks the professor, "Well, I want to be a cardiac surgeon—do you really think in the 'real world' I need to know this?" I have had very few friends who have dared asked similar questions. It turned out that in all such cases the professors doubted the seriousness of the student and started to doubt their ability to become a professional doctor. I agree that we need to question everything and always encourage students to never stop questioning. However, I also believe that when a group of faculty, external advisors, educators, and professional engineers get together and approve a curriculum, they probably have a good idea why each student has to take the subjects. We should trust such a group more than a few scattered examples of people in very specific specialties that claim something is not needed.

2. Where is the "real world?"

The other issue that I would like to address is the fact that many students, and even professional engineers, do not believe that the university is the "real world." They believe that the "real world" is a place outside the university where most of the knowledge gained in the university setting is not really useful. So academics like myself have to ask, where is this "real world" and why are we not a part of it?

I have been searching for the "real world" for a long time. In the last decade or so, I have had the opportunity to be a student and to work with different industries, different clients, various engineers of great talents, and a number of fine and capable business leaders as well as some wonderful students. I have come up with the conclusion that the "real world" as opposed to the fantasy world or "non-real-world" is not the right terminology to use.

When we use the term "real world," what we really mean, indeed, is the "commercial world." Let me guarantee you that we in the university are also a part of the real world, but perhaps with different constraints than the "commercial world."

Perhaps what we mean by the "real world" is the environment where professional engineers, technical staff, and business leaders are working together with a focus on the market need trying to solve practical problems. Practical problems are problems for which there are paying customers! Should we call such an environment the "real world?" We should not forget that there are many problems with paying clients that are addressed in the universities. These clients include national funding agencies as well as large and small companies who would like to utilize the expertise of the professors for research and investigations. Consequently, I believe the universities are also in the "real world," but their focus is not the commercial market-oriented projects.

What about the "commercial world"—The world where companies survive based on the quality of their products as well as the price? In such places, things are judged by the contribution to the bottom line. If we are working to be profitable and we are contributing, we will be on the team—otherwise we have to move on. In such environments, there is very little tolerance for mistakes. If we are asked to do something, we need to learn fast, use our experience, and finish the job. No one cares

how much or how long we worked, and there are no partial credits. In the commercial world, only the final working product is of value. Perhaps we can get a consultant, but we will be responsible for the outcome. It is up to us to know if the consultant is the right person and is trustworthy to deliver. For most of the working engineers, the "real world" indeed means the "commercial world" of the industry, where inefficiencies will lead to loss of market share and victory of the competitors. There are people who believe we should conduct our classes based on the commercial world demands and constraints (strict deadlines, no partial credits, and so on). I do not think that is the best approach for the academic environment.

In the university and academic environment, things are slightly different. We need to question everything from the foundation and come up with new ways to learn more effectively, new ways to view things more clearly based on our understanding of the fundamentals and our vision of the future. Almost all of the professors are engaged in creative works. We are all conducting research and are working with student projects. The students need to be trained to think critically and creatively, gain enough confidence to work on new subjects, and get to the depth of the material. By definition of research, the universities have to constantly work on new frontiers—the frontiers that are not clearly known. So we need to try to learn fast, question everything, and come up with hypotheses, theories, and new ways of formulation. As a result of working in research areas that are not fully developed, there will be mistakes, and we need to learn from the mistakes and keep going. This is the process of learning and what is meant by education. Indeed the process of being able to think critically, suggesting creative ways, and being ready to try, fail, learn, and try again makes the academic world so special and not a part of the "commercial world." We were meant to complement each other.

I guarantee you that the universities are as real as it gets for those involved. While cost, profit, inventory, competitor, market share, and all of the non-engineering hurdles haunt the commercial world, the academic environment is constantly challenged by the ability to tackle areas that no one has conquered before. The academic goal is being brave enough to try areas that are difficult for an overwhelming majority of the technical people, and knowing that by hard work, creative endeavor, and systematic approach, great achievements are accomplished. So as you can see, both the competition and reality are out there in academia, but the process and evaluation is not the same as in the "commercial world."

