Curriculum Vitae
PRAMOD P. KHARGONEKAR

Education

Ph. D. – Electrical Engineering, University of Florida, August 1981
Dissertation Advisor: Professor R. E. Kalman

M. S. – Mathematics, University of Florida, December 1980

B. Tech. – Electrical Engineering, Indian Institute of Technology, Bombay, India, June 1977

Current and Previous Positions

1. Vice Chancellor for Research
   University of California, Irvine
   June 2016-now

2. Distinguished Professor of Electrical Engineering and Computer Science
   University of California, Irvine
   January 2017-now

3. Assistant Director for Engineering
   National Science Foundation
   March 2013 – June 2016

4. Deputy Director for Technology
   Advanced Research Projects Agency – Energy (ARPA-E)
   U. S. Department of Energy
   September 2012 – February 2013

5. Eckis Professor of Electrical & Computer Engineering
   University of Florida
   July 2001 – June 2016

6. Dean, College of Engineering
   University of Florida
   July 2001 – July 2009

5. Chair, Dept. of Electrical Engineering and Computer Science
   The University of Michigan
   October 1997 – June 2001

6. Claude E. Shannon Professor of Engineering Science
The University of Michigan
September 2000 – June 2001

7. Associate Chair, Dept. of Electrical Engineering and Computer Science
The University of Michigan
September 1995 – September 1997

8. Director
AFOSR/ARPA MURI Research Center on Intelligent Electronics Manufacturing: Modeling and Control of Plasma Processing
The University of Michigan
September 1995 – June 2001

9. Professor, Dept. of Electrical Engineering and Computer Science
The University of Michigan
September 1989 – June 2001

10. Professor, Dept. of Electrical Engineering
University of Minnesota
September 1988 – August 1989

11. Associate Professor, Dept. of Electrical Engineering
University of Minnesota
August 1984 – September 1988

12. Assistant Professor, Dept. of Electrical Engineering
University of Florida
August 1981 – August 1984

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Major Leadership Experiences and Accomplishments

Vice Chancellor for Research, University of California, Irvine: Since July 2016, I have been serving in this role and am responsible for leading the UCI research enterprise. UCI is a top 10 public research university and is a member of the Association of American Universities, an organization of selected research universities. In this role, I lead strategic research initiatives, sponsored research administration, human research protections, animal research programs, research compliance and integrity, research infrastructure, etc. A major goal in the current strategic plan (2016) has been to substantially increase UCI research portfolio with an aspirational quantitative target of $500M annual in external grants and contracts. This goal was achieved in FY2019-20 and our external funding for 2021-22 exceeded $590M. We have been successful in winning an NSF Materials Research Science and Engineering Center (MRSEC) and renewing NIH funded centers such as Comprehensive Cancer Center, Alzheimer's Disease Research Center and Clinical and Translational Sciences Institute. In an unprecedented leadership and management challenge, we successfully and collaboratively executed the ramp-down and ramp-up of the UCI research enterprise during the COVID-19 pandemic. I represent UCI in the UC-wide Council of Vice Chancellors of Research. I serve on the UC Global Climate Change Leadership Council as co-chair the Applied Research Working Group. With Professor Marianne Maryann Martone, I co-chaired a UC-wide working group on the use of Research Information Management Systems (RIMS) at the University of California leading to a final report in late 2021. In collaboration with leaders from LANL, LLNL, UCLA, UCR and UCSD, we have launched the UC National Labs Southern California Hub in 2020.

I also actively participate in national organizations of higher education such as AAU and APLU. I particularly focus on topics of benefits to society from research-based innovations. I co-organized an NSF funded workshop in National Networks of Research Institutes (NNRI). Workshop report has had a very large impact and has catalyzed creation of the NSF Regional Innovation ENGINES program. I am currently serving as a co-PI on NSF funded Engineering Research Visioning Alliance (ERVA).

Some specific examples of new programs at UCI include:

- Seed funding program to catalyze multidisciplinary research collaborations
- Team Scholarship Accelerator Lab (TSAL) to facilitate faculty groups to work together
- Faculty Hiring for Leveraged Research Excellence (FHLRE) to recruit faculty members to strategically benefit from major research investments
- Research infrastructure program to invest in state-of-art equipment
- New Provisional Organized Research Units (ProORU) program to seed new multidisciplinary research centers and institutes
- Catalyzed new centers in Arts and Humanities: Creativity in the 21st Century in the School of the Arts and Center for Liberation, Anti-racism, and Belonging

- Block grants to support research in fields such as humanities, arts, and social sciences that don't have major federal programs
- COVID-19 Basic, Translational and Clinical Research Funding Opportunity for seed funding of research projects on COVID-19
- Research security processes

Assistant Director, National Science Foundation: I held this position during 2013-16. In this position, I led the Directorate of Engineering (ENG) with an annual budget that exceeds $950M. I was also a member of the senior leadership team at NSF responsible for setting research priorities, multi-disciplinary collaborations, policies, and processes. We have strongly promoted collaborations within NSF (BIO, CISE, EHR, GEO, MPS, SBE Directorates) on multidisciplinary research across science and engineering. We have also developed collaborations on education, broadening participation, and broader impacts.

Research: I participated in and provided leadership for many NSF wide and multi-directorate initiatives:

- In collaboration with the National Academy of Engineering President Dan Mote, laid the groundwork for the creation of the NAE Report "A New Vision for Center-Based Engineering Research". It resulted in the NSF Gen-4 Engineering Research Center program.
- Advanced Manufacturing: Cyber-manufacturing, Nano-manufacturing, and Cellular Bio-manufacturing
- Risk and Resilience – Critical Resilient Interdependent Infrastructure Systems and Processes (CRISP)
- INFEWS: Innovations and Nexus of Food, Energy, and Water Systems
- Three of NSF's 10 Big Ideas: Growing Convergence Research, Future of Work at the Human-Technology Interface, and Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (INCLUDES)
- Understanding the Brain and Brain Research through Advancing Innovative Neurotechnologies (BRAIN)
- National Nanotechnology Coordinated Infrastructure (NNCI)
- Natural Hazards Engineering Research and Infrastructure (NHERI)
- Germination of Research Ideas for Large Opportunities and Critical Societal Needs (GERMINATION)

Education and Workforce: A large emphasis was on dealing with the issue of under-representation by women and minorities in science and engineering. I participated and provided leadership in the creation of the NSF Big Idea at addressing this issue: NSF INCLUDES – Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science. This is now the flagship program at NSF for inclusion and diversity. We also created a new initiative called Professional Formation of

Engineers – Revolutionizing Engineering Departments (RED) in collaboration with Computer, Information Science and Engineering and Education and Human Resources Directorates.

Innovation: We made very strong efforts in strengthening the nation's innovation eco-system through "Lab-to-Market" initiatives. A key focus is on pursuing an aggressive vision that seeks to achieve national scaling of the NSF Innovation Corps (I-Corps) program via collaborations with other Federal agencies, national labs, and states. We have also participated in and supported the Exploring Innovation Frontiers Initiative (EIFI) with the Council on Competitiveness.

Impact: Through establishing new research initiatives and strengthen core programs, budget for the Engineering Directorate increased by more than $100M during my tenure. In terms of management, we achieved several successes in increasing the quality, efficiency, transparency and accountability of our various business processes. We successfully recruited excellent women and under-represented minority leaders to highly visible roles in the Engineering Directorate. As a result of our focus on employee engagement, the Engineering Directorate ranked among the top 10% among mid-size federal agencies in terms of employee satisfaction in 2015.

Deputy Assistant Director, Advanced Research Projects Agency – Energy (ARPA-E), Department of Energy: I served in this role from September 2012 to March 2013. Although my tenure was quite brief, I worked with the team of program directors at ARPA-E to formulate and launch new programs in metals manufacturing (A-TEME), safe batteries and electric vehicles (RANGE), and methanotrophic organisms for fuels (REMOTE).

Dean of Engineering at the University of Florida: The College of Engineering at the University of Florida has approximately 5000 undergraduate students, 2500 graduate students, 280 faculty, and total expenditures of $150M. Soon after taking this position in 2001, I worked closely with the faculty and senior UF leadership to develop an ambitious strategic plan aimed at elevating the College of Engineering to be among the top 20 public & private engineering colleges in the nation. During my term as Dean, we made substantial progress towards this goal with a significant rise in the national rankings - the USNWR graduate program ranking moved up to 25 (15 among public universities) from 35 (20 among public universities).

- **Major Programmatic Initiatives:** Below are some of the highlights of programmatic initiatives.

