

CURRICULUM VITAE

Lucy Y. Pao

Palmer Endowed Chair Professor, Electrical, Computer, and Energy Engineering Department
Professor (by courtesy), Aerospace Engineering Sciences Department
Fellow, Renewable and Sustainable Energy Institute
University of Colorado Boulder
Tel +1 303 492 2360, Fax +1 303 492 2758
Email pao@colorado.edu, URL <http://ecee.colorado.edu/~pao>

Research Interests:

Control systems (with applications to flexible structures, wind turbines, wind farms, power converters, tape systems, disk drives, atomic force microscopy, near-field scanning optical microscopy and lithography); multi-sensor fusion (with applications to uninhabited autonomous vehicles, satellites, and automotive active safety systems); and haptic and multi-modal visual/haptic/audio interfaces (with applications to scientific visualization and spatial communication).

Education:

- 9/1988 – 1/1992 **Stanford University**, Stanford, CA
Ph.D., Electrical Engineering. GPA: 4.00
Thesis Topic: *Proximate Time-Optimal Control of Higher-Order Servomechanisms*
Advisor: Professor Gene F. Franklin
- 9/1987 – 6/1988 **Stanford University**, Stanford, CA
M.S., Electrical Engineering. GPA: 3.93
- 9/1985 – 6/1987 **Stanford University**, Stanford, CA
B.S., Electrical Engineering, *with distinction*. GPA: 3.89

Major Honors and Awards:

- 2019 ASME Nyquist Lecturer Award
- 2019 Plenary Speaker, ASME Dynamic Systems and Control Conference, Park City, Utah
- 2019 Institute for Advanced Study Fellowship, Hanse-Wissenschaftskolleg, Delmenhorst, Germany
- 2017 – 2020 Member of IFAC Executive Board
- 2017 Scientific Award, European Academy of Wind Energy
- 2017 Control Engineering Practice Award, American Automatic Control Council
- 2016 – 2017 Institute for Advanced Study Fellowship, Hanse-Wissenschaftskolleg, Delmenhorst, Germany
- 2016 Plenary Speaker, Alpbach Technology Symposium, Alpbach, Austria
- 2016 Plenary Speaker, American Control Conference, Boston, MA
- 2015 SIAM Journal on Control and Optimization Best Paper Prize
- 2013 Fellow of the International Federation of Automatic Control

2013 Plenary Speaker, IEEE Conference on Decision and Control, Florence, Italy
2012 IEEE Control Systems Magazine Outstanding Paper Award
2012 Plenary Speaker, ASME Dynamic Systems and Control Conference, Ft. Lauderdale, FL
2012 Fellow of the IEEE
2011 – 2013 Elected Member, IEEE Control Systems Society Board of Governors
2007 – 2013 General Chair, 2013 American Control Conference
2010 – 2011 Member, US Defense Science Study Group
2011 Plenary Speaker, ASME International Mechanical Engineering Congress & Exposition
2008 – 2014 Distinguished Lecturer, IEEE Control Systems Society
2008 Visiting Miller Professor, Miller Institute for Basic Research in Science, University of California at Berkeley
2008 Keynote Speaker, International Federation of Automatic Control Triennial World Congress, Seoul, Korea
2006 Plenary Speaker, IEEE Conference on Decision and Control, San Diego, CA
2005 Best Paper Award, World Haptics Conference, Pisa, Italy
2005 – 2007 Elected Member, IEEE Control Systems Society Board of Governors
2004 Best Commercial Potential Award, International Symposium on Haptic Interfaces for Virtual Environments and Teleoperator Systems
2001 – 2004 Program Chair, 2004 American Control Conference
1997 – 2000 Young Investigator Award, Office of Naval Research
1996 – 2001 Early Faculty CAREER Award, National Science Foundation
1996 Young Author Prize, International Federation of Automatic Control Triennial World Congress
1988 – 1991 Graduate Fellowship Award, National Science Foundation

Other Honors and Awards:

2018 – Palmer Endowed Chair Professor, College of Engineering and Applied Science
2017 Plenary Speaker, Congreso Nacional de Control Automático
2015 Clean Energy Education & Empowerment Awards Finalist
2015 Appointed Member, IEEE Control Systems Society Board of Governors
2013 Keynote Speaker, Society of Instrument and Control Engineers Annual Conference
2013 Plenary Speaker, IEEE Power and Energy Conference at Illinois
2013 Dean's Faculty Fellowship, College of Engineering and Applied Science
2012 Distinguished Lecturer, Chinese Control and Decision Conference
2010 – Courtesy Professor, Aerospace Engineering Sciences Department
2009 – Fellow, Renewable and Sustainable Energy Institute
2009 – 2014 Richard and Joy Dorf Professor, Electrical, Computer, and Energy Engineering
2007 – 2011 Founding Scientific Director, Center for Research and Education in Wind
2008 – 2010 Honorary Seat, Renewable and Sustainable Energy Institute Leadership Council
2006 Dean's Faculty Fellowship, College of Engineering and Applied Science

- 2005 Featured in the “People in Control” column of the *IEEE Control Systems Magazine*, pp. 18-21, Dec. 2005
- 2005 Invited Participant, US-Japan Workshop on Sensors, Smart Structures, and Mechatronic Systems, Tokyo, Japan
- 2005 Project on “Haptic Interfaces for Spatial Reasoning” featured in the US National Science Foundation's Fiscal Year 2004 Performance Highlights
- 2004 Finalist, University of Colorado's Technology Transfer Office's Proof of Concept Program
- 2003 Subaru Teaching Excellence Award
- 2003 Appointed Member, IEEE Control Systems Society Board of Governors
- 2002 Special Service Recognition Award, American Automatic Control Council
- 2001 – 2002 Senior Common Room Member, Cabot House, Harvard University
- 2001 – 2002 Faculty Fellowship Award, University of Colorado Council on Research and Creative Work
- 2001 Co-author and advisor on the paper that received the 2001 American Control Conference (ACC) Best Student Paper Award
- 2000 Exemplary Project Award, Colorado Advanced Software Institute
- 2000 Keynote Speaker, Japan/USA/Vietnam Workshop on Research and Education in Systems, Computation, and Control Engineering, Ho Chi Minh City, Vietnam.
- 2000 Invited Participant (by the US National Academy of Engineering), German-American Frontiers of Engineering Symposium, Bremen, Germany
- 1998 Elevated to Senior Member of the IEEE
- 1998 Keynote Speaker, Japan/USA/Vietnam Workshop on Research and Education in Systems, Computation, and Control Engineering, Hanoi, Vietnam
- 1997 Invited Participant, US National Academy of Engineering's Frontiers of Engineering Symposium
- 1997 Young Careerist Award, Boulder Business and Professional Women
- 1997 Junior Faculty Development Award, University of Colorado
- 1995 Member, Who's Who in the Midwest
- 1994 Nominated by the Stanford Alumni Association for an Alumni Trustee position on the Stanford Board of Trustees
- 1990 Scholarship Award, President Chiang Education Foundation
- 1987 – 1988 Masters Fellowship Award, Hughes Aircraft Company
- 1986 – 1987 Career Scholarship Award, Pacific Gas & Electric Company
- 1985 – 1987 Scholarship Award, Society of Women Engineers
- 1986 National Technical Presentation Award, Society of Women Engineers
- 1985 Scholarship Award, Chinese Medical and Health Association
- 1984 Special Superior Achievement Award, Naval Surface Warfare Center
- 1984 1st place, Washington, D.C. Society of Engineers undergraduate research paper competition

Employment:

8/1995 – **University of Colorado**, Electrical, Computer, and Energy Engineering Department, Boulder, CO

Palmer Endowed Chair of the College of Engineering and Applied Science (2018-), Richard and Joy Dorf Professor of Electrical, Computer, and Energy Engineering (2009-2014), Fellow of Renewable and Sustainable Energy Institute (2009-), Professor (2004-), Associate Professor (1999-2004), Assistant Professor (1995-1999), Courtesy Professor of Aerospace Engineering Sciences (2010-): Developing combined feedforward/feedback controllers for flexible structures while being robust to parameter errors. Developing and analyzing multisensor fusion algorithms and sensor management methods. Studied human-tool and human machine interaction and developed haptic and combined visual/haptic displays for virtual environments. Teaching Sustainable Energy (Fall 2013 and Fall 2014), Linear Systems (Fall 1995, Fall 1998, Fall 2002, Spring 2005, and Spring 2008), Control Systems Analysis (Spring 1996, Fall 1996, Spring 2000, Spring 2001, Spring 2003, Fall 2015, Fall 2017-2019), Automatic Control Systems (Spring 1998, Spring 2004, Spring 2007, and Spring 2011), Advanced Linear Systems (Fall 1999, Fall 2003, and Fall 2010), and Sampled-Data and Digital Control Systems (Fall 1997, Fall 2000, Fall 2004-2007, Spring 2010, Spring 2012, Fall 2012, Spring 2014-2016, Spring 2018-2020). Developing massive open online courses in Control Systems Analysis and Sampled-Data and Digital Control Systems (2017-), to be hosted on Coursera. Was a founding faculty member of the Colorado Center for Information Storage, 1997. Have served on the following Electrical, Computer, & Energy Engineering Department committees: Control Systems Graduate Preliminary Exam Committee (1995- , Chair in 1997-1998, 2002-2003, 2006-2007, 2009-2010, 2014-2015, and 2018-2019), Graduate Orientation Committee (1996, 2000, 2003, 2007, 2009, 2013, and 2015), Graduate Studies Committee (1997-2002, 2004-2005, 2009, and 2015-2016), Hiring Planning Committee (1998), Curriculum Committee (2002-2004), Faculty Search Committee (2002-2004, 2008-2009, 2011-2012, 2013-2014 (chair), and 2017-2018 (chair)), ABET Linear Systems Core Course Assessment Team (2004-2005), Executive Committee (2005-2007), Reappointment, Tenure, and Promotion Committee (2007-2008, 2013-2014, and 2018-2020), and the departmental leadership committee (2014-2016). Have also served on the Aerospace Engineering Sciences Department Faculty Search Committee (2004-2006), the College of Engineering Dean's Faculty Leadership and Advancement Group (2002-2005), the Colorado Center for Information Storage Executive Committee (2002-2007), the College Faculty Research Council (2006-2007), as a College of Engineering Dean's Scholar (2005-2008), as Chair of the Research and Engineering Center for Unmanned Vehicles (RECUV) Curriculum Committee (2005-2008), on the College Integrated Teaching and Learning Laboratory (ITLL) Task Force (2006-2008), on the University of Colorado Energy Initiative and Renewable and Sustainable Energy Institute Leadership Council (2008-2010), as a participating faculty member in the graduate and undergraduate Interdisciplinary Certificate Programs in Energy (2007-2011), as the Founding Scientific Director for the Center for Research and Education in Wind (2007-2011), on the Executive Committee of the College of Engineering Water-Energy Nexus Interdisciplinary Research Theme (2017-2018), and as the coordinator for the Robotics, Controls, and Dynamical Systems (RCDS) seminar series (2017-2019). Currently serving

as a Renewable and Sustainable Energy Institute Fellow (2009-), the ECEE representative coordinating Joint ECEE/RASEI Big Energy seminars (2011-), and founder and coordinator of the RCDS Faculty Coffee Hours (2018-).

1/2009 – **National Renewable Energy Laboratory**, National Wind Technology Center, Golden, CO

Visiting Researcher (since 2009) and Joint Appointee (since 2019): Exploring advanced algorithms for control of individual wind turbines and for distributed control of wind farms. Developing model predictive controllers using preview measurements of upstream wind conditions from lidar sensors. Deriving models of continuous-wave and pulsed lidars. Investigated the use of coherence functions in modeling wind evolution. Developed a novel optical icing sensor and distributed hybrid controllers for de-icing wind turbine blades. Applied game theoretic methods for developing coordinated controllers for arrays of wind turbines. Investigating active power control algorithms for wind turbines and wind power plants.

