

The 12th International Federation of Automatic Control Advances in Control Education Symposium, IFAC-ACE 2019 was held at the Philadelphia Marriott Downtown Hotel in the center of Philadelphia, US, July 7-9, 2019 (<https://ifac-ace2019.org>). The symposium was held in conjunction with the ACC2019 conference, July 10-12, 2019. The IFAC-ACE 2019 is an international forum on recent developments and advances in control education that includes academic researchers and lecturers in control, R&D specialists in instrumentation, control and industrial automation, and practicing control engineers from a variety of industrial sectors. The goal of the symposium is to bring together experts from the field of control and education that will contribute to: demonstrating, discussing, evaluating and linking existing resources in the control education area; increasing awareness of the automatic control importance in our society; and linking different sources and authors active in development and provision of open educational resources.

Bozenna Pasik-Duncan (University of Kansas, US), NOC general chair, patterned this symposium after the previous symposiums she has organized. The program included plenary lectures, panel sessions, technical sessions, interactive sessions, software demonstrations and poster presentations. Seventy-two participants from over twenty countries attended. A STEM workshop for high school students and teachers was also included. Anthony Rossiter (University of Sheffield, UK) served as the International Program Committee (IPC) chair of ninety members. Sonja Glavaski-Radovanovic, Chief Scientist from Energy Digitalization at Energy & Environment Directorate of Pacific Northwest National Labs as vice-chair from industry and Stephen Kahne, Embry-Riddle Aeronautical University was Honorary Chair of the Symposium. IPC vice-chair from industry was Atanas Serbezov (Rose-Hulman Institute of Technology and consultant to Eli Lilly and Company, US). Many others contributed by chairing sessions and panels.

The plenary talks were:

Shaping the future of Higher Education: The Role of Systems and Controls

Bonnie Ferri, Vice Provost for Graduate Education and Faculty Development Professor, School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta, US. Bonnie is the winner of the 2018 IEEE Undergraduate Teaching Award for her pioneering work in hands-on learning and flipped classroom techniques.

Teaching Feedback and Control to Non-Specialists

Iven Mareels, Director, IBM Research, Australia and honorary professor at the University of Melbourne. He has received numerous awards for his contributions to control engineering research and education. Pedro Albertos, emeritus professor at Universitat Politècnica de València, Spain, contributed to the talk. He is a past president of IFAC and a world recognized expert in real-time control. Pedro Albertos and Iven Mareels are co-author of the book “Feedback and Control for Everyone,” the 2017 Winner of the IFAC Harold Chestnut Control Engineering Textbook Prize (The IFAC World Congress, Toulouse – July 2017)

Included along with invited talks ranging from classroom teaching methodologies and techniques to remote labs in control engineering education and online delivery tools were panel discussions and a demonstration and poster session.

Panel sessions:

Panel on Improving Students' Learning in Control Education with Data and Feedback Driven Methodologies. Organized by Steffi Korn (Uppsala University, Sweden), Damiano Varagnolo (Norwegian University of Technology and Science) and Atanas Serbezov. Panelists were Ryan Baker (University of Pennsylvania, US), Cristina Stoica Maniu (Centrale Supélec, France), and Ramon Vilvanova I Arbos (Universitat Autònoma de Barcelona, Spain). This panel discussion explored possibilities, benefits, and drawbacks of data- and feedback- driven methodologies in a control curriculum to: improve information gathering and feedback sharing mechanisms; improve teaching methods by assessing the level at which students master the concepts and fulfill the program goals; avoid compartmentalization and provide continuity by assessing its structural functionality with respect to its program goals; and improve collaboration between course instructors by fostering multidisciplinary partnerships and team works.

Panel on Industry, Academia and Government-Best Practices for Interaction. Co-chaired by Bozenna Pasik-Duncan and Atanas Serbezov. Panelists were Irina Dolinskaya (National Science Foundation, US), Frank Doyle (Harvard University, US), Sonja Glavaski (Pacific Northwest National Lab, US), Iven Mareels (IBM – Australia), Tariq Samad (University of Minnesota, US) and Dawn Tilbury (NSF & University of Michigan, US). The panel discussed topics on transferring technology from university to industry, NSF industry partnership programs; developing “win-win opportunities” for pathways to technology; facilitating and amplifying communication; bridging the gap between academia and industry; and increasing industry participation in and impact from IFAC activities.

IFAC Technical Committees: Educational Activities and Their Best Practice. Co-chaired by Bozenna Pasik-Duncan and Iven Mareels. Panelists were Pasik-Duncan, Mariana Netto (IFSTTAR, France), Hitay Ozbay (Bilkent University, Turkey), Claudia Califano (Università Di Rome, Italy), Matjaz Colnaric, University of Maribor, Slovenia) and Lars Eriksson (Linköping University, Sweden). Panel topics included stochastic adaptive control and its broader impact to education; a case study on teaching applied control design; a brief report on educational activities of IFAC TC2.2-Linear Control Systems; recent educational activities in the nonlinear control field; which computer-related competences are required for a control graduate; and teaching and attracting students to model-based automotive control.