✓ **Biomedical Engineering Department:** Started a new Department of Biomedical Engineering which was formally created in July 2002. A new interdisciplinary Biomedical Sciences Building, in collaboration with the College of Medicine, to house the BME Department, was completed in 2009. We secured a $10M naming gift for this department which, (after 1:1 match from the State of Florida,) created a $22M endowment for the BME Department.

- ✓ **Nano-science Institute for Medical and Engineering Technologies (NIMET):** College of Engineering partnered with the College of Liberal Arts and Sciences and the Health Science Center Colleges to create the Nano-science Institute for Medical and Engineering Technologies (NIMET). A new building for this was completed and is home to a state-of-the-art multi-user laboratory facility for research into nano-scale science for biomedical and engineering applications.
- ✓ **Sustainability – Energy and Water:** In collaboration with the Institute for Food and Agriculture Sciences, Florida Institute for Sustainable Energy was created. We were also a major partner in the UF Water Institute which focuses on a variety of pressing research issues relating to water use, quality, conservation, etc.
- ✓ **High Performance Computing:** We collaborated with several other colleges in the creation of High Performance Computing infrastructure and research collaborations.
- ✓ **Creation of Mechanical and Aerospace Engineering Department:** A major organizational transformation was the merger of the Department of Mechanical Engineering with the Department of Aerospace Engineering, Mechanics, and Engineering Sciences to create a new Department of Mechanical and Aerospace Engineering.

- **Research and Graduate Education:** During my tenure as Dean, the total research expenditures (external + internal) in the College grew from about $65M to more than $109M. In education, the number of PhD's graduated per year jumped dramatically from 95 to 189. We ranked in the top 10 nationally in the number of PhD's graduated and in the top 15 in the number of PhD's per faculty member per year. The quality of graduate students improved steadily as measured by GPA and test scores. Strong research and educational collaborations have been developed with Health Science Center Colleges, College of Liberal Arts and Sciences, Institute for Food and Agricultural Sciences, Fine Arts, Business and Law. A major new initiative aimed at providing complete Masters' degrees through distance education was launched successfully.

- **Technology Transfer and Industrial Collaboration:** We developed a comprehensive intellectual property agreement with Harris Corp. After three years of sustained efforts, the University of Florida joined the University of Central Florida and the University of South Florida, as a full partner in the Florida High Tech Corridor.

- **Undergraduate Education and Students:** Several departments made major revisions to the undergraduate curricula. We institutionalized a minority student mentoring program for incoming freshmen called StepUp. This six-week residential program was initially developed under the NSF SUCCEED Coalition. We also developed a new one-week Engineering Freshmen Transition Program (EFTP) to help all freshmen get off to a fast start in their undergraduate education. A student advisory committee was formed to create a platform for monthly discussion of issues students were facing. During my term as Dean, we also successfully received a full six-year accreditation of our undergraduate programs.

- **Inclusion and Diversity:** Several programs, such as GatorTrax, were implemented to focus on outreach to middle and high school students and teachers to increase interest in science, mathematics, and engineering. Our college was a top producer of Hispanic undergraduate engineers in the nation. The climate for women and minority faculty in the College improved steadily with several individuals in key leadership positions of associate deans and department chairs. Among the faculty, the number of women increased by 50% and Hispanic faculty doubled. The number of African American faculty increased very modestly as new hires were largely offset those who left. We also instituted new mentoring programs for women and minority faculty members.

- **Faculty:** We recruited more than 90 excellent new faculty members from top universities. A new full year orientation program for new faculty was put in place. In 2002, we implemented a new third year mid-term review for assistant professors on tenure-track with the aim of providing concrete and constructive feedback towards success in the final tenure and promotion review. Shared governance was significantly enhanced by a refresh of the College constitution by a faculty committee. In addition, faculty and staff committee advice was sought in dealing with budget cuts during the financial crisis.

- **Fund Raising:** The college endowment tripled rising from $24M in 2001 to $72M in 2007.

Chair, Department of Electrical Engineering and Computer Science, University of Michigan:

I led a department with more than 1200 undergraduate, 600 graduate students, 90 faculty members, and a total budget of $50M. During my tenure as Chair, we were able to secure an NSE Engineering Research Center on Wireless Integrated Microsystems. At the College level, I participated in planning efforts for a new capital campaign. My biggest challenge was to deal with the exploding student enrollments in computer science and engineering in an era when it was a challenge to retain faculty who were being lured away by the booming internet revolution. I was able to secure eight new faculty positions for computer science. I also led a major curricular reform effort aimed at streamlining the electrical engineering, computer engineering and computer science degree programs. A major accomplishment was to establish an undergraduate program in computer science through the College of Engineering.

Leadership in Major Interdisciplinary Research Centers at the University of Michigan:

I held several leadership positions in large multidisciplinary research centers at the University of Michigan. I was the Director of an AFOSR/DARPA MURI Center on Modeling and Control of Plasma Processes. (This was one of the first six MURI Centers awarded in the nation.) I was a Thrust Area leader in the Research Center for Display Technology and Manufacturing which was funded by the State of Michigan. My multidisciplinary work on control and estimation for plasma processes pioneered application of modern control

theory and contributed to the development of advanced process control for semiconductor manufacturing and specifically to the development of optical metrology which is in wide use in industry now.

I was a Thrust Area leader in an NSF Engineering Research Center (ERC) on Reconfigurable Machining Systems (RMS). My main contribution was to provide intellectual and technical leadership for discrete logic control to enable reconfigurable manufacturing.

In these roles, I led efforts to develop multidisciplinary collaborations spanning several academic departments leading to substantial research proposals and activities, mentoring of graduate and undergraduate students, and technology transfer.

Awards & Honors

Awards

- **IEEE Control Systems Award,** 2019.
- **IEEE Control Systems Society Bode Lecture Prize,** 2021.
- **Presidential Young Investigator Award**, National Science Foundation, 1985.
- **W. R. G. Baker Prize Paper Award** (co-authored with J. Doyle, K. Glover and B. Francis), IEEE, 1991.
- **George S. Axelby Best Paper Award** (co-authored with J. Doyle, K. Glover and B. Francis), IEEE Control Systems Society, 1990.
- **Donald P. Eckman Award** – Best Young (under the age of 35) Control Engineer, American Automatic Control Council, June 1989.
- **O. Hugo Schuck Best Paper Award** (co-authored with J. Krause, K. Nagpal, K. Poolla and A. Tikku), American Automatic Control Council, June 1993.
- **Fellow,** IEEE, 1993.
- **Fellow,** International Federation of Automatic Control, 2014.
- **Fellow,** American Association for Advancement of Science, 2018.
- **Distinguished Alumnus Award**, Indian Institute of Technology, Bombay, India, 1997.
- **Research Excellence Award**, College of Engineering, The University of Michigan, 1994.
- **George Taylor Award for Research**, Institute of Technology, University of Minnesota, 1987.
- **Teaching Excellence Award**, EECS Department, The University of Michigan, 1992.
- **Distinguished Service Award,** Indian Institute of Technology, Bombay, India, 2011.
- **Best Faculty Paper Award**, Department of Electrical Engineering, University of Florida, 1983.
- **Sigma Xi Award for Outstanding Research on Mathematical System Theory**, University of Florida, 1982.
- **Best Ph.D. Dissertation**, Department of Electrical Engineering, University of Florida, 1981.
- **Several Conference Best Paper Awards** – See list of publications.

Honors

- **Web of Science Highly Cited Researcher,** 2001**.**
- **Russell Springer Professor,** Dept. of Mechanical Engineering, University of California, Berkeley, Fall 2010.
- **Japan Society for Promotion of Science Fellowship**, 2007, 1992.
- **Eckis Professor of Electrical and Computer Engineering,** University of Florida, July 2001 – 2016.
- **Claude E. Shannon Professor of Engineering Science**, The University of Michigan, September 2000 – June 2001.
- **Fellow**, CIC (Big 10 Committee on Institutional Cooperation) Academic Leadership Program, September 2000 – May 2001.

