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Welcome Letters

Celebrating 40 Years of Innovation

October 27 - 30, 2010

Marriott Crystal Gateway, Arlington, Virginia



*Larry G Richards
University of Virginia
FIE 2010 General Chair*

On behalf of our two host schools and three sponsoring societies, welcome to the 40th Annual Frontiers in Education Conference. Deans of Engineering James Aylor of the University of Virginia and Richard Benson of Virginia Tech welcome you to Arlington and invite you to visit their schools in Charlottesville and Blacksburg. Three professional societies - ASEE Educational Research and Methods Division (ERM), IEEE Education Society, IEEE Computer Society - have collaborated for many years to establish the tradition of excellence in engineering education and research represented by FIE.

Frontiers in Education is the premier conference for educational innovation and research in engineering and computing. FIE 2010 continues a long tradition of disseminating results in these areas. We have an exciting conference with papers, works in progress, special sessions, panels, and workshops.

FIE is a unique conference and anyone who has attended can attest to its special nature. FIE is inclusive, collegial, and welcoming. We celebrate new participants and welcome old friends. FIE is more than a place to present papers. It is a venue for interacting with colleagues. FIE provides opportunities to meet with other engineering educators, discuss ideas, reflect on the topics and issues from the sessions, and chart new directions and collaborations. We hope to see lots of new faces at FIE 2010, and also hope that those who have attended previous FIEs will join us for this one.

There is a tremendous amount of work involved in producing a conference like this. The Planning Committee has organized an outstanding technical program. The program was assembled by program chairs representing the three societies: Maura Borrego of ERM, Jennifer Polack - Wahl of the IEEE Educational Society, and J. Fernando Naveda of the IEEE Computer Society. Lisa D. McNair serves as Chair for workshops, panels and special sessions. Our International Chairs are Melany M. Ciampi, Edmundo Tovar Caro, and Javier Quezada. Bob Hofinger continues in his key role as Exhibits Chair. Our Awards Chair is Tony Mitchel, and Ingrid St Omar is the Chair of the New Faculty Fellows Program. Reid Bailey is Local Arrangements Chair, and Ed Jones is our Conference Historian and Official FIE Photographer. All of these folks deserve our thanks for their contributions to the success of FIE 2010.

All of us learned our roles from those who went before - especially the FIE 2009 Planning Committee: Jeff Froyd, Rich Layton, David Cordes, Mani Mina, and Dan Moore, and the many Program Chairs and General Chairs who have created conference anew each year. Finally I want to acknowledge essential role of the FIE Steering Committee in managing this conference and insuring its continued success.

There are two people who have been essential to the success of FIE for many years. We owe special thanks to Kevin Curry, Assistant to the General Chair, and Dan Budny, Publications Chair. Their efforts make the whole thing work; they bring all the pieces together. They provide continuity from year to

year and have the institutional memory to make it possible for the rest of us to do our jobs. They do much more work than is apparent from the outside, and we could not manage this conference without them. Kevin and his team are based at the University of Kansas in Continuing Education, and Dan and his colleagues are at the University of Pittsburgh.

National Academy of Engineering has identified enhancing personalized learning as one of its Grand Challenges for the 21st Century. FIE has been at the forefront of educational research and practice since 1971, and we will highlight many exciting innovations at this year's conference. I look forward to seeing you in Arlington at FIE2010.

*Larry G Richards
University of Virginia
FIE 2010 General Chair*

Welcome From The Program Co-Chairs

Welcome to FIE 2010! We hope that you will find your experience here enjoyable and valuable as you participate in the broad range of paper and panel sessions, workshops and social activities the planning committee has scheduled.