10/2016 – 7/2017 **Hanse-Wissenschaftskolleg, Institute for Advanced Study**,
and Delmenhorst, Germany, and

6/2019 – 8/2019 **ForWind Center for Wind Energy Research, Oldenburg University**,
Oldenburg, Germany

Fellow: Investigated control of wind turbines and wind farms, control of atomic force microscopes, and control of tape drive systems.

9/2016 – 10/2016 **Boston University**, Boston, MA

Center for Information and Systems Engineering Resident Scholar: Investigated control of atomic force microscopes, control of wind turbines and wind farms, and control of tape drive systems.

8/2008 – 12/2008 **University of California**, Miller Institute for Basic Research in Science,
and Department of Mechanical Engineering, Berkeley, CA

Visiting Miller Professor: Investigated different combined feedforward/feedback control architectures and algorithms, with applications ranging from megawatt wind turbines to disk drives to atomic force microscopes.

- 8/2001 – 7/2002 **Harvard University**, Division of Engineering and Applied Sciences, Cambridge, MA
Visiting Scholar: Developed aggressive control methods for disk-drive and tape-drive systems. Investigated applications of ordinal optimization and computing budget allocation techniques in the evaluation and comparison of multisensor fusion algorithms. Derived novel mechanism and hand models in order to achieve higher bandwidth force control of in-parallel multi-degree of freedom haptic interfaces. Explored how haptic interfaces can enhance spatial learning in blind users, users with learning disabilities, as well as the general population. Participated as a Senior Common Room Member of Cabot House, one of the residential houses at Harvard.
- 8/1993 – 7/1995 **Northwestern University**, Electrical Engineering and Computer Science Department, Evanston, IL
Assistant Professor: Derived robust near time-optimal control algorithms for flexible structures. Studied methods for human-robotic cooperation in assembly tasks. Compared and analyzed several implementations of multisensor fusion algorithms for tracking applications. Developed control algorithms for multifingered robotic hands. Set up an Engineering School wide instructional control laboratory. Taught Introduction to Feedback Systems (Winter 1994 and Winter 1995), Optimal Control (Spring 1994), System Theory (Fall 1993 and Fall 1994), and Nonlinear Problems in Engineering (Spring 1995). Served as Freshmen Advisor, on the Undergraduate Advisory Committee, Electrical Engineering Curriculum Committee, Instructional Laboratory Equipment Committee, McCormick Control Council, and as Secretary/Treasurer of the Northwestern University Chinese-American Faculty Association.
- 11/1991 – 8/1993 **The MITRE Corporation**, Signal Processing Department, Bedford, MA
Member of Technical Staff: Developed and evaluated centralized multisensory data fusion algorithms for multiple target tracking scenarios. Analyzed the tradeoffs in performance versus computational complexity and communication requirements of the developed algorithms.
- 9/1988 – 11/1991 **Stanford University**, Information Systems Laboratory, Stanford, CA
Research Assistant: Developed nonlinear robust near time-optimal control algorithms for third- and fourth-order servomechanisms. Proved global stability of several nonlinear controllers for different third-order marginally stable plants. Simulation and experimental results demonstrated the effectiveness of the algorithms developed.
- 6/1988 – 9/1988 **AT&T Bell Laboratories**, Machine Perception Research Department, Holmdel, NJ
Member of Technical Staff: Developed an algorithm for the transformation of human hand positions for controlling robotic hands. Applied the algorithm to the Utah/MIT Dextrous Hand using (one at a time) the VPL DataGlove and the Exos Dextrous Hand Master as the human hand position measurement device.

- 6/1987 – 9/1987 **Hughes Aircraft Company**, Space and Communications Group, Dynamics and Control Department, El Segundo, CA
Member of Technical Staff: Designed and tested a compensator for a proportional control automobile anti-lock braking system modulator. Developed a servovalve and actuator model and implemented it in an active suspension control algorithm simulation program for a Chevrolet Corvette.
- 6/1986 – 9/1986 **Pacific Gas & Electric Company**, Transmission Planning Department, San Francisco, CA
Technical Intern: Analyzed and predicted loading conditions to improve power distribution efficiency.
- 5/1985 – 1/1986 **Naval Surface Warfare Center**, Electromagnetics Branch, Silver Spring, MD
Engineering Technician: Performed software and hardware engineering for a hand-held prototype timer programmer.
- 6/1983 – 5/1985 **Naval Surface Warfare Center**, Metallic Materials Branch, Silver Spring, MD
Engineering Aide: Conducted thermal analysis and magnetic annealing experiments on shape memory alloys and metallic glasses.

Publications

Book Chapters

- BC4) L. Y. Pao, “Active Power Control of Wind Power Plants for Grid Integration,” updated article in *Encyclopedia of Systems and Control*, 7 pages, edited by J. Baillieul and T. Samad, Springer-Verlag London 2020, in press.
- BC3) A. Wright, P. Fleming, A. Scholbrock, K. Johnson, L. Pao, and J.-W. van Wingerden, “Wind Turbine Control Design,” chapter in *Wind Energy Modeling and Simulation*, pp. 169-233, Vol. 2, Turbine and System, edited by P. Veers, IET London 2019. ISBN 978-1-78561-523-8
- BC2) S. Shajiee, L. Y. Pao, and R. R. McLeod, “Monitoring Ice Accumulation and Active De-Icing Control of Wind Turbine Blades,” chapter in *Wind Turbine Control and Monitoring*, pp. 193-230, *Advances in Industrial Control* series, edited by N. Luo, Y. Vidal, and L. Acho, Springer 2014. ISBN 978-3-319-08412-1
- BC1) L. Y. Pao, “Active Power Control of Wind Power Plants for Grid Integration,” article in *Encyclopedia of Systems and Control*, 6 pages, edited by J. Baillieul and T. Samad, Springer-Verlag London 2014. DOI: [10.1007/978-1-4471-5102-9_272-1](https://doi.org/10.1007/978-1-4471-5102-9_272-1)

Book Foreword

- BF1) L. Y. Pao, Foreword for book on *Stochastic Simulation Optimization for Discrete Event Systems – Perturbation Analysis, Ordinal Optimization, and Beyond*, World Scientific, 2013.

Refereed Technical Journal Papers

- J85) B. Shrestha, D. S. Zalkind, L. Y. Pao, V. Petrović, and M. Kühn, “Optimized Activation of Controller Strategies for Minimizing Structural Loads and Actuator Usage,” under preparation, to be submitted for publication in *Wind Energy*.
- J84) S. Shajiee, A. Najafi, L. Y. Pao, and R. R. McLeod, “Closed-Loop Thermal Control of Distributed Resistive Heaters for Active De-icing of Wind Turbine Blades,” under preparation, to be submitted for publication in *Wind Energy*.
- J83) J. H. Laks and L. Y. Pao, “Observer-Controllers for Output Regulation: The Internal Model Principle Revisited,” under preparation, to be submitted for publication in *IEEE Trans. Automatic Control*.
- J82) D. Martin, K. Johnson, S. Kianbakht, D. Zalkind, L. Pao, E. Loth, C. Noyes, J. Simpson, M. Chetan, S. Yao, D. T. Griffith, and M. Selig, “Design Space Exploration and Decision Making for a Segmented Ultra-light Morphing 50MW Wind Turbine,” under preparation, to be submitted for publication in *Wind Energy*.
- J81) D. Martin, K. Johnson, C. Bay, D. Zalkind, L. Pao, M. Kaminski, and E. Loth, “LPV Modeling and Torque Control of a Downwind, Two-Bladed, Ultralight Wind Turbine Rotor,” under preparation, to be submitted for publication in *Wind Energy*.
- J80) K. Garifi, L. Y. Pao, and B. Touri, “Model Predictive Control with Disturbance Prediction for Reference Tracking in Tape Drive Systems,” under preparation, to be submitted for publication in *IEEE Trans. Magnetics*.
- J79) M. N. Sinner and L. Y. Pao, “Linear Parameter Varying Model Predictive Control of Wind Turbines,” under preparation, to be submitted in Apr. 2020 for publication in *Wind Energy*.
- J78) M. Kaminski, E. Loth, D. Zalkind, L. Pao, M. Selig, and K. Johnson, “An Ideal Servo-Aero-Gravoelastically Scaled Turbine Model of a 13-MW Downwind Turbine,” pre-print, to be submitted in Mar. 2020 for publication in *J. Renewable and Sustainable Energy*.
- J77) D. S. Zalkind, E. Dall’Anese, L. Y. Pao, “Automatic Controller Tuning Using a Zeroth-Order Optimization Algorithm,” pre-print, to be submitted in Mar. 2020 for publication in *Wind Energy Science*.
- J76) L. Y. Pao, D. S. Zalkind, D. T. Griffith, M. Chetan, M. S. Selig, G. K. Ananda, C. J. Bay, T. Stehly, and E. Loth, “Control Co-Design of 13 MW Downwind Two-Bladed Rotors to Achieve 25% Reduction in Levelized Cost of Wind Energy,” pre-print, to be submitted in Feb. 2020 for publication in *Applied Energy*.
- J75) M. Vali, V. Petrović, L. Y. Pao, and M. Kühn, “Model Predictive Active Power Control for Optimal Structural Load Equalization in Waked Wind Farms,” pre-print, to be submitted in Feb. 2020 for publication in the *IEEE Trans. Control Systems Technology*.
- J74) C. Qin, E. Loth, D. S. Zalkind, L. Y. Pao, S. Yao, D. T. Griffith, M. S. Selig, and R. Damiani, “Downwind Coning Concept Rotor for a 25 MW Offshore Wind Turbine,” conditionally accepted for publication in *Renewable Energy*, under revision.
- J73) R. A. Braker, Y. Luo, L. Y. Pao, and S. B. Andersson, “Improving the Image Acquisition Rate of an Atomic Force Microscope through Sub-sampling and Reconstruction,” accepted for publication in the *IEEE/ASME Trans. Mechatronics*, to appear.
- J72) R. A. Braker and L. Y. Pao, “A Comparison of Tracking Step Inputs with a Piezo Stage using MPC and Saturated LQG Control,” submitted for publication in the *IEEE Trans. Control Systems Technology*, under review.