- **Arthur F. Thurnau Professor**, University of Michigan, 1995-1998.
- **Bode Lecture:** "Climate Change Mitigation and Adaptation: Role of Systems and Control", IEEE Conference on Decision and Control, December 2021.
- **Plenary Speaker:** "Cognitive Cyber-Physical Systems: Vision and Ideas for Exploring a New Frontier," 7th Indian Control Conference, December 2021.
- **Plenary Speaker,** "Grid Integration of Renewable Energy and Distributed Control," Conference on Information Sciences and Systems (CISS), Johns Hopkins University, March 20, 2019.
- **Plenary Speaker,** Opportunities and Challenges in Integration of Renewable Energy in Electric Grids, 1st IEEE Conference on Control Technology and Applications, Hawaii, August 2017.
- **Keynote Speaker:** Enabling Research for the Future Electric Energy Grid: NSF Role, IEEE SmartGridComm, November 2015, Miami, FL.
- **Keynote Speaker:** Cyberphysical Systems and Emerging Directions at NSF, ADHS 2015, International Federation of Automatic Control, October 2015, Atlanta, GA.
- **Plenary Speaker:** Cyber-Physical-Social Systems and Resilient Infrastructures – A Perspective from NSF, Human-Machine Networks and Intelligent Infrastructures, King Abdullah University of Science and Technology, October 2015.
- **Keynote Speaker:** Enabling Research for Infrastructure Resilience: An NSF Perspective, Resilience Week, Philadephia, August 2015.
- **Keynote Speaker:** Building Energy Efficiency – A Perspective from NSF, Keynote speaker, SinBerBEST Mini Symposium, Singapore, August 2015.
- **Keynote Speaker:** Communications and Computing Research at NSF, IEEE Symposium on Computers and Communications, Cyprus, July 2015.
- **Keynote speaker,** Broader Impacts: Achieving Greater Goals, Keynote Talk, Broader Impacts Summit, National Alliance for Broader Impacts, University of Wisconsin, April 2015.
- **Keynote speaker,** Innovative Neurotechnologies for Brain Research: A Perspective from the NSF Engineering Directorate**,** IEEE EMBS BRAIN Grand Challenges Conference, November 2014.
- **Keynote Speaker,** Advanced Manufacturing and Factories of the Future, Innovation Connecting Show, Toulouse, France, September 2014.
- **Keynote speaker,** STEM Smart: Lessons Learned from Successful Schools, Atlanta, GA, June 2013.
- **Plenary Speaker,** Second International Conference on Power, Signals, Control, and Computation, Thrissur, India, January 2012.
- **Plenary Speaker,** SCI'07, Kyoto, JAPAN, May 2007.
- **Plenary Speaker,** Turkish Automatic Control Conference, Ankara, Turkey, 2002.
- **Keynote Speaker**, International Conference on Automation, Robotics, Control, and Vision, Singapore, 2000.
- **Plenary Speaker,** Spring Research Conference on Statistics in Industry and Technology, Minneapolis, 1999.
- **Plenary Speaker**, IFAC Robust Control Design Symposium, Budapest, Hungary, 1997.

- **Plenary Speaker**, Feedback Control, Nonlinear systems, and Complexity, Conference held to Honor Professor George Zames on his 60th Birthday, McGill University, 1994.
- **Plenary Speaker**, 32nd IEEE Conference on Decision and Control, San Antonio, TX December 1993.
- **Plenary Speaker**, International Conference on Control Theory and Applications, Jerusalem, Israel, October 1993.
- **Special Topics Lecturer**, International Symposium on the Mathematical Theory of Networks and Systems, Kobe, Japan, June 1991.
- **Keynote Speaker**, Robust Control System Design using $\mathcal{H}_\infty$ and Related Methods, Cambridge, U.K., 1991
- **Plenary Speaker**, First International Conference on Mathematical Theory of Control, Bombay, INDIA, December 1990.
- **Plenary Speaker**, 2nd SIAM Conference on Linear Algebra in Signals, Systems and Control, San Francisco, CA, November 1990.
- **Keynote Speaker**, 1st International Conference on Systems Engineering, Dayton, OH, August 1989.
- **Plenary Speaker**, International Symposium on the Mathematical Theory of Networks and Systems, Beer Sheva, Israel, 1983.
- Also (listed later in the CV) numerous keynote talks, symposia lectures, and invited seminars delivered in my role as Assistant Director for Engineering, National Science Foundation, 2013-2016.

Research Activities and Accomplishments: My research is in the broad area of systems and control theory and engineering applications. Some of the major highlights of my research achievements are listed below. Many of my publications are referenced in textbooks and monographs in the control systems area. Several have been reprinted in IEEE Press books. (All references are to the publications list in this CV.)

1. Our work on the state-space approach to the $\mathcal{H}_\infty$ control problem has had a very large impact [48, 53, 58, 72, 73, 74]. The $\mathcal{H}_\infty$ control problem was a problem of central importance in the field at the time. The use of the state-space approach was a major departure from the established frequency domain approach and somewhat reminiscent of the classical work of my advisor and mentor Professor Kalman when he gave completely new solutions to the optimal control and filtering problems in his legendary work. Our paper [58] won the George Axelby Award from IEEE Control Systems Society. It also won the IEEE W. R. G. Baker Prize which is given to the *best paper in all IEEE Transactions.* It has a very large number of citations. It is also included in many text books. It is also used in many control systems design toolboxes from Mathworks.

2. We showed that the concepts of quadratic Lyapunov stability and stabilization were deeply connected with $\mathcal{H}_\infty$ optimal control. This work [64] has had a large impact on the subsequent work in robust control and $\mathcal{H}_\infty$ control and is my second highest cited paper. Again, this result is in several text books.

3. In [72], we showed that the problem of mixed $\mathcal{H}_2/\mathcal{H}_\infty$ optimal controller design could be solved by convex optimization. This was one of the first papers to introduce convex optimization into robust and $\mathcal{H}_\infty$ control. This has subsequently become a very successful research direction with several books and large numbers of papers. It is also referenced in many books on robust control theory.

4. My early work was in the area of algebraic systems and control theory. The main idea was to exploit the algebraic structures inherent in dynamic control systems. In [16], we obtained formulae for computing coprime factorizations for multivariable transfer functions. This result is at the foundation of a large number of papers and books.

5. Robust control deals with the analysis and design of control systems with worst-case stability and performance guarantees in the face of modeling uncertainties. In [28], we showed that the problem of gain margin maximization is equivalent to the optimal sensitivity problem. This paper made a deep connection between two hitherto unrelated research directions.

6. Motivated by applications such as gain scheduling for nonlinear systems, we explored linear systems whose coefficients depend on parameters [19]. This paper has been a major catalyst for the large body of papers on the so-called linear parameter-varying control systems.

7. We showed that linear periodic controllers can offer significant improvements in robustness over linear time-invariant controllers for robust control problems. This was done in [29]. More importantly, in this paper we deployed the "lifting technique". This idea was instrumental in future studies of sampled-data systems and a large number of publications along this direction.

8. We showed [38, 43, 52] that nonlinear time-varying controllers offer no advantages over linear time-invariant controllers for robust stabilization under unstructured dynamic uncertainty. This is an impossibility result and has deep implications for the limits to possible performance improvement by adaptive control. This led to a subsequent body of literature on similar results for other situations.

9. In [37, 41], we developed a deep result connecting spectral factorization and interpolation theory. This has been used in subsequent work on the partial stochastic realization problem.

10. We made several foundational contributions [81, 88, 90, 91, 93] to the modern theory of digital control known as sampled-data control theory.

11. We developed a theory of system identification [78, 80, 82, 87] in the frequency domain with error bounds in $\mathcal{H}_\infty$.

12. We developed a time-domain theory of model (in)validation for models with uncertainty in [97]. This paper won the American Automatic Control Council's Hugo Schuck Award.

13. We came up with a very innovative approach [106] to the implementation of gain scheduled nonlinear controllers. This was a beautiful solution to a ubiquitous problem in practical applications of control theory. This result is in the widely used graduate level textbook *Nonlinear Systems* by Khalil.

14. In [205], we showed that randomized algorithms for robust stability have polynomial complexity. This paper led to the development of a new research direction and a large number of papers. The influence of our paper has been prominently acknowledged in the leading book on this topic, *Randomized Algorithms for Analysis and Control of Uncertain Systems,* by Tempo, Calafiore, and Dabbene.

15. We were among the first groups to work on applications of control theory to semiconductor manufacturing. We focused on estimation and control of reactive ion etching which is a key unit step in the manufacture of integrated circuit chips. This led to a series of papers [108, 110, 112, 113, 114, 115, 116, 120, 121, 122, 125, 130, 131]. My intellectual leadership in this area was recognized by the IEEE Control Systems Society when I was invited to give a plenary speech at the flagship IEEE Conference on Decision and Control in 1993. When we were first working in this area, advanced process control was considered long-range

research but in the subsequent years, it has become much more accepted in industry. There are some industry patents that cite some of these papers. Our multidisciplinary work on control and estimation for plasma processes pioneered application of modern control theory and contributed to the development of advanced process control for semiconductor manufacturing and specifically to the development of optical metrology which is in wide use in industry now.

16. We worked with some Xerox engineers on the application of control theory to color xerography processes. This led to a few papers [301, 305, 129] and two patents [315, 316]. Colleagues at Xerox indicate that these patents are being used in current Xerox Corp. products.