This year's conference theme is 40 Years of Innovation. We are looking forward to reminiscing about prior FIE conferences and welcoming new colleagues to the community. If you are new to the conference, you will find sessions on a wide variety of topics related to engineering, computing and K-12 education. If you have been to FIE before, you will discover new opportunities - tracks with an international emphasis. Special sessions in nearly every track of the conference offer an alternative to traditional paper sessions. The technical program is complemented by the Conference's social activities. Don't miss the chance to network during breakfast and lunch and, of course, during the conference's reception. We hope that you will also make the time to explore Washington D. C., whose monuments, museums, historical sites and wide variety of ethnic restaurants provide great opportunities to relax, learn and enjoy your visit.

Our authors deserve the credit for the quality of this conference - their innovative and compelling work and their promising works-in-progress are a sure bet. We thank them and hope all those who submitted papers will attend the conference, attend a session in the track you submitted to, find out what those authors are doing and see how they can inspire your work even further. We encourage authors, attendees, conference chairs and everyone else to attend something new and to stimulate your teaching. We are also grateful to our reviewers who volunteered hundreds of hours to ensure the quality of the program.

Enjoy your time at FIE 2010!



*ASEE/ERM Program Co-Chair
Maura Borrego
Virginia Tech*



*International Co-Chair, Europe
Edmundo Tovar Caro
Universidad Politécnica de Madrid*



*IEEE/Education Society
Program Co-Chair
Jennifer Polack-Wahl
University of Mary
Washington*



*International Co-Chair, South
America
Melany M. Ciampi
Council of Researches in Educ. and
Sciences*



*IEEE/Computer Society
Program Co-Chair
J. Fernando Naveda
Rochester Institute of
Technology*



*Special Sessions, Workshops &
Panels Program Co-Chair
Lisa D. McNair
Virginia Polytechnic Institute and
State University*

Messages From The Sponsoring Societies

Educational Research and Methods Division of ASEE

It is exciting to be Celebrating 40 Years of Innovation the FIE way! Welcome to this milestone conference and welcome to Washington DC on behalf of the Educational Research and Methods Division of ASEE. FIE has been dedicated all these years to advancing the frontiers of engineering education - in practice, in research, and in the strengthening the link between the two. Committed to Margaret Mead's notion that a small group of thoughtful, committed citizens can change the world, FIE has always focused on providing experiences to nurture the citizenry of engineering education.

The Frontiers in Education experience in 2010 is brought to you by a large number of volunteers who are passionate about engineering education, particularly General Chair Larry Richards, Local Arrangements Chair Reid Bailey, and ERM Program Co-Chair Maura Borrego (all of whom are ERM members). The selection of New Faculty Fellows by Ingrid St. Omer keeps the frontier alive with fresh ideas; the work of International Program Co-Chairs Melany Ciampi, Javier Quezada, and Edmundo Tovar ensures that the conference has international relevance; the Special Sessions, Workshops & Panels selected by Lisa McNair embody the innovative delivery formats that have distinguished FIE from other conferences; the exhibits arranged by Robert Hofinger provide an opportunity to collaborate with a broad base of partners to bring innovation to engineering education; and the 12 members of the FIE Steering Committee strive to maintain and improve the conference's challenge to advance the frontier not only of what is innovative in engineering education, but what is innovative about the conference itself, while Ed Jones, conference historian, notes the distinctiveness of each conference. The conference would not be successful without the representatives of the IEEE Education and Computer Societies, the reviewers, and the session chairs.

If you are new to FIE, you will find that the conference is more than the sum of its technical sessions, workshops, special sessions, panels, and exhibits. Conversations following inspiring sessions that extend into dinner discussions, time spent renewing existing friendships and collaborations and starting new ones, and practicing a new teaching approach during the conference itself are some of the exciting opportunities at FIE.

I look forward to seeing you at the conference! Learn more about ERM at <http://www.fie-conference.org/erm/>, and consider working with us to support innovation at FIE and elsewhere in engineering education.



Matthew W. Ohland

Chair, Educational Research and Methods Division, ASEE

IEEE Computer Society

On behalf of the IEEE Computer Society, I would like to welcome you to the 2010 Frontiers in Education (FIE) Conference, *Celebrating 40 Years of Innovation*. The programme is full and varied, and I hope that you will all have an enjoyable and productive time.