- J71) R. Ungurán, V. Petrović, L. Y. Pao, and M. Kühn, “Uncertainties Identification of Blade-Mounted Lidar-Based Inflow Wind Speed Measurements for Robust Feedback-Feedforward Control Synthesis,” *Wind Energy Science*, 4(4): 677-692, Dec. 2019. DOI: [10.5194/wes-4-677-2019](https://doi.org/10.5194/wes-4-677-2019)
- J70) D. S. Zalkind, G. K. Ananda, M. Chetan, D. P. Martin, C. J. Bay, K. E. Johnson, E. Loth, D. T. Griffith, M. S. Selig, and L. Y. Pao, “System-Level Design Studies for Large Rotors,” *Wind Energy Science*, 4(4): 595-618, Nov. 2019. DOI: [10.5194/wes-4-595-2019](https://doi.org/10.5194/wes-4-595-2019)
- J69) P. Veers, K. Dykes, E. Lantz, S. Barth, C. Bottasso, O. Carlson, A. Clifton, J. Green, P. Green, H. Holttinen, D. Laird, V. Lehtomäki, J. K. Lundquist, J. Manwell, M. Marquis, C. Meneveau, P. Moriarty, X. Munduate, M. Muskulus, J. Naughton, L. Pao, J. Paquette, J. Peinke, A. Robertson, J. S. Rodrigo, A. M. Sempreviva, J. C. Smith, A. Tuohy, and R. Wisler, “Grand Challenges in the Science of Wind Energy,” *Science*, Vol. 366, Issue 6464, Oct. 2019. DOI: [10.1126/science.aau2027](https://doi.org/10.1126/science.aau2027)
- J68) M. Vali, V. Petrović, G. Steinfeld, L. Y. Pao, and M. Kühn, “An Active Power Control Approach for Wake-Induced Load Alleviation in a Fully Developed Wind Farm Boundary Layer,” *Wind Energy Science*, 4(1): 139-161, Mar. 2019. DOI: [10.5194/wes-4-139-2019](https://doi.org/10.5194/wes-4-139-2019)
- J67) M. Vali, V. Petrović, S. Boersma, J.-W. van Wingerden, L. Y. Pao, and M. Kühn, “Adjoint-Based Model Predictive Control for Optimal Energy Extraction in Waked Wind Farms,” *Control Engineering Practice*, Vol. 84, pp. 48-62, Mar. 2019. DOI: [10.1016/j.conengprac.2018.11.005](https://doi.org/10.1016/j.conengprac.2018.11.005)
- J66) B. M. Doekemeijer, S. Boersma, L. Y. Pao, T. Knudsen, and J.-W. van Wingerden, “Online Model Calibration for a Simplified LES Model in Pursuit of Real-Time Closed-Loop Wind Farm Control,” *Wind Energy Science*, 3(2): 749-765, Oct. 2018. DOI: [10.5194/wes-3-749-2018](https://doi.org/10.5194/wes-3-749-2018)
- J65) R. A. Braker and L. Y. Pao, “Proximate Time-Optimal Control of a Harmonic Oscillator,” *IEEE Trans. Automatic Control*, 63(6): 1676-1691, June 2018. DOI: [10.1109/TAC.2017.2759059](https://doi.org/10.1109/TAC.2017.2759059)
- J64) F. Dunne and L. Y. Pao, “Optimal Blade Pitch Control with Realistic Preview Wind Measurements,” *Wind Energy*, 19(12): 2153-2169, Dec. 2016. DOI: [10.1002/we.1973](https://doi.org/10.1002/we.1973)
- J63) P. Fleming, J. Aho, A. Buckspan, E. Ela, Y. Zhang, V. Gevorgian, A. Scholbrock, L. Pao, and R. Damiani, “Effects of Power Reserve Control on Wind Turbine Structural Loading,” *Wind Energy*, 19(3): 453-469, Mar. 2016. DOI: [10.1002/we.1844](https://doi.org/10.1002/we.1844)
- J62) E. Simley, N. Angelou, T. Mikkelsen, M. Sjöholm, J. Mann, and L. Y. Pao, “Characterization of Wind Velocities in the Upstream Induction Zone of a Wind Turbine using Scanning Continuous-Wave Lidars,” *J. Renewable and Sustainable Energy*, 8(1), 013301, pp. 1-26, Jan. 2016. DOI: [10.1063/1.4940025](https://doi.org/10.1063/1.4940025)
- J61) P. M. O. Gebraad, F. W. Teeuwisse, J. W. van Wingerden, P. A. Fleming, S. D. Ruben, J. R. Marden, and L. Y. Pao, “Wind Plant Power Optimization through Yaw Control Using a Parametric Model for Wake Effects – a CFD Simulation Study,” *Wind Energy*, 19(1): 95-114, Jan. 2016. DOI: [10.1002/we.1822](https://doi.org/10.1002/we.1822)
- J60) E. Simley and L. Y. Pao, “Evaluation of a Wind Speed Estimator for Hub-Height and Shear Components,” *Wind Energy*, 19(1): 167-184, Jan. 2016. DOI: [10.1002/we.1817](https://doi.org/10.1002/we.1817)
- J59) D. Schlipf, E. Simley, F. Lemmer, L. Pao, and P. W. Cheng, “Collective Pitch Feedforward Control of Floating Wind Turbines Using Lidar,” *J. Ocean and Wind Energy*, 2(4): 223-230, Nov. 2015. DOI: [10.17736/jowe.2015.arr04](https://doi.org/10.17736/jowe.2015.arr04)

- J58) S. Shajiee, L. Y. Pao, and R. R. McLeod, "Optimizing the Layout of Heaters for Distributed Active De-icing of Wind Turbine Blades," *Wind Engineering*, 38(6): 587-600, Dec. 2014. DOI: [10.1260/0309-524X.38.6.587](https://doi.org/10.1260/0309-524X.38.6.587)
- J57) I. P. Girsang, J. S. Dhupia, E. Muljadi, M. Singh, and L. Y. Pao, "Gearbox and Drivetrain Models to Study Dynamic Effects of Modern Wind Turbines," *IEEE Trans. Industry Applications*, 50(6): 3777-3786, Nov. 2014. DOI: [10.1109/TIA.2014.2321029](https://doi.org/10.1109/TIA.2014.2321029)
- J56) J. R. Marden, H. P. Young, and L. Y. Pao, "Achieving Pareto Optimality through Distributed Learning," *SIAM J. Control & Optimization*, 52(5): 2753-2770, Oct. 2014. DOI: [10.1137/110850694](https://doi.org/10.1137/110850694), **Awarded the 2015 SIAM J. Control & Optimization Best Paper Prize.**
- J55) E. Simley, L. Y. Pao, R. Frehlich, B. Jonkman, and N. Kelley, "Analysis of Light Detection and Ranging Wind Speed Measurements for Wind Turbine Control," *Wind Energy*, 17(3): 413-433, March 2014. DOI: [10.1002/we.1584](https://doi.org/10.1002/we.1584)
- J54) N. Bernstein, D. Lawrence, and L. Pao, "Dynamics Modeling for Parallel Haptic Interfaces with Force Sensing and Control," *IEEE Trans. Haptics*, 6(4): 429-439, Oct.-Dec. 2013. DOI: [10.1109/TOH.2013.3](https://doi.org/10.1109/TOH.2013.3)
- J53) J. P. Aho, A. D. Buckspan, F. Dunne, and L. Y. Pao, "Controlling Wind Energy for Utility Grid Reliability," *ASME Dynamic Systems and Control Magazine*, 1(3): 4-12, Sept. 2013.
- J52) J. R. Marden, S. D. Ruben, and L. Y. Pao, "A Model-Free Approach to Wind Farm Control using Game Theoretic Methods," *IEEE Trans. Control Systems Technology*, 21(4): 1207-1214, July 2013. DOI: [10.1109/TCST.2013.2257780](https://doi.org/10.1109/TCST.2013.2257780)
- J51) J. A. Butterworth, L. Y. Pao, and D. Y. Abramovitch, "Analysis and Comparison of Three Discrete-Time Feedforward Model-Inverse Control Techniques for Nonminimum-Phase Systems," *Mechatronics*, 22(5): 577-587, Aug. 2012. DOI: [10.1016/j.mechatronics.2011.12.006](https://doi.org/10.1016/j.mechatronics.2011.12.006)
- J50) J. A. Butterworth, L. Y. Pao, and D. Y. Abramovitch, "A Discrete-Time Single-Parameter Combined Feedforward/Feedback Adaptive-Delay Algorithm with Applications to Piezo-Based Raster Tracking," *IEEE Trans. Control Systems Technology*, 20(2): 416-423, March 2012. DOI: [10.1109/TCST.2011.2178095](https://doi.org/10.1109/TCST.2011.2178095)
- J49) V. V. Kulkarni, L. Y. Pao, and M. Safonov, "On Stability Analysis of Systems Featuring a Multiplicative Combination of Nonlinear and Linear Time-Invariant Feedback," *Int. J. Robust & Nonlinear Control*, 21(18): 2101-2108, Dec. 2011. DOI: [10.1002/rnc.1684](https://doi.org/10.1002/rnc.1684)
- J48) J. Laks, L. Y. Pao, A. D. Wright, N. Kelley, and B. Jonkman, "The Use of Preview Wind Measurements for Blade Pitch Control," *Mechatronics*, 21(4): 668-681, June 2011. DOI: [10.1016/j.mechatronics.2011.02.003](https://doi.org/10.1016/j.mechatronics.2011.02.003)
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Technical Conference Presentations

- CP8) D. S. Zalkind, L. Y. Pao, and C. J. Bay, "An Analysis of Peak Load Shaving Control Methods," *WindTech2017: Int. Conf. Future Technologies in Wind Energy*, Boulder, CO, Oct. 2017.
- CP7) M. N. Sinner and L. Y. Pao, "Individual and Collective Pitch Actuation using Lidar-Enabled Model Predictive Control," *WindTech2017: Int. Conf. Future Technologies in Wind Energy*, Boulder, CO, Oct. 2017.
- CP6) C. J. Bay, T. Taylor, J. Annoni, L. Y. Pao, and K. E. Johnson, "Distributed Model Predictive Control of Wind Farms for Power Tracking," *WindTech2017: Int. Conf. Future Technologies in Wind Energy*, Boulder, CO, Oct. 2017.
- CP5) D. S. Zalkind, L. Y. Pao, and D. T. Griffith, "Targeted Controls for a Segmented Ultralight Morphing Rotor," *Wind Energy Science Conf.*, Lyngby, Denmark, June 2017.
- CP4) J. W. van Wingerden, L. Y. Pao, and P. Fleming, "Closed-Loop Wind Farm Control," *Wind Energy Science Conf.*, Lyngby, Denmark, June 2017.
- CP3) M. N. Sinner and L. Y. Pao, "Model Predictive Control of Wind Turbines," *Wind Energy Science Conf.*, Lyngby, Denmark, June 2017.
- CP2) B. Shrestha, D. S. Zalkind, L. Y. Pao, V. Petrović, and M. Kühn, "Optimized Activation of Individual Pitch Controller," *Wind Energy Science Conf.*, Lyngby, Denmark, June 2017.

- CP1) L. Y. Pao and G. F. Franklin, "A Comparative Study of Proximate Time-Optimal Controllers for Type-2 Third-Order Servomechanisms," *ASME Winter Annual Meeting*, Atlanta, GA, Dec. 1991.

Invited (non-refereed) Technical Conference Papers

- W5) J. A. Butterworth, L. Y. Pao, and D. Y. Abramovitch, "GOALI: Control Architectures and Adaptive Model-Inverse Based Methods for Nonminimum-Phase Uncertain Systems, with Applications to Atomic Force Microscopes," *Proc. NSF Engineering Research and Innovation Conf.*, Honolulu, HI, 8 pages, June 2009.
- W4) D. Y. Abramovitch, S. B. Andersson, L. Y. Pao, and G. Schitter, "A Tutorial on the Control of Atomic Force Microscopes," *Proc. Agilent Technical Conf.*, pp. 132-136, Santa Clara, CA, Feb. 2007.
- W3) M. K. Kalandros and L. Y. Pao, "Sensor Management for Tracking Interacting Targets," *Proc. Workshop on Estimation, Tracking, Fusion, and Control: A Tribute to Yaakov Bar-Shalom*, Monterey, CA, pp. 221-248, May 2001.
- W2) L. Y. Pao, "Strategies for Shaping Commands in the Control of Flexible Structures," *Proc. Japan/USA/Vietnam Workshop on Research and Education in Systems, Computation, and Control Engineering*, Ho Chi Minh City, Vietnam, pp. 309-318, June 2000.
- W1) L. Y. Pao and D. A. Lawrence, "Synergistic Visual/Haptic Computer Interfaces," *Proc. Japan/USA/Vietnam Workshop on Research and Education in Systems, Computation, and Control Engineering*, Hanoi, Vietnam, pp. 155-162, May 1998.

Published Reviews

- R2) J. H. Laks and L. Y. Pao, "Review of *Optimal Control of Wind Energy Systems: Towards a Global Approach*, by I. Munteanu, A. I. Bratcu, N.-A. Cutululis, and E. Ceanga, Springer-Verlag, 2008," *IEEE Control Systems Magazine*, 29(3): 105-108, June 2009.
- R1) L. Y. Pao, "Review of *Computational Optimal Control*, R. Bulirsch & D. Kraft (Editors), *Int. Ser. Numer. Math.*, Vol. 115, Birkhauser, Basel, 1994," *AMS Mathematics of Computation*, Vol. 64, pp. 1758-1759, Oct. 1995.

Published Interviews

- M1) "People in Control: Rocky Mountain High," *IEEE Control Systems Magazine*, pp. 18-21, Dec. 2005.