17. Over the last decade, I have focused on smart electric grids and integration of renewable electricity into electric power systems. This is a very challenging problem since solar and wind generators are inherently uncertain and variable [145, 148, 150, 153, 162, 164, 165, 170, 171, 176, 177]. Our work on cybersecurity in smart grids [149, 163] has also had significant influence in the research community.

18. Our most recent research direction is at the intersection of machine learning and control. We are exploring neuroscience inspired ideas for learning and control [178, 179, 180, 181, 182, 183, 187].

Teaching Activities:

1. During the last 30 years, I have taught a wide variety of courses, both at the undergraduate and graduate levels, in systems and control at Michigan, Minnesota and Florida. These include courses on signals and systems, classical feedback control, digital control, linear systems, multivariable control design, optimal control, robust and $\mathcal{H}_\infty$ control, adaptive control and system identification, and intelligent systems.

2. In the 1993 fall term, under an NSF Grant, Professor F. L. Terry, Jr. and I developed and taught a new course on the subject of Process Control for Microelectronics Manufacturing. This was among the first set of grants awarded by NSF under the Combine Research and Curriculum Development (CRCD) program. This program was the fore-runner of the current NSF IGERT program.

3. During 2004 and 2006 Fall Semesters, I taught a new Freshman Seminar Course entitled "Contemporary Issues in Technology and Society" at the University of Florida. This course aims to educate students for critical independent thinking in the context of contemporary economic, global, legal, environmental, and policy issues arising from cutting edge technological developments.

4. In Spring 2010, I taught EGN 1935, Introduction to Electrical and Computer Engineering. This is a freshman level introductory course. My main objective was to give freshmen and sophomore students a glimpse into the exciting developments in the field of electrical and computer engineering. I believe the course was extremely well received. I believe it is very important for senior faculty members like myself to engage lower division students and get them excited about the future of engineering and technology in general, and electrical and computer engineering in particular.

5. Over the years, I have given short courses at various conferences based on my research activities. I was a member of a team that gave a one-day course on Smart Grid at the 2011 American Control Conference, one of the two premier conferences in the field of control systems. I created a first of its kind course on Smart Grid – A Cyber Physical Systems Approach when I was at the University of Florida.

6. I have created a new graduate level course at the confluence of machine learning and control. I have also given talks at several workshops on this topic during 2018-22.

Recognition of teaching excellence: I was awarded the **Arthur F. Thurnau Professorship** which is a 3 year term appointment in recognition of teaching excellence at the University of Michigan. Competition for this award is at the university level. I was also awarded Teaching Excellence Award by the Department of Electrical Engineering and Computer Science at the University of Michigan.

Doctoral Student Supervision:

University of Florida (1981-1984)

1. Dr. A. B. Ozguler (Co-Supervisor with Professor R. E. Kalman)
   Thesis Title: Skew-Primeness in the Regulator problem with Internal Stability
   Graduation Date: December 1982
2. Dr. T. T. Georgiou (Co-Supervisor with Professor E. W. Kamen)
   Thesis Title: Partial Realization Problem for Covariance Sequences
   Graduation Date: August 1983
3. Dr. K. R. Poolla (Co-Supervisor with Professor E. W. Kamen)
   Thesis Title: Linear Time-Varying systems: Representation and Control via Transfer Function Matrices
   Graduation Date: August 1984

University of Minnesota (1984-1989)

4. Dr. A. M. Pascoal
   Thesis Title: Nonlinear Controllers for Robust Control of Linear Time-Invariant Plants
   Graduation Date: September 1987
5. Dr. J. Krause (Co-Supervisor with Prof. K. S. P. Kumar)
   Thesis Title: Robust Identification and Adaptation
   Graduation Date: December 1987
6. Dr. K. Zhou
   Thesis Title: Robust Control of Uncertain Systems
   Graduation Date: June 1988
7. Dr. G. Gu (Co-Supervisor with Professor E. B. Lee)
   Thesis Title: An $\mathcal{H}_\infty$ Approach to the Control of Multivariable Systems with Time Delays
   Graduation Date: June 1988
8. Dr. K. Lenz
   Thesis Title: Topics in Applied $\mathcal{H}_\infty$-Optimal Control
   Graduation Date: August 1988
9. Dr. R. Rajamani
   Thesis Title: Robust Control of Linear Time-Varying Systems
   Graduation Date: July 1990
10. Dr. M. Rotea
    Thesis Title: Multiple Objective Optimal Control of Linear Systems
    Graduation Date: May 1990

University of Michigan (1989-2001)

11. Dr. P. M. Olin (Co-Supervisor with Professor G. Rizzoni)
    Thesis Title: Fault Detection and Isolation in the Joint Time-Frequency Domain

Graduation Date: May 1992

12. Dr. I. Kaminer
    Thesis Title: Application of $\mathcal{H}_\infty$ Synthesis to the Motion Control of Rigid Bodies and Related Theory
    Graduation Date: June 1992
13. Dr. H. Akcay
    Thesis Title: Robust Identification in $\mathcal{H}_\infty$
    Graduation Date: December 1992
14. Dr. W. Sun
    Thesis Title: $\mathcal{H}_\infty$ Filtering and Control for Sampled-Data Systems
    Graduation Date: April 1993
15. Dr. N. Sivashankar
    Thesis Title: Robust Sampled-Data Systems
    Graduation Date: December 1993
16. Dr. D. Shim
    Thesis Title: Analysis and Synthesis of Linear Time-Invariant Systems with Positive Real Uncertainty
    Graduation Date: December 1993
17. Dr. S. Lee (Co-Supervisor with Professor J. Stein)
    Thesis Title: A Study of Robust Control and Estimation for Systems with Real Parameter Uncertainties
    Graduation Date: December 1993
18. Dr. J. Friedman
    Thesis Title: Modeling, Identification and Control of Flexible Systems
    Graduation Date: April 1996
19. Dr. M. Hankinson (Co-Advisor with Professor K. Irani))
    Thesis Title: Process Improvement Using Classification Trees for Run-to-Run Control of a Reactive Ion Etching Process
    Graduation Date: May 1997
20. Dr. C. Schumacher
    Thesis Title: Tactical Missile Autopilots: Gain Scheduled $\mathcal{H}_\infty$ Control and Dynamic Inversion
    Graduation Date: December 1997
21. Dr. T. Vincent
    Thesis Title: Nonlinear Estimation with Applications to In-Situ Etch Rate and Film Thickness Measurements in Reactive Ion Etching
    Graduation Date: December 1997
22. Dr. A. Yoon
    Thesis Title: Randomized Algorithms and Global Optimization for Optimal and Robust Control
    Graduation Date: December 1997
23. Dr. E. Hamby (Co-Advisor: Prof. P. Kabamba)
    Thesis Title: A Bayesian Approach to Modeling and Control
    Graduation Date: June 1998

24. Dr. O. Patterson
    Thesis Title: A Methodology for Selection of Feedback Variables for the Control of Reactive Ion Etching
    Graduation Date: October 1998
25. Dr. C. Galarza
    Thesis Title: Learning and Estimation Theory for Manufacturing Systems Applied to Microelectronics Manufacturing
    Graduation Date: February 1999
26. Dr. E. Park (Co-Advisor: Professor D. Tilbury)
    Thesis Title: Modular Logic Controllers for Reconfigurable Machining Systems
    Graduation Date: October 1999
27. Dr. D. Kalita
    Thesis Title: Formal Verification for Analysis and Synthesis of Logic Controllers for Reconfigurable Machining Systems
    Graduation Date: May 2001
28. Dr. J.-W. Lee
    Thesis Title: Nonlinear Filtering for Real-Time Sensing of Patterned Wafers
    Graduation Date: May 2002
29. Dr. R. E. Groff (Co-advisor with Dr. D. E. Koditschek)
    Thesis Title: Piecewise Linear Homeomorphisms for Approximation of Invertible Maps
    Graduation Date: April 2003

University of Florida (2001- 2016)

30. Dr. E. Boykin (Chair, Co-Chair: W. Ogle)
    Thesis Title: Detecting Effective Connectivity in Neural Time Series
    Graduation Date: May 2011
31. Dr. Zachariah Fuchs
    Thesis Title: Cooperative Control Strategies and Deception in Adversarial Systems
    Graduation Date: August 2012
32. Dr. Jung Son (Co-Chair, Chair: H. Latchman)
    Thesis Title: Adaptive and Robust Controls for Uncertain Linear and Nonlinear Systems
    Graudation Date: August 2012
33. Dr. Manu Nandan (Chair, Co-Chair: S. Talathi)
    Thesis Title: Fast SVM Training Using Approximate Extreme Points
    Graduation Date: December 2013
34. Dr. Y. Guo (Co-Chair, Chair: M. Fang)
    Thesis Title: Energy Optimization and Control for Data Centers and Smart Grids
    Graduation Date: August 2014
35. Dr. R. Shivakeshavan (Co-Chair, Chair: S. Talathi)
    Thesis Title: Influence of Synaptic Changes on Synchronization in Neuronal Networks
    Graduation Date: December 2014
36. Dr. Anshu Ranjan (Co-chair, Chair: S. Sahni)

Thesis title: Approximation Algorithms for Offline Scheduling of Power Loads in Smart Grids
Graduation Date: May 2016

37. Dr. P. Chakraborty
Thesis Title: Optimization and Control of Flexible Demand and Renewable Supply in a Smart Power Grid
Graduation Date: December 2016

38. Dr. Scott Nivison
Thesis Title: Sparse and Deep Learning based Nonlinear Flight Control Design with Hypersonic Flight Applications
Graduation Date: December 2017

Selected Invited Lectures since 2010

1. Neural Synchrony: Analysis and Control, Invited Speaker, Horizons in Systems and Control, Symposium in Honor of 80th Birthday of Elmer Gilbert, The University of Michigan, March 2010.

