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# **AC 2011-2413: PANEL DISCUSSION: COMPLETING THE CYCLE OF INNOVATION IN ENGINEERING EDUCATION BY FOSTERING IMPLEMENTATION OF BEST PRACTICES**

## **Aidsa I. Santiago-Roman, University of Puerto Rico, Mayagez**

Aidsa I. Santiago Roman is an Assistant Professor in the Department of Engineering Science and Materials and the Director of the Strategic Engineering Education Development (SEED) Office at the University of Puerto Rico, Mayaguez Campus (UPRM). Dr. Santiago earned a B.A. (1996) and M.S. (2000) in Industrial Engineering from UPRM, and Ph.D. (2009) in Engineering Education from Purdue University. Her primary research interest is investigating students' understanding of difficult concepts in engineering science with underrepresented populations. She also teaches introductory engineering courses such as Problem Solving and Computer Programming, Statics, and Mechanics.

## **Christopher Papadopoulos, University of Puerto Rico, Mayagez**

Christopher Papadopoulos is an Assistant Professor in the Department of Engineering Science and Materials at the University of Puerto Rico, Mayagez. He earned B.S. degrees in Civil Engineering and Mathematics from Carnegie Mellon University (1993) and a Ph.D. in Theoretical & Applied Mechanics at Cornell University (1999). Prior to coming to UPRM, Papadopoulos served on the faculty in the Department of Civil Engineering & Mechanics at the University of Wisconsin, Milwaukee.

Papadopoulos has primary research and teaching interests in mechanics, including nonlinear structural analysis, computational mechanics, and biomechanics. He is also active in engineering education and engineering ethics, particularly in mechanics education and appropriate technology.

At UPRM, Papadopoulos serves as the coordinator of the Engineering Mechanics Committee, which manages the mechanics courses taken by all engineering majors. He also co-coordinates the Social, Ethical, and Global Issues (SEGI) in Engineering Program, and Forums on Philosophy, Engineering, and Technology.

## **Matthew W. Ohland, Purdue University, West Lafayette**

Matthew W. Ohland is Associate Professor of Engineering Education at Purdue University. He has degrees from Swarthmore College, Rensselaer Polytechnic Institute, and the University of Florida. His research on the longitudinal study of engineering students, team assignment, peer evaluation, and active and collaborative teaching methods has been supported by over \$11.4 million from the National Science Foundation and the Sloan Foundation and his team received the William Elgin Wickenden Award for the Best Paper in the Journal of Engineering Education in 2008 and multiple conference Best Paper awards. Dr. Ohland is Chair of ASEE's Educational Research and Methods division and an At-Large member the Administrative Committee of the IEEE Education Society. He was the 2002-2006 President of Tau Beta Pi.

## **Ruth A. Streveler, Purdue University, West Lafayette**

Ruth A. Streveler is an Assistant Professor in the School of Engineering Education at Purdue University. Before coming to Purdue she spent 12 years at Colorado School of Mines, where she was the founding Director of the Center for Engineering Education. Dr. Streveler earned a B.A. in Biology from Indiana University, Bloomington, M.S. in Zoology from the Ohio State University, and Ph.D. in Educational Psychology from the University of Hawaii, Manoa. Her primary research interests are investigating students' understanding of difficult concepts in engineering science and helping engineering faculty conduct rigorous research in engineering education.

## **Dr. Anna Dollar, Miami University**

Anna Dollar is an associate professor in the Department of Mechanical and Manufacturing Engineering at Miami University in Oxford, OH, and previously was on the faculty of the Illinois Institute of Technology (IIT) in Chicago. She received her Ph.D. in applied mechanics from Krakow University of Technology in Poland. Her teaching has been recognized by many awards including: University Excellence in Teaching Award (IIT), and E. Phillips Knox University Teaching Award (Miami University). Her research focuses on mechanics of solids and engineering education.

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**Dr. Cynthia J. Atman, University of Washington**

Cynthia J. Atman is the founding Director of the Center for Engineering Learning & Teaching (CELT), Director of the Center for the Advancement of Engineering Education (CAEE), Professor in Human-Centered Design & Engineering, and the inaugural holder of the Mitchell T. & Lella Blanche Bowie Endowed Chair at the University of Washington.

She earned her doctorate in engineering and public policy from Carnegie Mellon University and joined the University of Washington in 1998 after seven years on the faculty at the University of Pittsburgh.

Her research focuses on engineering design learning and students as emerging engineering professionals. She is a fellow of AAAS and ASEE, was the 2002 recipient of the ASEE Chester F. Carlson Award for Innovation in Engineering Education, and received the 2009 David B. Thorud Leadership Award, which is given to a UW faculty or staff for demonstrating leadership, innovation, and teamwork.

**Dr. Jennifer A. Turns, University of Washington**

Jennifer Turns is an Associate Professor in the Department of Human Centered Design and Engineering at the University of Washington. She is interested in all aspects of engineering education, including how to support engineering students in reflecting on experience, how to help engineering educators make effective teaching decisions, and the application of ideas from complexity science to the challenges of engineering education.

**Dr. Sunil Saigal, P.E., New Jersey Institute of Technology**

Sunil Saigal joined the faculty of NJIT as Dean and Distinguished Professor of the Newark College of Engineering in 2007. He held previous positions as Assistant Professor of Mechanical Engineering at Worcester Polytechnic Institute; Professor of Civil and Environmental Engineering at Carnegie Mellon University; and Chair of Civil and Environmental Engineering and Professor of Biomedical Engineering at the University of South Florida. He also served as Interim Dean of Engineering at USF.