Technical Reports

- T28) K. Dykes, P. Veers, E. Lantz, H. Holttinnen, O. Carlson, A. Touhy, A. M. Sempreviva, A. Clifton, J. Sanz Rodrigo, D. Berry, D. Laird, S. Carron, P. Moriraty, M. Marquis, C. Meneveau, J. Peinke, J. Paquette, N. Johnson, L. Pao, P. Fleming, C. Botasso, V. Lehtomaki, A. Robertson, M. Muskulus, J. Manwell, J. O. Tande, L. Sethuraman, O. Roberts, and J. Fields, "IEA Wind TCP: Results of IEA Wind TCP Workshop on a Grand Vision for Wind Energy Technology," International Energy Agency Technical Report, 138 pages, April 2019.
- T27) E. Simley and L. Y. Pao, "Blade Effective Wind Speed Estimates, Optimal Filtering Methods, and Spectral Models for Use in Wind Turbine Preview Control," National Renewable Energy Laboratory Technical Report, 81 pages, 2016.

- T26) F. Dunne and L. Y. Pao, "Benefit of Wind Turbine Preview Control as a Function of Measurement Coherence and Preview Time," National Renewable Energy Laboratory Technical Report, 39 pages, 2016.
- T25) J. Aho, L. Pao, P. Fleming, and E. Ela, "Controlling Wind Turbines for Secondary Frequency Regulation: An Analysis of AGC Capabilities under New Performance Based Compensation Policy," National Renewable Energy Laboratory Technical Report, NREL/CP-5D00-62815, Feb. 2015. Report available at <https://www.nrel.gov/docs/fy15osti/62815.pdf>.
- T24) D. Schlipf and L. Y. Pao, "Preview Control of Wind Turbines," in *IEEE Control Systems Society Impact of Control Technologies Report*, 2nd edition, T. Samad and A. Annaswamy (Eds.), 2014.
- T23) E. Ela, V. Gevorgian, P. Fleming, Y. C. Zhang, M. Singh, E. Muljadi, A. Scholbrock, J. Aho, A. Buckspan, L. Pao, V. Singhvi, A. Tuohy, P. Pourbeik, D. Brooks, and N. Bhatt, "Active Power Controls from Wind Power: Bridging the Gaps, National Renewable Energy Laboratory Technical Report, NREL/TP-5D00-60574, 154 pages, Jan. 2014. Report available at <http://www.nrel.gov/docs/fy14osti/60574.pdf>.
- T22) I. Girsang, J. Dhupia, E. Muljadi, M. Singh, and L. Pao, "Gearbox and Drive-Train Models for Studying the Dynamic Effects of Modern Wind Turbines," National Renewable Energy Laboratory Technical Report, NREL/CP-5500-58960, Oct. 2013. Report available at <http://www.nrel.gov/docs/fy14osti/58960.pdf>.
- T21) A. M. Annaswamy et al. (I am among 40 authors), *IEEE Vision for Smart Grid Controls: 2030 and Beyond*, 168 pages, July 2013, published by IEEE.
- T20) F. Dunne, D. Schlipf, and L. Y. Pao, "Comparison of Two Independent Lidar-Based Pitch Control Designs," National Renewable Energy Laboratory Technical Report, NREL/SR-5000-55544, 36 pages, Aug. 2012. Report available at <http://www.nrel.gov/docs/fy12osti/55544.pdf>.
- T19) E. Simley and L. Y. Pao, "LIDAR Wind Speed Measurements of Evolving Wind Fields," National Renewable Energy Laboratory Technical Report, NREL/SR-5000-55516, 41 pages, July 2012. Report available at <http://www.nrel.gov/docs/fy12osti/55516.pdf>
- T18) A. Buckspan, J. Aho, P. Fleming, Y. Jeong, and L. Y. Pao, "Combining Droop Curve Concepts with Control Systems for Wind Turbine Active Power Control," National Renewable Energy Laboratory Technical Report, NREL/CP-5000-55211, June 2012. Report available at <http://www.nrel.gov/docs/fy12osti/55211.pdf>.
- T17) J. Aho, A. Buckspan, J. Laks, P. Fleming, Y. Jeong, F. Dunne, M. Churchfield, L. Pao, and K. Johnson, "A Tutorial of Wind Turbine Control for Supporting Grid Frequency through Active Power Control," National Renewable Energy Laboratory Technical Report, NREL/CP-5000-54605, March 2012. Report available at <http://www.nrel.gov/docs/fy12osti/54605.pdf>.
- T16) F. Dunne, E. Simley, and L. Y. Pao, "LIDAR Wind Speed Measurement Analysis and Feedforward Blade Pitch for Load Mitigation in Wind Turbines," National Renewable Energy Laboratory Technical Report, NREL/SR-5000-52098, 53 pages, Oct. 2011. Report available at <http://www.nrel.gov/docs/fy12osti/52098.pdf>.
- T15) J. H. Laks, F. Dunne, and L. Y. Pao, "Feasibility Studies on Disturbance Feedforward Techniques to Improve Load Mitigation Performance in Wind Turbines," National Renewable Energy Laboratory Technical Report, NREL/SR-5000-48598, 52 pages, Dec. 2010. Report available at <http://www.nrel.gov/docs/fy11osti/48598.pdf>.

- T14) L. Y. Pao and M. K. Kalandros, "Computationally Efficient Algorithms for Managing Sensor Information that Incorporate Models of Data Association," Colorado Advanced Software Institute Technical Report, Nov. 2000.
- T13) L. Y. Pao, C. F. Cutforth, and M. A. Lau, "Precise Control of Elastic Components for Tape Systems," Colorado Advanced Software Institute Technical Report, CASI-TR-00-6, Nov. 1999.
- T12) L. Y. Pao, N. T. Baltz, and M. K. Kalandros, "Sensor Management in Centralized and Decentralized Multisensor Systems," Colorado Advanced Software Institute Technical Report, CASI-TR-99-7, Nov. 1998.
- T11) L. Y. Pao and M. K. Kalandros, "Control of Sensor Information in Centralized Multisensor Systems," Colorado Advanced Software Institute Technical Report, CASI-TR-98-10, Feb. 1998.
- T10) K. H. Kim, S. D. O'Neil, L. Y. Pao, and R. K. Saha, "Multisensor Fusion Algorithms for Tracking: Track-Level Algorithm Development," MITRE Technical Report, Sept. 1993.
- T9) L. Y. Pao, "Control of a Rigid Two-Link Planar Manipulator," MITRE Technical Report, Feb. 1993.
- T8) L. Y. Pao, S. D. O'Neil, S. Dhar, and D. J. Muder, "Multisensor Fusion Algorithms for Tracking: Algorithm Development," MITRE Technical Report, Feb. 1993.
- T7) K. R. King, S. D. O'Neil, L. Y. Pao, and K. H. Kim, "Multisensor Fusion Algorithms for Tracking: Parametric Studies," MITRE Technical Report, Feb. 1993.
- T6) L. Y. Pao and F. Hatch, "Test Report on an Anti-Lock Braking System Proportional Isolation Valve/Displacement Cylinder," Hughes Aircraft Company Report, Oct. 1987.
- T5) L. Y. Pao, "A Simple Servovalve and Actuator Model," Hughes Aircraft Company/General Motors Corporation Report, Aug. 1987.
- T4) F. Hatch and L. Y. Pao, "A Proportional Control System for an Anti-Lock Braking System," Hughes Aircraft Company/General Motors Corporation Report, Aug. 1987.
- T3) L. Y. Pao, "Tests for an Anti-Lock Braking System Modulator," Hughes Aircraft Company/General Motors Corporation Report, June 1987.
- T2) L. Y. Pao, "Preparation of Base Cases in Loss Calculation Studies," Pacific Gas & Electric Company Report, Sept. 1986.
- T1) L. Y. Pao, "A Study of the Effects of Different Annealing Conditions on the Coupling Factor of the Metallic Glass Alloy $Fe_{81}B_{13.5}Si_{3.5}C_2$," Naval Surface Warfare Center Report, Sept. 1984.

Tutorial and Invited Sessions (Refereed)

- S12) J.-W. van Wingerden, P. Fleming, D. Schlipf, K. Johnson, and L. Y. Pao, "Wind Turbine and Wind Farm Control: Challenges and Solutions," *IFAC World Congress*, Berlin, Germany, July 2020.
- S11) J.-W. van Wingerden, P. Fleming, D. Schlipf, K. Johnson, and L. Y. Pao, "Wind Turbine and Wind Farm Control: Challenges and Solutions," *IFAC World Congress*, Toulouse, France, July 2017.

- S10) L. Fagiano and L. Y. Pao, co-organizers, Tutorial Session on “Systems and Control Aspects in Wind Energy: State of the Art and Future Challenges,” *American Control Conf.*, Montreal, Canada, June 2012.
- S9) D. Y. Abramovitch, G. Clayton, A. Fleming, K. Leang, L. Y. Pao, and Q. Zou, co-organizers, Invited Session on “Control of Nanopositioning and Scanning Probe-Based Systems,” *American Control Conf.*, San Francisco, CA, June 2011.
- S8) D. Y. Abramovitch, G. Clayton, A. Fleming, K. Leang, L. Y. Pao, and Q. Zou, co-organizers, Two Invited Sessions on “Advances in Modeling and Control Methods for Nano-measurements,” *American Control Conf.*, Baltimore, MD, June 2010.
- S7) K. Leang, L. Y. Pao, Q. Zou, and A. Fleming, co-organizers, Three Invited Sessions on “Mechanism Dynamics, Design, and Control of Nanopositioning and Scanning Probe Microscopy Systems,” *American Control Conf.*, St. Louis, MO, June 2009.
- S6) L. Y. Pao and K. E. Johnson, co-organizers, Tutorial Session on “Dynamics and Control of Wind Turbines and Wind Farms,” *American Control Conf.*, St. Louis, MO, June 2009.
- S5) Q. Zou, L. Y. Pao, D. Y. Abramovitch, M. Steinbuch, K. Leang, and C. Su, co-organizers, Three Invited Sessions on “Modeling and Control of Scanning Probe Microscopes,” *American Control Conf.*, Seattle, WA, June 2008.
- S4) D. Y. Abramovitch, S. B. Andersson, L. Y. Pao, and G. Schitter, co-organizers, Tutorial Session on “A Tutorial on the Mechanisms, Dynamics, and Control of Atomic Force Microscopes,” *American Control Conf.*, New York, NY, July 2007.
- S3) L. Y. Pao and Y. Bar-Shalom, co-organizers, Tutorial Session on “Multisensor Management and Fusion Algorithms for Target Tracking,” *American Control Conf.*, Boston, MA, June-July 2004.
- S2) L. Y. Pao, organizer, Invited Session on “Haptic Interfaces,” *IFAC Conf. Mechatronic Systems*, Berkeley, CA, Dec. 2002.
- S1) L. Y. Pao, organizer, Invited Session on “Control of Flexible Structures,” *IFAC Conf. Mechatronic Systems*, Berkeley, CA, Dec. 2002.

Plenary Lectures

- P10) “Design and Control of Extreme-Scale Wind Turbines,” Nyquist Lecture, *ASME Dynamic Systems and Control Conference*, Park City, UT, Oct. 2019.
- P9) “Control of Wind Turbines and Wind Farms,” Texas Systems Day, Dallas, TX, Apr. 2018.
- P8) “Active Power Control of Wind Turbines and Wind Farms,” *Congreso Nacional de Control Automático*, Monterrey, Mexico, Oct. 2017.
- P7) “Challenges and Opportunities in Integrating Large Amounts of Wind and Solar Energy into Utility Grids,” *Alpbach Technology Symposium*, Alpbach, Austria, Aug. 2016.
- P6) “Combined Feedforward/Feedback Control of Flexible Structures: Recurring Themes across Diverse Applications,” *American Control Conference*, Boston, MA, July 2016.
- P5) “Controlling Wind Energy for Utility Grid Reliability,” *IEEE Conference on Decision and Control*, Florence, Italy, Dec. 2013.
- P4) “Wind Energy Control and Grid-Related Issues,” *IEEE Power and Energy Conference at Illinois*, University of Illinois at Urbana-Champaign, Feb. 2013.