2. Neural Synchrony: Analysis and Control, Invited Speaker, Symposium on Systems, Control, and Signal Processing, In Honor of 60th Birthday of Yutaka Yamamoto, Kyoto University, March 2010.

3. Neural Synchrony: Analysis, Modeling, and Control, Springer Professor Colloquium, Department of Mechanical Engineering, University of California, Berkeley, November 2010.

4. Integration of Renewable Energy into the Smart Grid, Colloquium, Department of Aerospace Engineering, Texas A&M University, April 2011.

5. Integration of Renewable Energy into the Smart Grid, Colloquium, College of Engineering, Naval Postgraduate School, May 2011.

6. Sustainability, Economic Growth and Technology, Energy and Sustainability Session, Invited panelist, American Control Conference, June 2011.

7. Smart Grid and Systems and Control, Invited Speaker, NSF-ECEDHA Energy and Power Summer Program, July 8-12, 2011, Georgia Tech Global Learning Center, Atlanta, Georgia.

8. Smart Grid and Renewable Integration, Invited Speaker, IEEE Control Systems Society Smart Grid Vision Meeting, Atlanta, November 2011.

9. Smart Grid – Renewable Integration and Cybersecurity, Plenary Lecture, Florida Energy Systems Consortium Summit Meeting, November 2011.

10. Graduate Education for Cyber-Physical Energy/Power Systems, Invited Talk, Electrical and Computer Department Heads Association Meeting, Austin, TX, March 2012.

11. Smart Grid Cybersecurity, Plenary Lecture, 2012 Florida Green, Energy & Climate Conference/Expo, Palm Beach, FL, May 2012.

12. Invited Seminar at the University of California, Santa Barbara, CA on Integration of Renewable Energy into the Electric Grid, October 2012.

13. Invited Panelist, IEEE Smart Grid Vision, IEEE Smart Grid World Forum, Geneva, December 2012.

14. Invited Panelist, Commercial Aviation Alternative Fuels Initiative, November 2012.

15. Integrating Renewable Energy into Smart Grid, SEC Symposium, Atlanta, GA, February 2013.

16. Energy Technology Research at ARPA-E, Workshop on Electric Energy Systems Curriculum, NAPA Valley, CA, February 2013.

17. The Joy of ST*E*M: Engineering is at the Heart of It, Keynote speaker, STEM Smart: Lessons Learned from Successful Schools, Atlanta, GA, June 2013.

18. Opportunities and Challenges in Smart Grid Controls, Invited Speaker, Mini-Symposium on Challenges in electricity smart grids of the future, SIAM Conference on Control and its Applications, San Diego, CA, July 2013.

19. Frontiers of Engineering Research and Education: An NSF Perspective, Inaugural Dean's Lecture, Fulton College of Engineering, Arizona State University, September 2013.

20. Intersections and Convergence: Engineering & Medicine/Biology - An NSF Perspective, University of Minnesota Institute of Engineering in Medicine, September 2013.

21. Engineering Education, Research, Entrepreneurship and Innovation, Panel Presentation, Capital Region IIT Event, October 2013.

22. Contemporary Issues in Engineering Research and Education: A View from NSF, Seminar at University of Texas at Dallas, October 2013.

23. Integration of Renewable Electricity and Smart Grids, ECS Distinguished Seminar, University of Texas at Dallas, October 2013.

24. Critical Role of Academic-Industry Partnerships in Future Science and Engineering Research, Government-University-Industry Research Roundtable (GUIRR), October, 2013.

25. Contemporary Issues in Engineering Research and Education – A View from NSF, Institute for Critical Technology and Applied Science, Virginia Tech, November 2013.

26. Engineering Research and Education @ NSF, American Institute for Chemical Engineering, November 2013.

27. Electric Energy Research and Education – An NSF Perspective, ONR/NSF/DOE Workshop on Electric Energy Systems Curriculum Reform, NAPA Valley, February 2014.

28. Building Innovation Ecosystem, Japan Science and Technology, Tokyo, JAPAN, February 2014.

29. Systems Science and Engineering @ NSF ENG, Keynote Speech, Symposium on Systems Science and Engineering, Japan Science and Technology, Tokyo, JAPAN, February 2014.

30. NSF ADVANCE Program: A Perspective from Engineering Directorate, ADVANCE PI Meeting, Alexandria, VA, March 2014.

31. Opportunities and Challenges in Engineering Research and Education, Keynote Speech at the ASME Mechanical Engineering Education Leadership Summit, San Juan, Puerto Rico, March 2014.

32. Wireless Communications Research at NSF, Keynote Speech, National Wireless Research Collaboration Symposium (NWRCS), Idaho National Labs, Idaho Falls, May 15, 2014.

33. Convergence: Examples from NSF on an Emerging Research Paradigm, Workshop on Convergence: Optimizing Cross-Sector & Interdisciplinary Partnerships, Government-University-Industry Research Roundtable Meeting, National Academy of Science Building, June 3, 2014.

34. Moderator, Briefing on Synthetic Biology, Capitol Hill, Washington, DC, June 26, 2014.

35. Cyber-Physical Systems, Power Grid, and Engineering Education – NSF Perspective, Opening Presentation, NSF-PEEC Workshop on Cyber-Physical Systems Education with emphasis on Power Grid, Arlington, VA, July 26-27, 2014.

36. Testimony on National Earthquake Hazard Reduction Program (NEHRP), Committee on Science, Space, and Technology, Subcommittee on Research and Technology, July 29, 2014.

37. Research and Policy: A Perspective from NSF, Invited Talk, CDS@20 Workshop, California Institute of Technology, August 7, 2014.

38. Invited Panelist, Increasing Impact and Funding Opportunities in Control, International Federation of Automatic Control World Congress, August 2014, Cape Town, SA.

39. Key Note, Advanced Manufacturing and Factories of the Future, Innovation Connecting Show, Toulouse, France, September 2014.

40. Opportunities and Challenges in Engineering Research and Education – *A View from NSF*, Invited Presentation at the University of Minnesota, October 2014.

41. Future of Electric Power Systems – NSF Role, Keynote Talk, Workshop for Reforming Power Engineering Curriculum, University of Minnesota, October 2014.

42. Opportunities and Challenges in Engineering Research and Education – *A View from NSF*, Invited Talk, Georgia Institute of Technology, October 2014.

43. Educating Leaders for the 21st Century – Role of Engineering, NSF ERC Biennial Meeting, October 2014.

44. Opportunities and Challenges in Engineering Research and Education – *A View from NSF*, Invited Talk, University of Pennsylvania, November 2014.

45. Opportunities and Challenges in Engineering Research and Education – *A View from NSF*, Invited Talk, North Carolina State University, November 2014.

46. Innovative Neurotechnologies for Brain Research: *A Perspective from the NSF Engineering Directorate,* Keynote talk, IEEE EMBS BRAIN Grand Challenges Conference, November 2014.

47. Building Innovation Ecosystem - *Catalyzing Technology Commercialization and Cultivating Entrepreneurship,* Invited Talk, Mexican High-Level Innovation Forum for Policymakers Wilson Center Mexico Institute, November 2014.

48. Foundational Knowledge for Smart Service Systems: *Towards an NSF Vision,* Invited Talk, NSF-MIT Workshop on Smart Service Systems, November 2014.

49. Emerging Frontiers in Robotics and Smart Systems, Keynote Talk, U.S. Naval Academy Science and Engineering Conference, November 2014.