FIE is fast becoming an international conference of increasing prominence. FIE will, therefore, play an increasingly important role in advancing education in 2010 and beyond. During the conference, researchers and practitioners from all over the world will bring new insights to the challenges of teaching. For me, one of the attractions of the discipline is that it is not only incredibly diverse but also quickly evolving. This, however, brings many challenges - we have to constantly revise fast-moving curricula and find new ways of teaching them, not only efficiently but also in a style that attracts and engages our students. In today's diverse world, universities take students from many different backgrounds. Often they arrive at university with little tradition of study in higher education. For a successful future, we need to ensure that each of our students seeks a graduate career within the discipline. As educators, we need to communicate the excitement and challenge of working in one area that is so vital to modern society. The programme committee has done a superb job in providing a programme that will be informative and interesting to each and every one of us.

FIE provides us all with a great opportunity to meet people working in different but related areas. Meeting others who have a shared interest in the various disciplines of computing and engineering education enables us to share experiences, and this will help all of us face the challenges our discipline brings. Remember that those listed on the programme are only a part of the success of FIE; those who will make a conference truly memorable are those sitting in the audience listening. Ask questions, challenge presenters and talk about your own experiences. Remember that successful education isn't passive. Nor are good conferences. Presenters will describe the outcomes of their research or experience; it's the audience that has the opportunity to further this work by exploring how the

outcomes can be adapted to work for you.

The 2010 FIE Conference takes place at a challenging time. Many companies are struggling to survive and many have already lost the fight. What is clear is that computing and engineering are likely to play a significant part in any social and financial recovery, whether it is through the opening up of new opportunities or solving problems that society faces. Ironically, many of us are finding it difficult to recruit sufficient students, and industry still finds it difficult to identify sufficient numbers of appropriately qualified students. FIE delegates will be considering how to promote those good practices in learning and teaching in our discipline that will help increase student participation. But you may also want to consider how we can more effectively communicate these practices to high school teachers so that they, too, can play a role in widening participation and interest in the field.

The IEEE Computer Society is delighted and honoured to participate in FIE because we share the same aims. The IEEE Computer Society Educational Activities Board (EAB) is involved in a broad range of projects ranging from curriculum development and accreditation of programmes to the provision of courses to support the Society's Certified Software Development Professional (and Associate) programmes. Moreover, the EAB is in the process of creating a Web site devoted to education and where we hope that many of the excellent ideas from FIE will be spotlighted. All these activities require volunteers to plan and implement them. I hope that participants in FIE 2010 will consider volunteering to help the EAB with some of these tasks. A significant number of the EAB committee will come to FIE so please seek them out and tell them what you would like from the Board.

Finally, I would like to thank the conference and programme committees for their hard work and dedication in ensuring the continued success of FIE. I hope that you will all enjoy the event, and I look forward to meeting you in Virginia.

Liz Burd
Vice President for Educational Activities
IEEE Computer Society

IEEE Education Society

On behalf of the IEEE Education Society, welcome to the 2010 Frontiers in Education (FIE) Conference! In 1971, visionary members of the Education Society held the first FIE. Now, in 2010, the hopes of the founders of the conference have been realized as we are "Celebrating 40 Years of Innovation". FIE continues to be a unique venue bringing together our members and colleagues with a passion for pushing forward the frontiers of knowledge and practice in engineering education. As we bring our collective creativity and engineering skills to bear on the challenge of how to best prepare current students to address major global challenges, we are truly working at the frontiers of engineering education.