- P3) "Control of Wind Turbines: Accomplishments and Continuing Challenges," *ASME Dynamic Systems and Control Conference*, Ft. Lauderdale, FL, Oct. 2012.
- P2) "Control of Wind Turbines: Accomplishments and Challenges," *ASME International Mechanical Engineering Congress & Exposition*, Denver, CO, Nov. 2011.
- P1) "Control of Flexible Structures: From Large Space Structures to Disk Drive Read/Write Arms," *IEEE Conference on Decision and Control*, San Diego, CA, Dec. 2006.

Keynote Lectures

- K5) "Wind Energy Control and Grid Integration Issues," *Society of Instrumentation and Control Engineers Annual Conference*, Nagoya, Japan, Sep. 2013.
- K4) "Control of Wind Turbines: Accomplishments and Challenges," *Chinese Control and Decision Conference*, Taiyuan, China, May 2012.
- K3) "Architectures for Tracking Control in Atomic Force Microscopes," *IFAC World Congress*, Seoul, Korea, July 2008.
- K2) "Strategies for Shaping Commands in the Control of Flexible Structures," *Japan, USA, and Vietnam Workshop on Research and Education in Systems, Computation and Control Engineering*, Ho Chi Minh City, Vietnam, June 2000.
- K1) "Synergistic Visual-Haptic Computer Interfaces," *Japan, USA, and Vietnam Workshop on Research and Education in Systems, Computation and Control Engineering*, Hanoi, Vietnam, May 1998.

Invited Presentations

- 121) *Design and Control of Extreme-Scale Wind Turbines*, Embry-Riddle Aeronautical University, Prescott, AZ, January 2020.
- 120) *Design and Control of Extreme-Scale Wind Turbines*, University of Colorado Boulder, October 2019.
- 119) *Design and Control of Extreme-Scale Wind Turbines*, Fraunhofer Institute for Wind Energy Systems (IWES), Bremerhaven, Germany, August 2019.
- 118) *Control of Wind Turbines and Wind Farms: Continuing Opportunities and Challenges*, Ruhr University of Bochum, Germany, July 2019.
- 117) *Challenges and Initial Results in Validating Novel Wind Turbine Designs and Controllers*, Keynote talk, ForWind Wind Physics Symposium, Oldenburg, Germany, July 2019.
- 116) *Boosting Wind and Solar Energy (SDG 7): Opportunities and Technological Challenges*, invited talk, Austrian Academy of Sciences International Symposium on "Global Sustainable Development Goals in a Mediatized World," Vienna, Austria, Apr. 2019.
- 115) *Winds of Progress*, Invited Lecture, Symposium on the Heart of Science and Art, Hanse-Wissenschaftskolleg, Institute of Advanced Study, Delmenhorst, Germany, Sep. 2018.
- 114) *Control of Wind Turbines and Wind Farms*, Johns Hopkins University, Mar. 2018.
- 113) *Challenges and Opportunities in Integrating Large Amounts of Wind and Solar Energy into Utility Grids*, Frontiers in Systems and Control Workshop, Institute for Advanced Study, City University of Hong Kong, Aug. 2017.

- 112) *Active Power Control of Wind Turbines and Wind Farms*, Technical University of Vienna, Austria, June 2017.
- 111) *Active Power Control of Wind Farms*, ForWind Symposium 2017: Results from Wind Physics, Oldenburg, Germany, June 2017.
- 110) *Closed-Loop Active Power Control of Wind Farms*, Universität Stuttgart, Germany, May 2017.
- 109) *Challenges and Opportunities in Integrating Large Amounts of Wind Energy while Maintaining Utility Grid Reliability*, Next Energy, Oldenburg, Germany, Apr. 2017.
- 108) *Closed-Loop Active Power Control of Wind Farms*, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, March 2017.
- 107) *Challenges and Opportunities in Integrating Large Amounts of Wind and Solar Energy into Utility Grids*, Fellow Lecture, Hanse-Wissenschaftskolleg, Institute of Advanced Study, Delmenhorst, Germany, Jan. 2017.
- 106) *Integration of Large Amounts of Wind Energy While Maintaining Utility Grid Reliability*, Institute of Physics Colloquium, Oldenburg University, Germany, Jan. 2017.
- 105) *Active Power Control of Wind Turbines and Wind Farms*, Delft Center for Systems and Control, Technical University of Delft, The Netherlands, Dec. 2016.
- 104) *Control of Wind Turbines and Wind Farms*, ForWind Center for Wind Energy Research, Oldenburg University, Germany, Nov. 2016.
- 103) *Control of Atomic Force Microscopes to Achieve Faster Imaging*, Boston University, Oct. 2016.
- 102) *Controlling Wind Turbines and Wind Farms for Utility Grid Reliability*, Boston University, Sept. 2016.
- 101) *Combined Feedforward/Feedback Control of Flexible Structures: Recurring Themes across Diverse Applications*, University of Colorado Boulder, Apr. 2016.
- 100) *Integration of Large Amounts of Wind Energy While Maintaining Utility Grid Reliability*, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, March 2016.
- 99) *Integration of Large Amounts of Wind Energy While Maintaining Utility Grid Reliability*, Japan Science and Technology Agency (JST) Creating Revolutionary Engineering and Science Technology (CREST) Workshop on *Principle Design, Experimental Proof, Implementation and Policy Recommendation to Establish Energy Supply-Demand Networks based on Integration of Economic Models and Physical Models*, Keio University, Japan, Nov. 2015.
- 98) *Controlling Wind Energy for Utility Grid Reliability: Demonstrated Capabilities and Continuing Challenges*, Universität Stuttgart, Germany, June 2015.
- 97) *Controlling Wind Turbines to Reduce the Cost of Wind Energy and to Increase Utility Grid Reliability*, Princeton University, Feb. 2015.
- 96) *Control of Wind Turbines to Reduce the Cost of Wind Energy and to Increase Utility Grid Reliability*, **Annual Kurtz Lecture**, University of Iowa, Oct. 2014.
- 95) *Control of Flexible Structures: From Atomic Force Microscopes to Megawatt Wind Turbines*, The Beauty of Controls Workshop for Middle and High School Students and Teachers, held at the American Control Conference, Portland, OR, June 2014

- 94) *Control of Wind Turbines to Reduce the Cost of Wind Energy and to Increase Utility Grid Reliability*, **Mercer Distinguished Lecture**, Rensselaer Polytechnic Institute, Mar. 2014.
- 93) *Control of Wind Turbines with Preview Measurements of Upstream Wind Speeds*, Risø National Laboratory for Sustainable Energy at the Technical University of Denmark, Dec. 2013.
- 92) *Combined Feedforward and Feedback Control of Wind Turbines*, Lund Center for Control of Complex Engineering Systems, Lund University, Sweden, Dec. 2013.
- 91) *Controlling Wind Energy for Utility Grid Reliability*, University of Colorado Boulder, Dec. 2013.
- 90) *Control of Wind Turbines: Accomplishments and Continuing Challenges*, Tokyo Institute of Technology, Japan, Sept. 2013.
- 89) *Control of Flexible Structures: From Atomic Force Microscopes to Megawatt Wind Turbines*, IBM Research – Zurich, Switzerland, July 2013.
- 88) *Wind Energy Control and Grid Integration Challenges*, University of Denver, April 2013.
- 87) *Wind Energy Control and Grid-Related Issues*, University of Colorado Boulder Alumni Breakfast Series, held at the National Renewable Energy Laboratory, April 2013.
- 86) *Control of Wind Turbines: Accomplishments and Continuing Challenges*, University of Colorado Boulder, Oct. 2012.
- 85) *Control of Wind Turbines and Wind Farms*, Boston University, Sept. 2012.
- 84) *Game Theoretic Approaches for Wind Farm Control*, Center for Research and Education in Wind Annual Symposium, Fort Collins, CO, Aug. 2012.
- 83) *Combined Feedforward/Feedback Control of Wind Turbines*, Chinese Academy of Sciences, Beijing, China, May 2012.
- 82) *Control of Wind Turbines: Accomplishments and Challenges*, Tsinghua University, China, May 2012.
- 81) *Wind Turbine Control Research*, Singapore Workshop on Offshore Renewables, Feb. 2012.
- 80) *Control of Wind Turbines: Accomplishments and Challenges*, Technical University – Eindhoven, The Netherlands, Dec. 2011.
- 79) *Control of Wind Turbines: Accomplishments and Challenges*, Universität Stuttgart, Germany, Nov. 2011.
- 78) *Control of Wind Turbines: Accomplishments and Challenges*, **Distinguished Lecture**, IEEE Denver Section, Nov. 2011.
- 77) *Control of Wind Turbines: Accomplishments and Challenges*, **Distinguished Lecture**, IEEE Control Systems Society Webinar, Nov. 2011.
- 76) *Development of Novel Ice Sensing and Active De-Icing Method for Wind Turbines*, Center for Research and Education in Wind Annual Symposium, Golden, CO, Aug. 2011.
- 75) *Control of Wind Turbines: Accomplishments and Challenges*, Agilent Technologies, Santa Clara, CA, June 2011.
- 74) *Control of Wind Turbines: Accomplishments and Challenges*, University of California at Los Angeles, Apr. 2011.

- 73) *Control of Wind Turbines: Accomplishments and Challenges*, University of Minnesota, Mar. 2011.
- 72) *Control of Wind Turbines: Accomplishments and Challenges*, University of California at Santa Barbara, Feb. 2011.
- 71) *Feasibility Study of Control of Novel Active Coating Materials for Preventing Icing on Wind Turbine Blades*, Center for Research and Education in Wind Annual Symposium, Golden, CO, Aug. 2010.
- 70) *Combined Feedforward/Feedback Control of Flexible Structures: from Atomic Force Microscopes to Megawatt Wind Turbines*, **Distinguished Lecture**, University of British Columbia, Vancouver, Canada, Mar. 2010.
- 69) *A Tutorial on the Control of Wind Turbines and Wind Farms*, **Distinguished Lecture**, IEEE Centennial Section, Fort Collins, CO, Jan. 2010.
- 68) *A Tutorial on the Control of Wind Turbines and Wind Farms*, **Distinguished Lecture**, IEEE Illinois Section, Nov. 2009.
- 67) *What do Imaging at the Nanoscale and Megawatt Wind Turbines Have in Common*, **CU Seminar**, University of Colorado Boulder, Oct. 2009.
- 66) *Haptic Interfaces: Making Touch Interfaces More Interactive*, **Distinguished Lecture**, Andres Bello University, Chile, Oct. 2009.
- 65) *Combined Feedforward/Feedback Control of Flexible Structures, with Applications Ranging from Atomic Force Microscopes to Megawatt Wind Turbines*, **Distinguished Lecture**, University of Santiago, Chile, Oct. 2009.
- 64) *A Tutorial on the Control of Wind Turbines and Wind Farms*, **Distinguished Lecture**, Catholic University of Valparaiso, Chile, Oct. 2009.
- 63) *Control of Flexible Structures: From Atomic Force Microscopes to Megawatt Wind Turbines*, **Inaugural Mechanical Engineering Department Seminar**, University of Texas at Dallas, Sept. 2009.
- 62) *Combined Feedforward and Feedback Control Architectures for Maneuvering Flexible Structures*, Department of Mechanical Engineering, University of California at Berkeley, Oct. 2008.
- 61) *Control of Flexible Structures*, Stanford University, CA, Oct. 2008.
- 60) *Interesting Connections in the Control of Systems Across Multiple Scales: From Megawatt Wind Turbines down to Atomic Force Microscopes*, Miller Institute for Basic Research in Science, University of California at Berkeley, Oct. 2008.
- 59) *Control of Flexible Structures: From Atomic Force Microscopes to Megawatt Wind Turbines*, Iowa State University, Mar. 2008.
- 58) *Reliable Track Loss Detection in Multisensor Fusion Algorithms*, Pennsylvania State University, Oct. 2007.
- 57) *Combined Feedforward/Feedback Control of Flexible Structures*, University of Illinois at Urbana-Champaign, Apr. 2007.
- 56) *Control of Flexible Structures: From Large Space Structures to Disk Drive Read/Write Arms*, University of Colorado Boulder, Dec. 2006.
- 55) *Feedback and Feedforward Control Techniques for Flexible Structures*, Colorado School of Mines, Nov. 2006.
- 54) *Multisensor Fusion Algorithms for Tracking Applications*, University of Wyoming, Apr. 2006.