50. Exciting Directions in Engineering Research and Education: A View from NSF, Distinguished Life Science and Biomedical Engineering Lecture Series, SUNY Binghamton University, December 2014.

51. Frontiers in Engineering Research, Education, and Innovation: A View from NSF, University of California, Riverside, CA, January 2015.

52. Plenary Roundtable Speaker, National Energy Education Summit, National Council for Science and the Environment, Washington, DC, January 2015.

53. Opening Remarks, Workshop on Liberal Studies in Engineering - Broadening the Path to the Profession, National Academy of Engineering, January 2015.

54. NSF Engineering Directorate FY16 Budget Presentation, ASEE Engineering Research Conference, Silver Springs, MD, March 2015.

55. Invited Panelist, Future of Electrical and Computer Engineering, ECEDHA (Electrical and Computer Engineering Department Heads Association) Annual Meeting, Hilton Head, SC, March 2015.

56. Opening Remarks, NCI-NSF Joint Workshop on Integrative Additive Biomanufacturing and Tumor Engineering, NIH Campus, April 2015.

57. NSF Engineering and High Performance Computing, Invited Presentation, Coalition for Academic Scientific Computation Meeting, Arlington, VA, April 2015.

58. Invited Panelist, Engineering Biology for Science & Industry Meeting, Sloan Foundation, New York, April 2015.

59. Broader Impacts: Achieving Greater Goals, Keynote Talk, Broader Impacts Summit, National Alliance for Broader Impacts, University of Wisconsin, April 2015.

60. Advanced Pharmaceutical Manufacturing: A Perspective from the NSF Engineering Directorate, Invited Presentation, Future of Pharmaceutical Manufacturing, FDA/Industry/Academic Workshop, Rutgers University, May 2015.

61. NSF Engineering Directorate – Overview and Priorities, Invited Presentation, U.S. National Committee on Theoretical and Applied Mechanics, Annual Meeting, May 1, 2015

62. Opportunities in Engineering Research, Education and Innovation: A Perspective from NSF, Invited Lecture, Missouri University Science and Technology, Rolla, MO, May 2015.

63. Opportunities in Engineering Research, Education and Innovation: A Perspective from NSF, Dean's Distinguished Lecture, University of California, Irvine, CA, May 2015.

64. Renewable Integration and Flexible Demand Management, Invited Lecture, University of California, Irvine, CA, May 2015.

65. Innovation and Partnerships, Invited Panelist, US-Brazil Joint Commission on Science and Technology Cooperation, Washington, DC, May 2105.

66. Moderator, Panel on Setting the Stage: Exploring New Models of Innovation, Exploring Innovation Frontiers Initiative: National Launch Dialogue, June 2015.

67. Invited Panelist, "Science, Policy and the Environment: the Case for Circular Science", part of a day-long event on "UN Sustainable Development Goals: A Circular Science Symposium," City University of New York, September 2015.

68. Opportunities in Engineering Research, Education and Innovation – A Perspective from NSF, Distinguished Symposium, Institute for Systems Research, University of Maryland, September 2015.

69. Opportunities in Engineering Research, Education and Innovation – A Perspective from NSF, Lehigh University, October 2015.

70. Invited Panelist, Outlook for Federal Funding for Biomedical Engineering Research, Biomedical Engineering Society Conference, October 2015, Tampa, FL.

71. Keynote Speaker, Enabling Research for the Future of Electric Energy Systems: NSF Role, Frontiers of Power Conference, Oklahoma State University, November 2015.

72. Invited Panelist, Plenary on Graduate Student Education, American Institute of Chemical Engineers (AICHE) meeting, November 2015.

73. William R. and Erlyn J. Gould Distinguished Lecture, Engineering for the 21st Century – A Perspective from the National Science Foundation, University of Utah, Salt Lake City, November 2015.

74. Keynote Speaker, Photonics Research— NSF Enabling Exploration at the Frontiers, 19th Annual Photonics Center Symposium, Frontiers in Plasmonics as Enabling Science in Photonics and Beyond, Boston University, December 3, 2015.

75. Invited Talk, Broader Impacts: Achieving Greater Goals, Boston University, December 4, 2015.

76. Invited Lecture, Opportunities in Engineering Research, Education and Innovation: A Perspective from NSF, Carnegie Mellon University, December 7, 2015.

77. Invited Talk, The Future of Center-Based Multidisciplinary Engineering Research, The National Academies Committee on the Future of Center-Based, Multidisciplinary Engineering Research, December 14, 2015.

78. Invited Presentation, Opportunities for Control Systems --- Perspective from the National Science Foundation, Special Lunch Session, Role of Control: From Funding Point of View, IEEE Conference on Decision and Control, December 17, 2015.

79. Invited Panelist, Advanced Manufacturing Research and Innovation at NSF, Congressional Briefing, Advanced Manufacturing – Gaining the Advantage in a Fiercely Competitive Global Economy, ASME, February 11, 2016.

80. Invited Seminar, Opportunities in Engineering Research, Education and Innovation: A Perspective from NSF, Florida Atlantic University, February 19, 2016.

81. Invited Panelist, Disruptive Resilience: Chief Technology Officers Map America's 2030 Water Future, February 29, 2016, San Francisco, CA.

82. Lunch Speaker, Wireless Communications Research at NSF, Enhancing Access to Wireless Spectrum Principal Investigators Meeting, March 15, 2016, Reston, VA.

83. Invited Panelist, Conversation about the National Water Model, Water Science and Technology Board and Board on Earth Sciences and Resources, The National Academies of Sciences, Engineering, and Medicine, March 23, 2016.

84. Invited Panelist, Convergence: The Future of Health Workshop, MIT, American Association for the Advancement of Science (AAAS), Washington, DC, March 24, 2016.

85. Invited Panelist, America's Water: Innovation at Work, Columbia Water Center, Earth Institute, Columbia University, March 25, 2016.

86. Invited Speaker and Panelist, Advanced Bio/Cell Manufacturing: A Perspective from NSF, Forum on Advanced Bio/Cell Manufacturing, National Materials and Manufacturing Board Committee Meeting, National Research Council, National Academies of Science, Engineering and Medicine, Washington, DC, April 6, 2016.

87. Plenary Speaker, UCLA Smart Energy Research Center (SMERC) Innovation Thought Leadership Forum: Advancing the Electric Grid for the 21st Century Energy Needs, Washington, DC, April 13, 2016.

88. Invited Speaker, Energy and Sustainability Research and Education enabled by NSF, "Energy from Renewables: Envisioning a Brighter Future", University of Minnesota, April 16, 2016.

89. Invited Speaker, Advanced Bio/Cell Manufacturing: A Perspective from NSF, National Materials and Manufacturing Board, The National Academies of Sciences Building, April 2016, Washington, DC.

90. Invited Speaker, Electric Energy Systems Transformation, Columbia University, May 2016.

91. Invited Lecture, Opportunities in Engineering Research, Education and Innovation: A Perspective from NSF, Grove School of Engineering The City College of New York, May 2016.

92. Invited Speaker, Future of Energy Systems, ETH Zurich, Workshop in honor of Professor Manfred Morari's retirement, May 2016.

93. Invited Seminar, Renewable Energy, Electric Grid Integration, and Distributed Control, University of Stuttgart, February 2017.

94. Keynote Presentation, Grid Integration of Renewable Energy – Trends, Challenges, and Opportunities, 4th JST-NSF-DFG-RCN Workshop, Tokyo, Japan, June 2017.

95. Plenary Speaker, Opportunities and Challenges in Integration of Renewable Energy in Electric Grids, 1st IEEE Conference on Control Technology and Applications, Hawaii, August 2017.

96. Penner Distinguished Lecture, Electric Grid Integration of Renewable Generation and Distributed Control, Mechanical and Aerospace Engineering, University of California, San Diego, 6 November 2017.

97. Plenary Speaker, Grid Integration of Renewable Generation and Control Theory, International Conference on Power, Control, Signals, and Computations, (EPSCICON18), Trissur, India, January 2018.

98. Invited Panelist, Advanced Manufacturing R&D: Innovation Ecosystems to Maximize the Value of Basic Academic Research, American Association for Advancement of Science Meeting, February 2018, Austin, TX.

99. Grid Integration of Renewable Energy and Distributed Control, seminar at the Center for Systems and Control, University of Southern California, March 2018.

100. Future of Smart Manufacturing in a Global Economy, 2018 Asia Pacific Workshop, Broadcom Foundation, Pasadena, CA, May 7, 2018.