So, how updated should the university classes be with respect to the "commercial world?" I hope that you remember what we have discussed before (teaching vs. educating, and teacher-centric vs. learner-centric concepts). I would say that since in the universities we are in a learner-centric environment, it is as much the students' responsibility to make sure this is a part of the practical as well as the commercial world as it is the professors'. I encourage all of you to look into your intentions when you think about the "real world." Perhaps realistic examples—true industrial cases and problems—can make your experience at the universities more beneficial and not just simple problems with highly mathematical content. How do we get there? As students, you should be excited to learn and work toward getting to know the depth, the practical side of the theoreti-

cal formulations. You should help the class to learn and be the best. We need to work together as student-faculty teams to make sure the quality of our education, our enthusiasm, and your critical thinking skills are maintained, dynamically developed, and always improved.

In the final analysis, universities are not trying to only prepare you for industry, the "commercial world;" nor are we only trying to prepare you for graduate school. Our goal is to provide you with a knowledge base to appreciate and understand what is needed to be electrical or computer engineers. We hope to create excitable, dependable, and creative thinkers who know the fundamentals needed for the EE and CprE world and know enough about the wonders of technology and the true culture of the modern times to be able to work in the related areas and learn, grow, and create what is needed to be successful in their chosen careers.

I hope we all work hard, learn the best we can, try to expand our knowledge base, and try to follow up with the realities of our field to make our experience within the university as "real" as it can get. Where do we find the "real" issues that are engaging engineers of our time? The easiest way is to follow various publications in our trade organizations. The largest organization for us is the IEEE, where thousands of engineers with similar interests are working together. You can keep up with the knowledge base by keeping up with IEEE journals that appear in all levels with various sophistications. [Note to Iowa State University students—As a part of the university system, you have access to all of them by following the link through the ISU library (http://ieeexplore.ieee.org/Xplore/DynWel.jsp).]

Finally, for those of you who would like to join the dynamic industries in our area, may the realities of your university years and your great experiences help you gain great success in the "commercial world."

Mani Mina
Department of Electrical and Computer Engineering
Iowa State University
mmina@iastate.edu

From your Editor

Bill Sayle
sayle@ece.gatech.edu

A big Thanks to **Rob Reilly** who has redesigned and rejuvenated the *IEEE Education Society Web* Site. If you have not already visited our new web site, please check it out at www.ieee.org/edsoc On our new web site, you will find up-to-date news about our conferences, including the 2004 *ASEE Annual Conference* in Salt Lake City, UT, USA and the ASEE/IEEE *Frontiers in Education (FIE) Conference* in Savannah, GA, USA. Both of these conferences are well worth attending if you have any interest in engineering education matters. Not only are the technical sessions very useful, but you will be able to meet and talk with our colleagues who share an interest in education in a relaxed environment.

For information about the *ASEE Annual Conference* (20-23 June 2004) , please refer to www.asee.org .

For information about *FIE* (20-23 October 2004), please refer to http://www.fie-conference.org/04/ .

Another event of interest is a workshop on *Project/Problem Based Learning*, Porsgrunn, Norway, May 10-11, 2004. For details, please check http://www-pors.hit.no/~trondc/IEEE-ESw.htm

As you read this issue of *The Interface*, you may have noted that accreditation of engineering programs is still a hot topic. The implementation of EC 2000, has continued and most engineering programs have faced at least one evaluation using the new "outcomes-based" criteria. Some grumbling has been heard from some institutions, but we must be reminded that many of the institutions doing the grumbling were the very institutions who asked to be treated differently from all the other institutions. EC 2000 allows institutions and programs to define their own program objectives and the set of outcomes they feel will ensure they achieve the program objectives. Along the way, the program must produce graduates who are ready to enter the practice of engineering. Seems reasonable, but of course ensuring the achievement of program outcomes and the evaluation of program objectives requires an effort by the program and institution personnel.