- 53) *An Overview of Selected Research in Multisensor Fusion and Haptic Interfaces*, National Taiwan University, Nov. 2005.
- 52) *Haptic Interfaces*, US-Japan Workshop on Sensors, Smart Structures, and Mechatronic Systems, Tokyo, Japan, Nov. 2005.
- 51) *Haptic Interfaces: Making Touch Interfaces More Interactive*, IEEE Presents – Innovation and Technology in Colorado, Colorado Tech Week, Denver, CO, Oct. 2005.
- 50) *Multisensor Data Fusion Techniques for Effectively Tracking Multiple Targets Using Multiple Sensors*, **Eminent Speaker Series**, University of Virginia, Apr. 2005.
- 49) *Low-Cost Haptic Interfaces for Enhancing Spatial Understanding and Communication*, Accessing Higher Ground Conference: Assistive Technology and Accessible Media in Higher Education, Boulder, CO, Nov. 2004.
- 48) *Tracking Protocols and Sensor Management for Active Safety Technologies*, University of Colorado Technology Transfer Office Proof-of-Concept Workshop, Sept. 2004.
- 47) *Multisensor Fusion Algorithms for Tracking Applications*, Kirtland Air Force Base, NM, July 2004.
- 46) *Haptic Interfaces for Spatial Learning*, Accessing Higher Ground Conference: Assistive Technology and Accessible Media in Higher Education, Boulder, CO, Nov. 2003.
- 45) *Speed and Tension Control in Tape Systems*, Carnegie Mellon University, PA, Oct. 2003.
- 44) *Distributed Multisensor Tracking of Interacting Targets in Cluttered Environments*, Orincon Corporation, VA, Apr. 2003.
- 43) *Variance Estimation and Ranking with Applications to Target Tracking Algorithms*, George Mason University, VA, Apr. 2003.
- 42) *Scientific Visualization Using Visual/Haptic Rendering Modes*, Catholic University of America, Washington, D.C., Mar. 2003.
- 41) *Haptic Interfaces for Conveying Spatial Ideas*, Joint Annual Meeting of the National Science Foundation's Human Resources Division, Arlington, VA, Mar. 2003.
- 40) *Using Combined Visual/Haptic Rendering Modes for More Effective Scientific Visualization*, University of Southern California, Oct. 2002.
- 39) *Multisensor Fusion Algorithms for Target Tracking*, Harvard University, MA, Apr. 2002.
- 38) *Enhancing Scientific Visualization by Combining Traditional Graphical Interfaces with Haptic Interfaces*, Harvard University, MA, Mar. 2002.
- 37) *Combined Feedforward/Feedback Methods for Effectively Slewing Flexible Structures*, Harvard University, MA, Feb. 2002.
- 36) *Strategies for Effectively Controlling Flexible Structures*, Massachusetts Institute of Technology, Feb. 2002.
- 35) *Sensor Fusion Techniques for Tracking Multiple Targets in Cluttered Environments*, Alphatech, Inc., MA, Feb. 2002.
- 34) *Efficient and Effective Ways of Processing Sensor Information for Tracking Targets in Cluttered Environments*, University of Connecticut, Nov. 2001.
- 33) *Exploring Complex Data Sets More Efficiently and Naturally Using Combined Visual/Haptic Interfaces*, Harvard University, MA, Sept. 2001.

- 32) *Managing Sensor Information in Tracking Applications*, DARPA Sensor Fusion Workshop, Providence, RI, Sept. 2001.
- 31) *Visual/Haptic Scientific Visualization of Complex Multi-Dimensional Data*, Purdue University, Aug. 2001.
- 30) *Effectively Allocating and Using Sensor Resources in Target Tracking Applications*, Air Force Research Laboratories, Dayton, OH, Mar. 2001.
- 29) *Enhancing Scientific Visualization by Augmenting Traditional Graphical Rendering with Haptic Rendering Modes*, Colorado School of Mines, Feb. 2001.
- 28) *Synergistic Visual/Haptic Computer Interfaces for Scientific Visualization*, Brigham Young University, UT, Oct. 2000.
- 27) *Combined Visual/Haptic Rendering Modes for Scientific Visualization*, University of California at Berkeley, Sept. 2000.
- 26) *Reducing Vibration in Flexible Structures by Altering the Control Command*, Quantum Corporation, Shrewsbury, MA, May 2000.
- 25) *Sensor Fusion and Management Algorithms for Target Tracking*, Harvard University, MA, May 2000.
- 24) *Input Shaping Methods for Vibration Reduction in Flexible Structures*, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland, April 2000.
- 23) *Distributed Multisensor Multitarget Tracking Algorithms*, ONR Winter Unmanned Autonomous Vehicles Workshop, Arlington, VA, Jan. 2000.
- 22) *Multisensor Fusion and Sensor Management Algorithms*, ONR Summer Unmanned Autonomous Vehicles Workshop, Berkeley, CA, Aug. 1999.
- 21) *Multisensor Fusion Algorithms for Tracking Applications*, ONR Winter Unmanned Autonomous Vehicles Workshop, Monterey, CA, Jan. 1999.
- 20) *Distributed Multisensor Fusion Algorithms for Tracking Applications*, ONR Summer Unmanned Autonomous Vehicles Workshop, Los Angeles, CA, July 1998.
- 19) *Multisensor Multitarget Tracking*, Computational Sciences Branch, Naval Air Warfare Center, China Lake, CA, July 1998.
- 18) *Strategies for Shaping Commands for Rapid and Robust Control of Flexible Structures*, University of Washington, Jan. 1998.
- 17) *Effectively Managing and Using Sensor Information in Tracking Applications*, University of Minnesota, Jan. 1998.
- 16) *Altering Control Inputs to Reduce Residual Vibration in Flexible Structures*, University of Minnesota, Jan. 1998.
- 15) *Minimizing Residual Vibration in the Control of Flexible Structures*, University of California at Irvine, Sept. 1997.
- 14) *Input Shaping Strategies in the Control Flexible Structures*, University of Colorado Boulder, Sept. 1997.
- 13) *Input Shaping Design for Flexible Systems with Multiple Actuators*, Massachusetts Institute of Technology, May 1996.
- 12) *Current Research in the Areas of Control of Flexible Structures and Multisensor Data Fusion*, University of Colorado Boulder, Oct. 1995.
- 11) *Rapid and Robust Control of Flexible Structures*, New Jersey Institute of Technology, Sept. 1995.

- 10) *Robust Near Time-Optimal Control of Flexible Structures*, University of Colorado Boulder, Apr. 1995.
- 9) *Multisensor Fusion Algorithms for Tracking Applications*, University of Colorado Boulder, Mar. 1995.
- 8) *Measurement-Level Multisensor Fusion Algorithms*, University of Illinois, Apr. 1993.
- 7) *Design for Robust Controls Having Almost Minimum Time Response*, Northwestern University, IL, Mar. 1993.
- 6) *Design for Rapid and Robust Controllers*, Princeton University, NJ, Feb. 1993.
- 5) *Multisensor Mixture Reduction Algorithms for Tracking Multiple Objects*, Wayne State University, MI, Jan. 1993.
- 4) *Near Time-Optimal Servomechanisms*, Draper Laboratories, MA, July 1991.
- 3) *Proximate Time-Optimal Controllers for Higher-Order Systems*, The MITRE Corporation, MA, June 1991.
- 2) *Proximate Time-Optimal Feedback Controllers*, Massachusetts Institute of Technology, May 1991.
- 1) *Robust Time-Optimal Feedback Systems*, Integrated Systems, Inc., Santa Clara, CA, Apr. 1991.

Short Course Taught

"Design of High-Performance Disk Drive Servo Systems," to servo system engineers and managers of Industrial Member Companies of the Colorado Center for Information Storage, co-taught with Dale A. Lawrence, July 2001.

Best Presentations of the Session Awards Received

For my presentations:

- American Control Conference, San Diego, CA, June 1999
- AIAA Guidance, Navigation, and Control Conference, Monterey, CA, Aug. 1993
- American Control Conference, San Francisco, CA, June 1993

For my students' presentations of our joint papers:

- F. Dunne, American Control Conference, Portland, OR, June 2014
- B. P. Rigney, American Control Conference, St. Louis, MO, June 2009
- H. Zhong, American Control Conference, Seattle, WA, June 2008
- J. A. Butterworth, American Control Conference, New York, NY, July 2007
- W. Khawsuk, American Control Conference, Boston, MA, July 2004
- L. Trailović, American Control Conference, Denver, CO, June 2003
- C. La-orpacharapan, 2 best presentation awards, American Control Conference, Denver, CO, June 2003
- M. D. Baumgart, American Control Conference, Denver, CO, June 2003
- M. D. Baumgart, American Control Conference, Arlington, VA, June 2001
- L. Trailović, American Control Conference, San Diego, CA, June 1999
- N. T. Baltz, American Control Conference, San Diego, CA, June 1999
- C. F. Cutforth, American Control Conference, Philadelphia, PA, June 1998

Sessions Chaired at Technical Conferences

- American Control Conference, June 2018
 - “Advanced Flow Control of Wind Farms” (chair)
- IFAC World Congress, July 2017
 - “Wind Turbine and Wind Farm Control: Control Challenges and Solutions” (co-chair)
- American Control Conference, June 2013
 - Chaired/Co-chaired 2 semi-plenary, 1 plenary, and 1 public lecture sessions
 - Gave introductory and brief remarks (as General Chair of the overall conference) at numerous meetings, receptions, and workshops
- IEEE Conference on Decision and Control, Dec. 2012
 - “Energy Systems II” (chair)
- American Control Conference, June 2012
 - “Systems and Control Aspects in Wind Energy” (co-chair)
- Joint IEEE Conference on Decision and Control and European Control Conference, Dec. 2011
 - “Optimization II” (chair)
- ASME International Mechanical Engineering Congress and Exposition, Nov. 2011
 - “Symposium on Servo and Control in Mechatronic Applications” (chair)
- AIAA Aerospace Sciences Meeting, Jan. 2011
 - “Wind Turbine Controls” (co-chair)
- IEEE Conference on Decision and Control, Dec. 2010
 - “Optimization III” (co-chair)
 - “Nonlinear Systems II” (co-chair)
- American Control Conference, June 2010
 - “Filtering” (chair)
- American Control Conference, June 2009
 - “Feedforward Control of Nanopositioning and SPM Systems” (co-chair)
 - “A Tutorial on the Control of Wind Turbines and Wind Farms” (chair)
- IFAC Triennial World Congress, July 2008
 - “Estimation and Control of States and Disturbances in Mechatronic Systems” (chair)
- American Control Conference, June 2008
 - “Control of Atomic Force Microscopes” (chair)
- American Control Conference, July 2007
 - “Command Shaping to Reduce Residual Vibration” (co-chair)
- American Control Conference, June 2006
 - “Adaptive Systems II” (co-chair)