Organizing a conference such as FIE10 requires a tremendous amount of effort over several years from dedicated volunteers. I particularly want to thank Larry Richards, FIE 2010 General Chair, for all of his work and leadership in organizing this conference and Jennifer Polack-Wahl for her dedicated work as the Education Society's Program Co-Chair. From personal experience, I know that both of these jobs require an extensive time commitment. I would also like to thank several other Education Society members for their valuable contributions including Melany Ciampi and Edmundo Tovar, International Program Co-Chairs, Ingrid St. Omer, New Faculty Fellows Chair, Tony Mitchell, Awards Chair, and Russ Meier and Edmundo Tovar for their service on the FIE Steering Committee. Once again, Ed Jones, does an excellent job as historian as he attends a record number of FIE conferences. Thanks also to the representatives of the ERM Division of ASEE and the IEEE Computer Society, as well as all of the volunteer reviewers and session chairs.

Most importantly, thank you - FIE would not be possible without presenters and attendees. I hope this conference provides many opportunities for you to learn new things, share your insights, and generate new research questions. I encourage you to consider joining your colleagues who are members of the Education Society (<http://ewh.ieee.org/soc/es/>) whose vision is to be the global leader in engineering education.

Welcome to Washington DC and have a great conference!



Susan M. Lord
President, IEEE Education Society

Message from The FIE Steering Committee

On behalf of the FIE Steering Committee it gives me the greatest pleasure to welcome you all to this year's Frontiers in Education conference. This year's conference collects a wide range of papers from around the world, and I hope you will find the mix of topics interesting. One aspect of FIE that I very much enjoy is the diversity of papers and disciplines to be encountered when attending the sessions. This is unique to FIE in my experience, most other education related conferences tend to be much more focused on specific disciplines. I encourage you to attend a wide range of talks, I have often found inspiration from disciplines well outside my own field (computing) when attending talks about educational challenges in teaching architecture and physics.

The FIE Steering committee manages the long term strategic development of the FIE conference series, and deals with general issues such as approving bids for future conferences, and overseeing contracting of key services, such as conference support and publications. In addition the Steering Committee takes responsibility for strategic initiatives affecting the conference series. In this regard there have been two important achievements during the last year.

Firstly we are proud to launch an official FIE logo, which provides the conference series with continuity and identity. We hope that this initiative will strengthen the recognition of the FIE conference, and help to maintain its unique status.

FIE is an important and well respected international conference, and maintaining the status and reputation of the conference is a high strategic priority in a climate of increased focus on bibliometrics and impact factors in assessing academic research outputs, such as the papers published here. One step in this process has been the outcome of the recent Australian Government ranking of international conferences and journals, which ranks the FIE conference highly, awarding it an A level ranking.

As always the FIE Steering Committee exists to serve our members, and we encourage you to contact any one of us during the conference to discuss any aspect of the FIE conference.

ASEE Educational Research and Methods Division Representatives

- Cynthia Finelli, University of Michigan, cfinelli@umich.edu (June 2009 - June 2012)
- Daniel Moore (Past Chair), Rose-Hulman Institute of Technology, dan.j.moore@rose-hulman.edu (June 2004 - June 2010)
- Jennifer Karlin, South Dakota School of Mines and Technology, jennifer.karlin@sdsmt.edu (June 2008 - June 2011)
- Beth Eschenbach, Humboldt State University, Elizabeth.Eschenbach@humboldt.edu (June 2010 - June 2013)

IEEE Computer Society Representatives

- Fernando Naveda, Rochester Institute of Technology, jfnaveda@computer.org (June 2006 - June 2012)
- Ann Sobel, Miami University, sobelae@muohio.edu (June 2004 - June 2010)
- Arnold Pears (Chair), Uppsala University (Sweden), Arnold.Pears@it.uu.se (June 2008 - June 2011)

IEEE Education Society Representatives

- Susan Lord, University of San Diego, slord@sandiego.edu (June 2006 - June 2012)
- Russ Meier, Milwaukee School of Engineering, meier@msoe.edu (June 2007 - June 2010)
- Edmundo Tovar Caro, Universidad Politecnica de Madrid, etovar@fi.upm.es (June 2008 - June 2011)

I look forward to meeting, and exchanging ideas with, many of you during the 2010 conference.

Sincerely,



*Arnold Pears, Chair
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