Participants were given the opportunity to network and meet up close with experts at the session of interactive demonstrations and poster presentations. A reception open to all participants was held for women in IFAC where they were able to have a conversation with Bonnie Ferri. Other social events like a continental breakfast each morning, dinner on Monday night, and the opening and closing receptions gave participants an informal way to meet. Participants also had the opportunity to take a historical walking tour of Philadelphia and enjoy the Reading Terminal Market across the street.



Women participants were treated to a reception and conversation with Bonnie Ferri.

All participants were invited to the workshop for high school students and teachers, *The Power, Beauty and Excitement of Cross-Boundaries Nature of Control—a Field that Spans Science, Technology, Engineering & Mathematics* (STEM). Conference graduate students and young professionals joined invited students from the Marine Advanced Technology Education (MATE) Center, a national partnership of organizations working to improve marine technical education. We were also joined by some of the high school participants who happened to be in the hotel for a chess tournament. They heard about our event and asked to join us!

This outreach event is designed to increase the general awareness of the importance of systems and control technology and its cross-disciplinary nature among high school students and teachers. Control is used in many common devices and systems: cell phones, computer hard drives, automobiles, and aircraft, but is usually hidden from view. The control field spans science, technology, engineering and mathematics (STEM). The success of all STEM disciplines depends on attracting the most gifted young people to science and engineering professions. Early exposure to middle and high school students and their teachers is a key factor. The goal of these outreach efforts is to promote an increased awareness of the importance and cross-disciplinary nature of control and systems technology.

STEM workshop presentations:

- *What is Control System and Why Should I Care*, Daniel Abramovitch (Agilent Technologies, US)
- *How We Can Improve Water Supply in the Developing World with Control Engineering*, Margret Bauer (University of Pretoria, South Africa)
- *Stepping Inside the Brain Using Virtual Reality*, Dominique Duncan (University of Southern California, US)
- *STEM is for Everyone!*, Ramla Qureshi (Women Engineers Pakistan)
- *Demonstrations of Control*, Peter Martin (Quanser Inc., Canada)

The MATE participants found their first experience at an international conference to be quite memorable and found the “customized STEM workshop to be incredible”. The students liked how the presentations covered various topics. One student commented, “It was astounding to see that water, a resource that we take for granted sometimes is so powerful and has a huge impact on daily lives.... It made me realize that water isn’t an infinite resource and we have to start conserving to make a change and preserve it.” Another student like the applications using virtual reality. Overall the graduate students and young professionals observed outstanding presentations on how to teach control. The high school students appreciated the international atmosphere and loved the world-wide topics.

At the closing ceremony, awards were presented to Cinthia Viviana Rojas Palacio (Universidad Nacional de Colombia sede Medellin, Columbia) for the ACE 2019 IFAC Foundation Young Authors Support Grant for presenting her paper at the symposium; Paul Beuchat (ETH, Zurich, Switzerland) was the winner of the IFAC Young Author Award for his paper *A Teaching System for Hands-on-Quadcopter Control* (coauthored with Yvonne Rebecca Stürz and John Lygeros (ETH Zurich); and Mihaela Ghita (Ghent University, Belgium) who received second place of the young author award for her paper *An interdisciplinary, Low-Cost Methodological Framework for Analyzing Dynamical Material Properties for Control-Related Applications* (coauthored with Isabela Roxana Birs, Cristina Ioana Muresan (Technical University of Cluj-Napoca), Maria Ghita, Copot Dana, Clara Ionescu (Ghent University)



Award recipients Paul Beuchat and Cinthia Rojas.

The IFAC-ACE2019 Symposium was very successful and most memorable.

Immediate feedback - thank notes from participants have been most enjoyable to read:

“I would like to thank you for this incredibly interesting symposium, with incredibly interesting people!”
“Please accept my sincere appreciation and congratulations for the wonderful conduct of the ACE 2019 at Philly. It was indeed my luck and pleasure that I participated in the symposium,” and from students:
“We honestly thank you for making us fell like being part of a big family and for helping us making connections in this ‘big control world’.

All papers and plenary talks as well as some presentations from STEM Workshop are posted on our webpage:

<https://ifac-ace2019.org> which will be open to public for one more year until the IFAC World Congress in July of 2020.

Many thanks go to our sponsors IFAC and AACC (American Automatic Control Council). In particular to Douglas Lawrence, General Chair of ACC2019, Frank Allgöwer, IFAC President, and Richard Braatz, AACC President. Their support and efforts made it possible for us to hold this symposium. We also greatly appreciate our co-sponsors: University of Kansas, SIGNITION LP, IEEE Women in Engineering and IEEE Control Systems Society Women in Control.



Submitted by:
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July 30, 2019