101. Convergence, Grand Challenges, Team Science, and Inclusion, Keynote Presentation, NSF EFRI Workshop on Convergence and Interdisciplinarity for Larger Scale Research, NSF, Alexandria, VA, May 14-15, 2018.

102. Visions for Systems and Control in the Era of Learning and Data Science, Presentation at the Workshop, New Problems on Learning and Data Science in Control Theory , American Control Conference, June 26, 2018.

103. Research to Innovation: Future Directions for Systems and Control, Presentation at the Workshop, From Theory to Practice in Control: Enhancing Innovation and Impact, American Control Conference, June 26, 2018.

104. Real-Time Decision and Control for Power Grid Resilience, Plenary Talk, NSF Workshop on Real-Time Data Analytics for Resilient Electric Grid, Portland, OR, August 4-5, 2018.

105. Food-Energy-Water Nexus: Convergence Framing for Research and Innovation, Keynote Lecture, CONFOMA2018, Future of Food and the Role of Technology, Minneapolis, MN, September 8-9, 2018.

106. Envisioning Smart Technologies and Innovations for Societal Good, Super Smart Society Promotion Consortium, Tokyo Institute of Technology, October 22, 2018.

107. Invited panelist, Fostering the Culture of Convergence in Research, National Academy of Sciences, Engineering, and Medicine, October 23-24, 2018.

108. Grid Integration of Renewable Energy and Distributed Control, Cornell Energy Systems Colloquium, October 25, 2018.

109. Invited panelist, "Interface between engineers and social-scientists: Low-hanging fruits, language barriers, and synergy," Prepared Remarks, 2nd IFAC Conference on Cyber-Physical-Human Systems (CPHS), Miami, December 2018.

110. Invited panelist, "Future of ECE in the Era of ML and AI,", ECE Department Heads Association Annual Meeting, Tucson, AZ, March 25, 2019.

111. Invited speaker, "Envisioning Smart Cities that Deliver Societal Benefits," Smart Cities for Sustainable Globalization, National Academy of Engineering Regional Meeting, Illinois Institute of Technology, Chicago, April 24, 2019.

112. Invited speaker, "Socially Responsible Automation," (with Meera Sampath), EmTechNext, MIT Technology Review, Boston, June 12, 2019.

113. Invited speaker, The Future of Work and Jobs, Future of Work Workshop, Oxford-UIDP Summit, July 30, 2019, Oxford University, Oxford, UK.

114. Invited speaker, Deep Learning, Generative Adversarial Networks, Reinforcement Learning and Control, Workshop on Learning and Control, IIT Mandi, India, July 22-26, 2019.

115. Keynote speaker, Convergence Research Paradigm: A Powerful Approach to Enable Major Advances, Key Note, SUNY Research Council Meeting, August 6-7, 2019.

116. Plenary speaker, Cognitive Cyber-Physical Systems: Vision for the Next CPS Frontier, ESWEEK, New York City, October 16, 2019.

117. Keynote speaker, Leveraging Machine Learning for Advancing Smart-X Systems and Control, GE Edge and Controls Symposium, September 10-12, 2019.

118. Organizer, Systems and Control Opportunities for Decarbonization of the Energy System, My presentation: Energy System and Decarbonization Challenge, (video here) IFAC World Congress, July 2020.

119. Invited Speaker, Cognitive Cyber-Physical Systems: Cognitive Neuroscience, Machine Learning, and Control, (video here), American Control Conference, July 2020. Tutorial talk at a special session organized by Professor M. Vidyasagar (IIT Hyderabad) and Professor B. Touri (UC San Diego) American Control Conference, July 2020. Video of the entire session is available here.

120. Invited Speaker, Kalman Filtering, Sensor Fusion, and Eye Tracking, (video here) OpenEyes: Eye Gaze in AR, VR, and in the Wild Workshop, ECCV'20 Online, August 2020.

121. Strategic Thinking for Achieving Broader Impacts, (video here), Invited Seminar, University of Texas at Dallas, October 2020.

122. Invited Panelist, NSF Workshop on Future of Semiconductors and Beyond: Devices & Technologies, February 2021.

123. A Perspective on Trust in Machine Learning and Control for Dynamic Autonomous Systems, Invited speaker, Trusted AI Challenge Series, Air Force Research Lab and SUNY, (video of the event here), October 2020.

124. Neuro-Cognitive Science Inspired Directions in Learning for Control, Invited Speaker, (video at the workshop website), Workshop on Cognition and Control, American Control Conference, May 24, 2021.

125. Control for Climate Change Mitigation and Adaptation, Panel presentation, IEEE CSS Workshop on Control for Societal Challenges, June 5, 2021.

126. Convergence Research Paradigm: Role for Engineering, Keynote talk, ECEDHA Emerging Technologies Summit, June 15, 2021.

127. Climate Change Mitigation and Adaptation: Role for Systems and Controls (video here), College of Engineering Control Seminar, University of Michigan, October 1, 2021.

128. Convergence Research Paradigm: Role in Science and Technology Centers (video), NSF STC Science and Technologies for Phosphorus Sustainability (STEPS) Center, Inaugural Visiting Seminar, November 4, 2021.

129. Climate Change Mitigation and Adaptation: Role for Systems and Controls, Bode Prize Lecture, (video), IEEE Conference on Decision and Control, December 16, 2021.

130. Cognitive Cyber-Physical Systems: Vision and Ideas for Exploring a New Frontier, (video), Plenary presentation, 7th Indian Control Conference, December 22, 2021.

131. Smart Cities: Ensuring Social Benefits from Advanced Technologies, (video), Invited Presentation, International Virtual Workshop on Smart Cities: A Road Map for Future Development, BITS Pilani, India, January 10, 2022.

132. Research, Innovation, Technology, and Society, (video), Invited Speaker, Bharat Abhiman Webinar Series, Savitribai Phule Pune University, May 11, 2022.

133. Climate Change Challenge: Role for ECE Departments, Invited Panelist, Climate Change and ECE, ECE Department Heads Association Annual Meeting, New Orleans, June 2022.

134. Fundamental Engineering Research to Societal Benefits, (video), Extraordinary Engineering Impacts, National Academy of Engineering Symposium, August 18, 2022.

135. Climate Action: Progress at Scale, University of California Disaster Resilience Network (UC DRN), Climate Workshop, Sacramento, CA, December 8, 2022.

136.

137. Numerous Invited Presentations at Conferences and Workshops without Published Papers.

Selected Professional Activities and Service

National and International

1. Member, Committee on Science for Judges - Development of the Reference Manual on Scientific Evidence, Fourth Edition, National Academy of Science, Engineering and Medicine, 2022-now.

2. Co-leader, Climate Change Mitigation and Adaptation, IEEE Control Systems Society Roadmap 2030, 2021-now.

3. Chair, Awards Nomination Committee, International Federation of Automatic Control, 2020-now.

4. Member, Editorial Board, Proceedings of IEEE, 2019-now.

5. Chair, External Advisory Board, NSF STC on Science and Technologies for Phosphorus Sustainability, 2022-now.

6. Member, Advisory Board, NSF Engineering Research Visioning Alliance (ERVA), 2021-2022. Co-PI since 2022.

7. Member, External Advisory Board, Institute for Systems Research, University of Maryland, 2020-now.

8. Member, Planning Committee, Implications of 'Convergence' for How the National Center for Science and Engineering Statistics Measures the Science and Engineering Workforce—A Workshop, National Academy of Science, Engineering and Medicine, 2020-21. [Measuring Convergence in Science and Engineering – Proceedings of a Workshop Report].

9. Member, Steering Committee, Engineering Section, American Association for Advancement of Science, 2019-now.

10. Member, Governing Board, Clean Energy Smart Manufacturing Innovation Institute, 2018-now.

11. Member, Scientific Advisory Board, NSF ERC on Internet of Things for Precision Agriculture (IoT4Ag), 2021-now.

12. Member, Board of Directors, California Council on Science and Technology, 2021-now.

13. Member, Global Advisory Board, University of the Future in India, 2018-now.

14. Member, Governing Board, CENIC, 2019-2021.

15. Chair, External Review Committee, Department of Electrical and Computer Engineering, The Ohio State University, 2019.

16. Member, Presidential Advisory Board, College of Engineering, Carnegie-Mellon University, 2017.

17. Member, Executive Committee, MForesight – an NSF-NIST funded Center for manufacturing foresight, 2016-2020.

18. Chair, Nichols Medal Committee, International Federation of Automatic Control, 2014-2020.

19. Member, Advisory Board, National Alliance for Broader Impacts, 2016-2018.

20. External Peer Review Committee, Indian Institute of Technology Bombay, July 2014.

21. Member, Panel for IEEE Vision for Smart Grid Controls: 2030 and beyond, 2012-13.

22. IEEE Control Systems Society Board of Governors, 2013-14.

23. Invited Participant, "Science and Innovation: research, infrastructure and international collaboration", ASPEN Institute Italia, CERN Headquarters, Geneva, Switzerland, October 2013.