If you have not already read the articles by **Mario Gonzalez**, chair of the IEEE Accreditation Policy Council and **Ken Cooper**, chair of the IEEE Committee on Engineering Accreditation Activities, please do so. Both of these gentlemen, Mario Gonzalez from academe and Ken Cooper from industry/government, have served our profession in an extraordinary manner. Both of them, like the rest of us involved in accreditation activities, are volunteers.
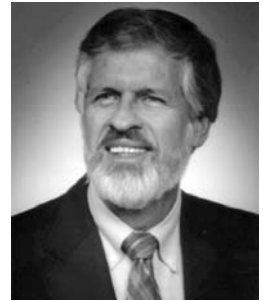
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David V. Kerns, Jr.
Provost
Olin College of Engineering
1735 Great Plain Avenue
Needham, MA 02492-1245 USA
Phone: +1 781 292 2350
E-mail: david.kerns@olin.edu

Vice President

Daniel Litynski
Provost
Western Michigan University
1903 W Michigan Ave.
Kalamazoo, MI 49008-5201 USA
Phone: +1 269 387 2380
E-Mail: dan.litynski@wmich.edu

Secretary

Joseph L. A. Hughes
Professor and Associate Chair
School of Electrical and Computer Engineering
Georgia Institute of Technology
Atlanta, GA 30332-0250 USA
Phone: +1 404 894 2930
E-mail: jhughes@ece.gatech.edu

Treasurer

Rodney J. Soukup
Henson Professor of Electrical Engineering
Department of Electrical Engineering
University of Nebraska, Lincoln
Lincoln, NE 68588-0511 USA
Phone: +1 402 472 1980 Fax: +1 402 472 4732
E-mail: rsoukup@unlinfo.unl.edu

Jr. Past President

Marion O. Hagler
Robert D. Guyton Chair of Teaching Excellence
Department of Electrical and Computer Engineering
216 Simrall Engineering Building, Hardy Road
Box 9571
Mississippi State University
Mississippi State, MS 39762 USA
Phone: +1 662 325 3665
Fax: +1 662 325 2298
E-mail: hagler@ECE.MSState.edu
WWW: www.msstate.edu

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Karan L. Watson
Associate Dean, College of Engineering
Texas A&M University
College Station, TX 77843-3127
Phone: +1 979 845 7441 Fax: +1 979 847 8654
E-mail: watson@tamu.edu
WWW: ee.tamu.edu/people/bios/bwatsonl.html

IEEE Division VI Director

Loretta J. Arellano
Senior Principal Engineer
Raytheon Electronic Systems
El Segundo, Calif., USA.
Phone: +1 310 334 5752
E-mail: l.arellano@ieee.org

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Adminsitrative Committee

Terms ending in 2006

Susan Conry
Clarkson University NY, USA
Email: conry@clarkson.edu

Haniph Latchman
University of Florida, USA
Email: latchman@list.ufl.edu

Tony Mitchell
North Carolina State University, USA
Email: tmitchel@eos.ncsu.edu

John Orr
Worcester Polytechnic Institute
Email: orr@wpi.edu

Terms ending in 2005

Melany M. Ciampi
University Center of Lusiada, Brasil
Email: melany@sp.senac.br

Victor P. Nelson
Auburn University, Alabama USA
Email: nelson@eng.auburn.edu

Wayne Johnson
Hewlett-Packard, USA
Email: wayne.johnson@hp.com

Russell Meier
Milwaukee School of Engineering, USA
Email: meier@msoe.edu

Terms ending in 2004

Susan Burkett
University of Arkansas, USA
Email: sburkett@uark.edu

Jeff Froyd
Texas A&M University, USA
Email: froyd@tamu.edu

Susan Lord
University of San Diego, USA
Email: slord@sandiego.edu

Claudio da Rocha Brito
University Center of Lusiada, Brasil
Email: cdbrito@sp.senac.br

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Daniel Litynski, Awards Committee Chair
Western Michigan University
+1 269 387 2380
dan.litynski@wmich.edu

Burks Oakley II
Mac Van Valkenburg Award Chair
University of Illinois
oakley@uillinois.edu

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N2ecj@iastate.edu

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csechrist@comcast.net

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daconner@uab.edu

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Hewlett-Packard/Harriett B. Rigas Award Chair

Mario Gonzalez
IEEE-ES Fellow Award Chair
University of Texas
Mario.Gonzalez@mail.utexas.edu

Chapter Committee Members

Rob Reilly, Chair
MIT Media Lab, USA
Email: reilly@media.mit.edu

Trond Clausen, Vice Chair
Telemark University College, Norway
Email: trond.clausen@hit.no