- American Control Conference, June 2005
 - “New Techniques in Command Shaping for Vibration Suppression” (chair)
 - “Mechanical Systems and Robotics” (chair)
- IEEE Conference on Decision and Control, Dec. 2004
 - “Nonlinear Control Applications” (co-chair)
- IEEE Conference on Decision and Control, Dec. 2003
 - “Noise and Vibration Control” (chair)
- American Control Conference, June 2003
 - “Concurrent Feedback Control Design and Command Shaping” (co-chair)
- IEEE Conference on Decision and Control, Dec. 2002
 - “Stochastic Systems” (chair)
 - “Systems with Nonlinear Dynamics” (chair)
- IFAC Conference on Mechatronic Systems, Dec. 2002
 - “Control of Flexible Structures I” (chair)
 - “Control of Flexible Structures II” (chair)
 - “Haptic Interfaces” (chair)
- American Control Conference, May 2002
 - “Estimation” (chair)
 - “Aerospace and Flexible Structures” (chair)
 - “Time-Varying Estimation” (chair)
- American Control Conference, June 2001
 - “Applications of Optimization II” (chair)
 - “Control of Disk Drives II” (chair)
- American Control Conference, June 2000
 - “Control of Flexible Structures” (chair)
 - “Target Tracking” (chair)
- Japan/USA/Vietnam Workshop on Research and Education in Systems, Computation, and Control Engineering, June 2000
 - “Research and Education in Control Engineering & Mechatronics” (chair)
- American Control Conference, June 1999
 - “Estimation Applications II” (co-chair)
 - “Control of Structures” (chair)
- AIAA Guidance, Navigation, and Control Conference, Aug. 1998
 - “Innovative Approaches to Flexible Structure Control” (co-chair)
- American Control Conference, June 1998
 - “Flexible Structures” (chair)

- American Control Conference, June 1997
 - “Robotic Systems Control” (chair)
 - “Flexible Structures II” (chair)
- IEEE Conference on Control Applications, Sept. 1995
 - “Robotics: Software and Modelling” (chair)
- American Control Conference, June 1995
 - “Estimation and Tracking” (chair)
 - “Flexible Structures” (chair)
 - “Multisensor Fusion” (co-chair)
- American Control Conference, June 1993
 - “H-infinity for Discrete/Sampled Data Systems” (chair)

Grants Awarded

64. Department of Energy/Advanced Research Projects Agency – Energy
Ultraflexible Smart Floating Offshore Wind Turbines (USFLOWT)
 (PI: S. Srinivas; Co-PIs: R. Damiani, K. Johnson, E. Loth, and L. Pao)
 2/2020 – 1/2022, \$1,500,000 (CU Boulder share is \$200,000)
63. Department of Energy/National Renewable Energy Laboratory
Advanced Controls Development for Floating Offshore Wind Turbines and Wind Farms
 10/2019 – 9/2020, \$198,576
62. Department of Energy/Advanced Research Projects Agency – Energy
Cost Extension: 25 MW Segmented Outboard Articulating Rotor (SOAR) Design
 (PI: E. Loth; Co-PIs: R. Blom, R. Damiani, D. Griffith, K. Johnson, L. Pao, and M. Selig)
 10/2019 – 12/2021, \$2,199,766 (CU Boulder share is \$220,178)
61. National Science Foundation
Planning Grant: Wind Integrated with Storage for Energy Resilience (WISER)
 (PI: E. Loth; Co-PIs: D. Gayme, L. Pao, D. Sadoway, and S. Smith)
 9/2019 – 8/2020, \$100,000
60. College of Engineering and Applied Science Autonomous Systems Interdisciplinary
 Research Theme
*Mobile Sensing using UAVs to Enable Accurate Wind Field Estimation Across Wind Farms:
 Extensions to Large Wind Farms, Multiple UAVs, and Time-Varying Wind Fields*
 (PI: L. Pao; Co-PI: M. Nicotra)
 1/2019 – 6/2020, \$13,493
59. Department of Energy/National Renewable Energy Laboratory
Advanced Controls Development for Floating Offshore Wind Turbines
 10/2018 – 9/2020, \$112,300
58. National Science Foundation
*Planning Grant: Engineering Research Center for Wireless Power (WiPOWER) for a Cordless
 World*
 (PI: S. Priya; Co-PIs: K. Ngo, L. Pao, and S. Wang)
 9/2018 – 8/2020, \$100,000

57. College of Engineering and Applied Science Autonomous Systems Interdisciplinary Research Theme
Guiding Autonomous Systems by Real-Time Characterization of Spatial Field Structures
(PI: U. Herzfeld; Co-PIs: B. Argrow, C. Dixon, and L. Pao)
5/2018 – 12/2018, \$17,698

56. College of Engineering and Applied Science Autonomous Systems Interdisciplinary Research Theme
Mobile Sensing using UAVs to Enable Accurate Wind Field Estimation Across Wind Farms: Feasibility Study
(PI: L. Pao; Co-PIs: C. Bay, C. Dixon, and U. Herzfeld)
5/2018 – 12/2018, \$8,000

55. Envision Energy
Model Predictive Control of Wind Turbines
10/2016 – 3/2019, \$221,518

54. Sponsor has requested to remain anonymous
Combined Feedforward and Feedback Control of Tape Systems using a Data-Driven Model for Predicting Lateral Tape Motion
9/2016 – 12/2018, \$75,000

53. Department of Energy/Advanced Research Projects Agency – Energy
50 MW Segmented Ultralight Morphing Rotors (SUMR) for Wind Energy
(PI: E. Loth; Co-PIs: D. Griffith, K. Johnson, P. Moriarty, L. Pao, and M. Selig)
4/2016 – 9/2019, \$3,569,580 (CU Boulder share is \$525,048)

52. US-Israel Binational Science Foundation
Previewed Disturbance Rejection with Application to the Control of Wind Turbines
(with M. Krystalny at Technion – Israel Institute of Technology)
9/2013 – 9/2016, \$109,800 (CU Boulder share is \$51,818)

51. Department of Energy/National Renewable Energy Laboratory
Development and Evaluation of Wind Turbine Lidar-Based Feedforward Controls
6/2013 – 9/2018, \$296,273

50. National Science Foundation
Collaborative Research: High-Speed Atomic Force Microscopy through Compressed Sensing
(with S. B. Andersson at Boston University)
9/2012 – 8/2017, \$233,708 (CU-Boulder share), with \$10,000 REU supplement

49. Department of Energy/National Renewable Energy Laboratory
Studying the Ability of Wind Turbines to Provide Advanced Power Control
1/2012 – 3/2016, \$292,983

48. Sponsor has requested to remain anonymous
Lidar-Based Control of Wind Turbines
10/2011 – 12/2012, \$251,196

47. Air Force Research Laboratory
Data Association and Sensor Management Algorithms for Tracking Applications
 (Co-PI: T. D. Murphey)
 10/2008 – 9/2011, \$250,000,
 with an additional \$300,000 supplement received for *Space-Based Search-Detect-Track* for
 9/2011 – 9/2013, (Co-PIs on supplement: G. Born, H. Schaub, and P. Axelrad)
46. Center for Research and Education in Wind
An Innovative Approach to the Design and Control of Wind Farms
 (PI: J. R. Marden; Co-PI: L. Y. Pao)
 8/2011 – 5/2013, \$25,000
45. Department of Energy/National Renewable Energy Laboratory
Development and Evaluation of Advanced Feedforward Controls for Wind Turbines
 1/2011 – 7/2013, \$220,000
44. Center for Research and Education in Wind/Colorado Center for Information Storage
*Feasibility Study of Control of Novel Active Coating Materials for Preventing Icing on Wind
 Turbine Blades*
 (PI: L. Y. Pao; Co-PI: R. R. McLeod)
 8/2010 – 7/2013, \$52,000
43. Department of Energy/National Renewable Energy Laboratory
Windplant Systems Engineering Analysis and Optimization
 4/2010 – 1/2011, \$60,000
42. Department of Energy/National Renewable Energy Laboratory
Offshore Wind Energy Technology and Challenges
 9/2009 – 6/2010, \$20,000
41. Sponsor has requested to remain anonymous
Lidar-Based Control of Wind Turbines: Feasibility Study
 (Co-PIs: R. G. Frehlich and K. E. Johnson)
 7/2009 – 7/2011, \$287,849
40. Department of Defense, SBIR
A Novel and Integrated Framework for Sensor Registration and Sensor Management
 (PI: C. Kwan, Co-PIs: L. Y. Pao and H. Leung)
 3/2009 – 9/2009, \$100,000
39. Information Storage Industries Consortium/Sun Microsystems/Colorado Center for
 Information Storage/Oracle Corporation
High-Bandwidth High-Precision Tape System Control
 1/2009 – 12/2012, \$220,500
38. Department of Energy/National Renewable Energy Laboratory
Advanced Controls for Wind Turbines
 1/2009 – 7/2011, \$219,358
37. University of Colorado Innovative Seed Grant Program
High-Speed Precision Motion Control for Near-Field Optical Microscopy and Lithography
 (Co-PI: R. R. McLeod)
 9/2008 – 6/2011, \$43,500

36. National Science Foundation
GOALI: Control Architectures and Adaptive Model-Inverse Based Methods for Nonminimum Phase Uncertain Systems, with Applications to Atomic Force Microscopes
 (Co-PI: D. Y. Abramovitch)
 7/2007 – 6/2012, \$250,000,
 with an additional \$50,728 Graduate Research Supplement received for 8/2009 – 6/2012
35. University of Colorado/National Renewable Energy Laboratory Energy Initiative
 Design of Lidar, Data Processing, and Control Algorithms for Optimal Wind Farm Performance
 (PI: R. G. Frehlich; Co-PI: L. Y. Pao)
 7/2007 – 12/2008, \$60,000
34. Air Force Office of Scientific Research/Air Force Research Laboratories
Data Association Algorithms for Tracking Satellites
 3/2007 – 9/2008, \$100,000
33. Agilent Technologies, Inc.
Control of Atomic Force Microscopes to Achieve Faster Sample Measurements
 11/2006 – 10/2009, \$139,964 (plus an atomic force microscope testbed equipment loan of approximately \$180,000)
32. Department of Education
Graduate Assistance in Areas of National Need (GAANN): Disaster-Tolerant and Interoperable Communications
 (Director: M. Varanasi; Co-Director: L. Y. Pao; Co-PIs: Y. Liu and T. X Brown)
 8/2006 – 8/2009, \$1,097,829
31. Sentina Systems, Inc.
Sensor Management Protocol for a Class of Hybrid Sensor Suites
 5/2005 – 4/2007, \$60,000
30. University of Colorado College of Engineering Engineering Excellence Fund, with matching from National Instruments Corporation and the Electrical & Computer Engineering and Aerospace Engineering Sciences Departments
Development of Hardware Control Experiments
 (PI: T. D. Murphey; Co-PIs: L. Y. Pao and D. A. Lawrence)
 5/2005 – 8/2006, \$85,000
29. Maxtor Corporation
Time Optimal Repetitive Control Algorithms
 (Co-PI: D. A. Lawrence)
 12/2004 – 11/2007, \$75,600
28. Colorado Center for Information Storage/Quantum Corporation
Rapid Slewing of Flexible Components
 9/2004 – 8/2006, \$47,000
27. Colorado Center for Information Storage/Quantum Corporation
Control of Tape Systems Accounting for Reel Eccentricities
 3/2004 – 8/2005, \$123,400