Sunil Saigal earned his Ph.D. in Aeronautics and Astronautics from Purdue University in 1985. He completed bachelors and masters degrees in civil engineering in India, earning a B.S. in Civil Engineering from the Punjab Engineering College in 1978 and an M.S. in Structures from the Indian Institute of Science in 1980.

Saigal's recent research interests include computational orthopedic biomechanics for the spine and shoulder; computational cardiomechanics; computational nanomechanics for nanocomposite structures; and computational mechanics. Saigal has also held several prestigious research appointments, including at NASA, Ford Motors, and Sandia and Oak Ridge National Laboratories, and Mercedes Benz. He has been the principal investigator on grants and contracts including research on computational models for the manufacture of advanced construction materials and medical prosthetics; research on crash simulation models for the Federal Highway Administration; and research on weapons systems and technology at Sandia National Laboratory and the Naval Surface Warfare Center.

Saigal is the co-author of five books on engineering mechanics and holds a patent for a method of manufacturing hot rolled I-beams. He is the author of over 100 peer reviewed articles and serves as associate editor of AIAA Journal and as a member of the editorial boards of the International Journal for Numerical Methods in Engineering; Engineering with Computers; and the International Journal for Computational Civil and Structural Engineering. He has served as a member of several committees of the American Society of Mechanical Engineers; as a member of the Board of Directors of the American Society of Civil Engineers West Coast Branch; and as a proposal review panelist for agencies including the National Science Foundation, Air Force, Army, Oak Ridge National Laboratory, and the Western Pennsylvania Advance Technology Center.

## **Panel Discussion: Completing the Cycle of Innovation in Engineering Education by Fostering Implementation of Best Practices**

In 2009, the ASEE published a report entitled *Creating a Culture for Scholarly and Systematic Innovation in Engineering Education: Ensuring U.S. Engineering has the Right People with the Right Talent for a Global Society*, arguing that systematic practice and application of engineering education research is crucial if engineering education is to continually refresh itself to keep pace with rapidly evolving technologies and societal needs. To this end, the ASEE Report proposes the enculturation of a continuous closed-loop “innovation cycle” in which (1) Educational Practice identifies and motivates important (2) Questions which are clearly posed and formulated, leading to (3) rigorous Educational Research, (4) resulting in Insights and Answers that are implemented back into (1) Educational Practice.

Activities corresponding to the first three elements of this cycle are flourishing, as evidenced by the multitude of research publications and proposals related to engineering education of the last decade, driven particularly by available funding and emerging academic programs in engineering education. These research and development efforts are generally characterized by developing fundamentally *new* pedagogies or findings, with the requirement or expectation that any new pedagogy can be disseminated through the adoption and implementation by other educators.

However, implementation, which is the adoption and/or adaptation of a prior work, seems to be less actively pursued and/or more difficult to achieve; it is perhaps the “missing link” in the innovation cycle. Indeed, quoting the *Engineer of 2020* (NAE, 2005), the ASEE Report laments that “[u]nlike the technical community, wherein data-driven results from one lab have widespread impact on the work of peers, many educational reformers have not incorporated research on learning into their work”. Replacing “educational reformers” with “instructors” and “work” with “teaching” further illuminates the issue.

To advance the cause of implementation, represented by element #4 of the innovation cycle, the Strategic Engineering Education Development (SEED) Office at the University of Puerto Rico, Mayagüez has organized this panel discussion. Both barriers against implementation and strategies to foster it will be discussed and debated, according to the following outline of speakers and topics:

- **Ruth Streveler and Matthew Ohland, Purdue University: The role of rigorous engineering education research in engineering education and pedagogy.** What are fundamental principles of rigorous research in engineering education? How can institutional data be used to help us understand the engineering student experience?
- **Anna Dollár, Miami University of Ohio: Implications of educational research in research dossier and tenure & promotion.** Is educational research considered as legitimate as disciplinary research, particularly by members of promotion and tenure committees? Is the evaluation of educational research similar or different to disciplinary research?

- **Jennifer Turns and Cindy Atman, University of Washington: Linking educational research to curriculum design and educator professional development.** Ideas to be explored will include the challenge of designing curricula that build on educational research while also adapting to local contexts (which require flexibility, adaptability and room for individual instructor's preferences) and the implications for educator professional development when the goal is that educators be able to engage in research-informed practice.
- **Christopher Papadopoulos and Aidsa Santiago, University of Puerto Rico, Mayagüez: Institutional strategies to designate and empower selected faculty to disseminate best practices.** Ideas to be explored will include the creation of formal mechanisms for instructors to document implementation of best practices and the designation of local "innovation captains" who can liaison between the general faculty and the education research community.
- **Sunil Saigal, New Jersey Institute of Technology: What lessons can be learned from industry that can promote dissemination of advances in engineering education?** Is it correct to use the same modalities of dissemination for education research as are used for the dissemination of traditional research? Are the issues addressed by engineering education research those that the engineering educator sees in the classroom? We know what it takes for traditional research to transition to market products. Do we have a corresponding mechanism available for transitioning engineering education research to the classroom? Are we correctly focused when we keep asking for tweaks in P&T procedures to affect changes in engineering education? A discussion of these questions could reveal that we need to head in new directions than the ones we have pursued to date.

Each panelist will speak for approximately 10 minutes (panelists from the same institution will share one 10 minute block), leaving ample time for discussion with the audience. After the seminar, the panelists will prepare a small booklet summarizing their remarks and salient comments and suggestions that emerge from the discussion. The booklet will be presented to the Continuing Professional Development Division Chair for dissemination through the Division website and future publication.