24. Member, External Advisory Committee, Directorate for Engineering, National Science Foundation, 2010-2013.

25. Member, Public Policy Committee, Engineering Deans Council, September 2005 – 2009.

26. Member, Advisory Board, Indian Institute of Technology, Mumbai, India, 2006-2012.

27. Member, Executive Committee, Board of Directors, IIT Bombay Heritage Fund, 2005-present.

28. Member (and Past Chair), Engineering Advisory Board, University of Georgia, 2008-2013.

29. Chair, External Review Committee, Department of Electrical and Systems Engineering, University of Pennsylvania, 2011.

30. Member, External Review Committee, Faculty of Engineering, Yale University, 2006.

31. Participant, International Forum for University Presidents on ICT Education, Beijing University of Posts and Telecommunications, 2005.

32. Site Visit Team Chair, NSF Science and Technology Center on Control, Dynamics, and Feedback in Nature, Caltech (in collaboration with Princeton and University of California, Santa Barbara), 2004.

33. External Assessor, Vision 2010, Department of Electrical and Computer Engineering, University of Waterloo, 2005.

34. Member, Awards Committee, American Automatic Control Council, 2005 – 2008.

35. Participant, NSF Workshop on Nanosystems Modeling and Control, March 2004. Participant, IEEE Deans' Summit – II, Miami, FL, January 2003.

36. Participant, Panel Discussion on Women in Control, IEEE Conference on Decision and Control, December 2003.

37. Participant, NAE LEAP Conference on Gender Equity in Engineering, Washington, DC, January 2003.

38. Participant, IEEE Joint Engineering Education Deans Workshop on Science, Mathematics and Technology in School Education, October 2001.

39. Participant, Government-University-Industry Roundtable Conference organized by NAS, NAE, and IOM, Washington, DC, February 1996.

40. Associate Editor, *IEEE Transactions on Automatic Control,* January 1987-December 1989.

41. Associate Editor, *SIAM Journal on Control and Optimization,* January 1992-September 1994.

42. Associate Editor, *Mathematics of Control, Signals, and Systems,* December 1986-December 1998.

43. Associate Editor, *Systems and Control Letters,* July 1988-June 1993.

44. Associate Editor, *International Journal of Robust and Nonlinear Control,* April 1991-March 1999.

45. Associate Editor, *Mathematical Problems in Engineering,* November 1994-

46. Program Vice Chair for Invited Sessions, American Control Conference, June 1992.

47. Workshop on Control of Semiconductor Manufacturing Processes, American Automatic Control Conference, Organizers and Main Lecturers, P. P. Khargonekar and B. H. Krogh, IFAC, 1996.

48. Member, Organizing Committee (T. Kailath, Chairman), Workshop on Signal Processing, Institute for Mathematics and Applications, University of Minnesota, June-August 1988.

49. Member, Organizing Committee (H. Sussmann, Chairman), Full Year on Control Theory, Institute for Mathematics and Applications, University of Minnesota, 1992-1993.

50. Participated in the Industry-University-Government Roundtable on Enhancing Engineering Education, Worcester Polytechnic Institute, May 1998.

51. Fellow, CIC (Committee for Institutional Cooperation) Academic Leadership Program, September 2000 – May 2001.

52. Chair, Theory Committee, *IEEE Control Systems Society,* 1993-1995.

53. Member, Program Committee, SPIE Microelectronic Manufacturing Conference, September 2000.

54. Member, Program Committee, *1987 IEEE Conference on Decision and Control*

55. Participated in the SIAM Workshop on the Mathematics of Systems and Signal Processing, Stanford University, August 31-September 3, 1987.

56. Member Program Committee, *1988 American Control Conference.*

57. Member, Technical Committee on Linear Systems *IEEE Control Systems Society.* In charge for reviewing technical notes and correspondence items submitted to the *IEEE Transactions on Automatic Control,* August 1981-December 1982.

58. Co-organizer and co-chairman of the invited session on "Algebraic Techniques in Feedback Control," *21st IEEE Conference on Decision and Control,* December 1982.

59. Co-chairman of the session entitled, "Algebraic Methods in Linear Systems," *21st IEEE Conference on Decision and Control,* December 1982.

60. Chairman of the session entitled, "Systems Over Groups, Rings, and Algebras," *International Symposium on the Mathematical Theory of Networks and Systems,* Beer Sheva, Israel, June 1983.

61. Co-chairman of the session entitled, "Design of Robust Feedback Systems," *23rd IEEE Conference on Decision and Control,* December 1984.

62. Chairman of the session entitled, "Robustness and Sensitivity in Feedback Systems," *23rd Allerton Conference Communication, Control, and Computing,* Monticello, Illinois, October 1985.

63. Co-organizer and co-chairman of the invited session on, "Robustness and $\mathcal{H}_\infty$ Synthesis Theory," *24th IEEE Conference on Decision and Control,* December 1985.

64. Technical Consultant to the Honeywell Corp., Boeing Co., General Electric Co., Xerox Corp., Delphi Corp., Mitsubishi Heavy Industries, Japan, DARPA (Defense Advanced Research Projects Agency).

65. Several NSF Proposal Review Panels.

66. Member, Technical Advisory Board, Voyan Corp., 1998-2002.

67. Member, Technical Advisory Board, Ubiquiti Corp., 1999-

University of California System-Wide Service

1. Co-Chair, Applied Research Working Group, and Member of Global Climate Leadership Council, 2019-now.

2. Co-Chair, Research Information Management Systems (RIMS) Working Group, 2019-2021.

3. Co-leader, UC National Labs Southern California Hub, 2019-now. [Includes UCI, UCLA, UCR, UCSD, LANL, and LLNL.]

4. Co-leader, Robert Noyce Initiative, 2020-now. [Includes UCB, UCD, UCI, UCSB, and UCSF.]

University of Florida

1. Member, Presidential Task Force on Strategic Planning, University of Florida, 2002.

2. Member, Search Committee, President of the University of Florida, February 2003 – October 2003.

3. Member, Budget Allocation Committee, September 2006-April 2007

4. Member, Board of Directors, University of Florida Foundation, May 2003 – June 2009.

5. Chair, Search Committee, Director of Institutional Research, January 2006-April 2006.

6. Member, Board of Directors, Center for Entrepreneurship and Innovation, College of Business, August 2002 – present

7. Member, Advisory Board, International Center for Automated Information Research, Levin College of Law, August 2002 - present

8. Member, Board of Directors, University of Florida Research Foundation, July 2001 – June 2008.

9. Member, Advisory Board, School of Natural Resources and Environment, July 2003 - present

10. Member, Research Policy Council, University of Florida, July 2001 – June 2009.

11. Member, Advisory Board, Digital Worlds Institute, January 2002 – June 2009.

12. Member, Deans Advisory Group, University of Florida Foundation, August 2004 – June 2008.

13. Chair, Search Committee, Dean of College of Liberal Arts and Sciences, University of Florida, September 2007 – April 2008.

14. Member, Executive Committee, Howard Hughes Medical Institute Science for Life Program, University of Florida, August 2009 –

15. Member, Advisory Board, Computational Biology Program, University of Florida, August 2009 –

16. Member, Strategic Planning Task Force for Energy Research, College of Engineering, University of Florida, September 2009 –

17. Member, Strategic Planning Task Force for Leadership Initiative, College of Engineering, University of Florida, October 2009 –

University of Michigan

1. Member, President's Information Revolution Commission, University of Michigan, Fall 2000.

2. Member, College of Engineering Campaign Planning Committee, September 1999-May 2000.

3. Member, Executive Committee, NSF Engineering Research Center on Reconfigurable Machining Systems, September 1998-June 2001.

4. Member, Executive Committee, Tauber Manufacturing Institute, 1996-1997.

5. Member, Executive Committee, Center for Display Technology and Manufacturing, 1997-1998.

6. External Visitor, Department of Mechanical Engineering and Applied Mechanics, 1997.

7. Member, College of Engineering Honors and Awards Committee, 1995-1997.

8. Member, Executive Committee, Department of Electrical Engineering and Computer Science, 1989-1991, 1996-2001.

9. Member, Executive Committee, College of Engineering Control Group, 1991-1993. Chaired the committee during 1992.

10. Graduate Advisor, Control Area, 1992.

11. Financial Aid chair, Systems Division, Department of Electrical Engineering and Computer Science, 1993-1995.

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