Manuel Castro
National Distance University of Spain
Email: mcastro@ieec.uned.es

Melany M. Ciampi
Council of Researchers in Education and Sciences (COPEC), Brasil
Email: melany@copec.org.br

Claudio da Rocha Brito
Council of Researchers in Education and Sciences (COPEC), Brasil
Email: cdrbrito@copec.org.br

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Email: batchman@engr.unr.edu
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Email: wdb@engr.uark.edu
University of Arkansas

Lance Pérez
Email: lperez@unl.edu
University of Nebraska-Lincoln

Wayne Johnson
Email: waynej@exch.hpl.hp.com
Hewlett-Packard

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Email: rsoukup@unl.edu
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Email: tang@rowan.edu
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Marion Hagler, Chair
Email: hagler@ece.msstate.edu
Mississippi State University

Ted Batchman
Email: batchman@engr.unr.edu
University of Nevada-Reno

Pat Daniels
Email: daniels@seattleu.edu
Seattle University, USA

Kruno Hernaut
Email: kruno@hernaut.de
Seimans AG, Germany

Joseph Hughes
Email: jhughes@ece.gatech.edu
Georgia Institute of Technology

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William E. Sayle II,Co-Chair
Interface Editor
Georgia Institute of Technology
Email: bill.sayle@ece.gatech.edu
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Email: daconner@uab.edu

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Email: david.kerns@olin.edu
Olin Colege of Engineering
Ted Batchman
Email: batchman@engr.unr.edu
University of Nevada at Reno
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Email: jroberts@ku.edu
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Joseph Hughes, General Chair
Email: joe.hughes@ece.gatech.edu
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Email: tskvaren@purdue.edu
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William Oakes, General Co-Chair
Email: oakes@ecn.purdue.edu
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Email: yokomoto@iupui.edu
IUPUI
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Email: voltmer@rose-human.edu
Rose-Hulman Institute of Technology
Susan Lord, EdSoc Program Co-Chair
Email: slord@sandiego.edu
University of San Diego

EdSoc Web Site Renovation Committee

William Sayle
Email: wsayle@ece.gatech.edu
Georgia Institute of Technology

Rob Reilly
Email: reilly@media.mit.edu
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2004 Frontiers in Education Conference
Expanding Educational Opportunities through Partnerships and Distance Learning
Hyatt Regency Savannah • Savannah, Georgia
October 20–23, 2004

The 2004 Frontiers in Education Conference (FIE 2004) continues a 34-year tradition of promoting the widespre dissemination of innovations in engineering and computer science education. FIE is a major annual international conference devoted to improvements in engineering education. It is an ideal forum for sharing your ideas, learning about new developments in engineering education, and interacting with your colleagues.

Engineering education faces significant challenges, such as rapidly evolving technologies, globalization, changin; student demographics, and cutbacks in government funding for higher education. Successfully addressing these issu will require innovative solutions, including use of new technologies to improve student learning; partnerships amon universities, industry, government, and K–12 educators; and distance learning to meet the needs of place-bound stud and support lifelong learning of engineering and computing professionals.

The FIE technical program will include paper presentations, panels, interactive sessions, and workshops. Abstrac are being solicited for contributed peer-reviewed full papers and works-in-progress. Proposals also are invited for panels, interactive sessions, and workshops. Topics of interest include:

- Accreditation and assessment
- Active and cooperative learning
- Capstone and creative design experiences
- Computer and Web-based software
- Computer science education
- Distance learning: methods and technologies
- Diversity: achieving it and teaching it
- Educational research in the classroom
- Entrepreneurship programs
- Ethics: creative ways to teach it
- Faculty development and retention
- Globalization initiatives and programs
- Historical perspectives and lessons

- Innovative degree programs and curricula
- K–12 initiatives and partnerships
- Laboratories: distance learning options
- Learning models and technologies
- Lifelong learning
- Multidisciplinary teaming
- Nontraditional students
- Partnerships with industry and government
- Software engineering education
- Teaching the art of teaching
- Technology in the classroom
- Undergraduate research experiences
- Women in engineering and computing

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