26. Lockheed Martin Federal Systems, Inc.
SBIRS (Space Based Infrared System) Analysis and Algorithm Development
(PI: G. Born; Co-PI: L. Y. Pao)
11/2003 – 2/2004, \$60,000
25. National Science Foundation
Projected Phase-Plane Control of Flexible Structures with Applications to Hard Disk Drives
6/2002 – 5/2007, \$222,310
24. Office of Naval Research
Sensor Management and Multisensor Fusion Algorithms for Tracking Applications
10/2001 – 9/2005, \$219,953
23. Council on Research and Creative Work, University of Colorado
Grants-In-Aid: Rapid Motion Control of Flexible Structures
8/2001 – 7/2002, \$5,000
22. University of Colorado College of Engineering Engineering Excellence Fund, with matching from the Electrical & Computer Engineering and Aerospace Engineering Sciences Departments
Development of Hardware Control Laboratories
(Co-PIs: D. A. Lawrence and J. Hauser)
5/2001 – 8/2002, \$25,575
21. National Science Foundation
Haptic Interfaces for Spatial Learning
(Co-PIs: D. A. Lawrence and H. Kramer)
4/2001 – 3/2005, \$449,866
20. Colorado Center for Information Storage/Storage Technology Corporation
Speed and Tension Control in Tape Systems
3/2001 – 10/2003, \$117,560
19. Colorado Advanced Software Institute/Data Fusion Corporation
Computationally Efficient Algorithms for Managing Sensor Information that Incorporate Models of Data Association
9/1999 – 8/2000, \$33,000
18. Colorado Advanced Software Institute/Storage Technology Corporation
Precise Control of Elastic Components for Tape Systems
7/1998 – 8/1999, \$30,000
17. National Science Foundation
Research Experiences for Undergraduates: Synergistic Visual-Haptic Rendering Modes for Scientific Visualization
(Co-PI: D. A. Lawrence)
3/1998 – 7/2003, \$20,000
16. National Science Foundation
Synergistic Visual/Haptic Computer Interfaces
(PI: D. A. Lawrence; Co-PI: L. Y. Pao)
8/1997 – 7/2003, \$438,252

15. Colorado Advanced Software Institute/Data Fusion Corporation
Control of Sensor Information in Distributed Multisensor Systems
7/1997 – 8/1998, \$39,972
14. University of Colorado Council on Research and Creative Work
Junior Faculty Development Award: Control of Flexible Structures with Multiple Actuators
7/1997 – 6/1998, \$5,000
13. Office of Naval Research
Young Investigator Award: Distributed Multisensor Fusion Algorithms for Tracking Applications
6/1997 – 5/2000, \$317,500
12. Office of Naval Research (Defense University Research Instrumentation Program)
Instrumentation for Research on the Synergism between Haptic and Visual Communication Channels in Human-Machine Interfaces
(Co-PI: D. A. Lawrence)
3/1997 – 8/1998, \$94,841 (equipment only), plus \$40,130 matching from the University of Colorado Boulder
11. Colorado Advanced Software Institute/Data Fusion Corporation
Control of Sensor Information in Centralized Multisensor Systems
1/1997 – 2/1998, \$28,614
10. University of Colorado's Optoelectronic Computing Systems Center (funded by the National Science Foundation)
Development and Application of New Optical Sensors for Teleoperation of Multifingered Robotic Hands
(PI: D. Z. Anderson; Co-PI: L. Y. Pao)
10/1996 – 4/1998, \$133,177
9. University of Colorado's Optoelectronic Computing Systems Center (funded by the National Science Foundation)
Haptic Communication in Human/Computer Interfaces
(Co-PI: D. A. Lawrence)
10/1996 – 4/1998, \$112,158
8. Wind River Systems, Inc.
Donation of Real-Time Operating System Software Licenses for Robotics and Control Experiments
8/1996 – 7/1997, market value of \$128,000
7. University of Colorado College of Engineering Undergraduate Excellence Fund
Development of Simulation Laboratories for Teaching Control Systems Concepts
7/1996 – 6/1997, \$9,248
6. National Science Foundation
CAREER Award: Rapid and Robust Control of Flexible Structures
6/1996 – 11/2001, \$210,000 base award plus \$90,000 matching for successful collaborations with industry

5. Council on Research and Creative Work, University of Colorado
Grants-In-Aid: Distributed Multisensor Fusion Algorithms
12/1995 – 11/1996, \$5,000
4. GM Foundation
Operator-Assistive Devices for Vehicle Assembly
(PIs: A. H. Haddad and J. Edward Colgate; Co-PIs: M. Mavrovouniotis, L. Y. Pao, M. A. Peshkin, and M. Van Oyen)
2/1995 – 1/2000, \$500,000
3. Northwestern University Research Grant
Teleoperation Control of Multifingered Robotic Hands
7/1994 – 6/1995, \$5,000
2. AT&T Bell Laboratories
Computer and Robotic Equipment Loan (Utah/MIT Dextrous Hand and Sun Workstation)
6/1994 – current, estimated value of \$100,000
1. AT&T Foundation
Development of an Instructional Control Laboratory
11/1993 – 6/1995, \$60,000

Postdoctoral Research Associates and Students Supervised

Postdoctoral Research Associates

5. Dr. Christopher J. Bay, 2017 – 2018. Now a Postdoctoral Research Associate at the US National Renewable Energy Laboratory, Golden, CO.
4. Dr. David Schlipf, 2015. Was a Postdoctoral Research Associate at the Universität Stuttgart, 2015 – 2018. Now a Professor at the Department of Energy and Biotechnology at Flensburg University, Germany.
3. Dr. Shalom D. Ruben, 2011 – 2012, co-advised with J. R. Marden. Now an Instructor in the Mechanical Engineering Department at the University of Colorado Boulder.
2. Dr. Vishwesh Kulkarni, 2003 – 2006. Now an Assistant Professor at the University of Warwick, UK, 2014 – . Was a Research Professor at the University of Minnesota, 2011–2014. Was an Assistant Professor at the Indian Institute of Technology, Mumbai, India, 2006–2011.
1. Dr. Lidija Trailović, 2003 – 2004. Now at Northrop Grumman Corp., Denver, CO, 2004 – .

Ph.D. Students

Primary advisor for:

27. Mandar Phadnis, 2020 – , in progress.
26. David J. Pasley, 2018 – , in progress. Recipient of the 2018-2019 Ryland Family Graduate Fellowship in Aug. 2018 and of an ECEE Department Outstanding Graduate Student Award in April 2019.
25. Nikhar Abbas, 2017 – , in progress.
24. Michael Sinner, 2016 – , in progress.

23. Daniel S. Zalkind, 2014 – , *Methods for Enabling Controls Collaboration During Wind Turbine Design*, expected to graduate in 2020. Recipient of an ECEE Department Graduate Student Community Honorable Mention Award in April 2017. First place winner in 2019 ARPA-E Aerodynamic Turbines with Load Attenuation Systems (ATLAS) Offshore Wind Challenge Competition.
22. R. Arnold Braker, 2014 – 2019, *Control Methods for Compressive Sensing in Atomic Force Microscopy*. Now at Amazon Robotics, 2019 – . Recipient of an ECEE Department Outstanding Graduate Student Research Award in April 2016.
21. Jacob P. Aho, 2011 – 2017, did not complete PhD degree. Recipient of an ECEE Department Graduate Community Award in April 2016 and an ECEE Department Graduate Student Research Honorable Mention Award in April 2017.
20. Fiona M. Dunne, 2009 – 2016, *Optimizing Blade Pitch Control of Wind Turbines with Preview Measurements of the Wind*. Now a Control Engineer at Siemens Wind Power, 2016 – . Recipient of an ECEE Department Outstanding Graduate Student Research Award in April 2016.
19. Shervin Shajiee, 2010 – 2015, *Direct Optical Ice Sensing and Closed-Loop Controller Design for Active De-icing of Wind Turbines Using Distributed Heating*. Now at Western Digital Corporation, 2015 – .
18. Eric J. Simley, 2010 – 2015, *Wind Speed Preview Measurement and Estimation for Feedforward Control of Wind Turbines*. **Recipient of Fulbright Fellowship (2013-2014) and 3rd Place in the 2014 IEEE New Faces of Engineering Program**. Now a Researcher at the National Renewable Energy Laboratory (2018 –). Was a Research Engineer at Envision Energy, Houston, TX (2015-2017), Menlo Park, CA (2017), and Boulder, CO (2017-2018).
17. Hua Zhong, 2004 – 2014, *Advanced Controller Designs for Head Positioning and Tension Regulation in Tape Drive Systems*. Was a Senior Servo Engineer at Oracle Corporation, Broomfield, CO, 2014 – 2017.
16. Andrew D. Buckspan, 2011 – 2014, left program without completing PhD. First position after CU Boulder was as a Project Engineer at CNJV, Golden, CO.
15. Jason H. Laks, 2008 – 2013, *Preview Scheduled Model Predictive Control for Horizontal Axis Wind Turbines*. Was a Postdoctoral Research Associate at the National Renewable Energy Laboratory, Golden, CO, 2013 – 2014. Now a Senior Servo Engineer at Western Digital Corporation, 2014 – .
14. Matthew J. Travers, 2007 – 2011, *Impulse Smoothing for Data Association*. Was a Postdoctoral Research Associate at Carnegie Mellon University (CMU), Pittsburgh, PA, 2011 – 2014; now a Systems Scientist at CMU, 2014 – .
13. Jeffrey A. Butterworth, 2006 – 2011, *Combined Feedback and Adaptive Feedforward Control for Tracking Applications in Atomic Force Microscopes*. Now a Wind Turbine Controls Research Engineer at Envision Energy, Boulder, CO, 2016 – . Formerly a Control Systems Engineer at Frontier Wind LLC, Rocklin, CA, 2011 – 2016.
12. Brian P. Rigney, 2004 – 2009, *Adaptive Settle-Optimal Control of Servomechanisms*, (co-advised with Dale A. Lawrence). Now an Engineering Program Director at Western Digital Corporation, 2008 – .
11. Nicholas L. Bernstein, 2001 – 2007, *Force Sensor Modeling and Friction Compensation for Haptic Interfaces*, (co-advised with Dale A. Lawrence). Now a Senior Systems Analysis at Intuitive Surgical, Inc., San Francisco, CA, 2011 – . Formerly at Touch of Life Technologies, Inc., Aurora, CO, 2006 – 2011.

10. Richard M. Powers, 1999 – 2007, *Track-Loss Detection in the Absence of Truth Data for Target Tracking in Clutter*. Co-Founder and Chief Technology Officer at WeatherCloud Inc., 2013 – . Was a Research Engineer at Vestas Wind Systems A/S, 2011 – 2012. Formerly Vice President of Research & Development at RavenBrick LLC, Denver, CO, 2005 – 2011.
9. Kathryn E. Johnson, 2002 – 2004, *Adaptive Torque Control of Variable Speed Wind Turbines*, (co-advised with Mark J. Balas). Now an Associate Professor in the Department of Electrical Engineering and Computer Science (EECS) at the Colorado School of Mines (CSM), Golden, CO, with a joint appointment at the National Renewable Energy Laboratory (NREL), 2012 – . Was the Clare Boothe Luce Assistant Professor in the Division of Engineering at CSM, 2005 – 2012. Formerly a Postdoctoral Research Associate at the National Renewable Energy Laboratory, Golden, CO, 2004 – 2005.
8. Chanat La-orpacharapan, 1999 – 2004, *Shaped Time-Optimal Closed-Loop Servomechanisms*. Now at Hitachi Global Storage Technologies, San Jose, CA, 2004 – . Formerly also with the Control Engineering Department, King Mongkut's Institute of Technology Ladkrabang, Thailand, 2004 – 2007.
7. Weerawat Khawsuk, 1998 – 2004, *Decorrelated State Estimation for Distributed Tracking in Cluttered Environments*. Now on the faculty at the Chulachomkiao Royal Military Academy, Thailand, 2004 – . **Recipient of the Electrical & Computer Engineering Outstanding Teaching Assistant Award for Academic Year 2001 – 2002.**
6. Matthew D. Baumgart, 2000 – 2003, *Control of Web-Winding Systems*. Now at Blue Canyon Technologies, Boulder, CO, 2014 – . Formerly at Ball Aerospace, Boulder, CO, 2003 – 2014.
5. Lidija Trailović, 1997 – 2002, *Ranking and Optimization of Target Tracking Algorithms*. Now at Northrop Grumman Corp., Denver, CO, 2004 – . Formerly a Lecturer in Applied Math and a Postdoctoral Research Associate in Electrical & Computer Engineering at the University of Colorado, Boulder, CO, 2003 – 2004.
4. Christopher D. Lee, 1998 – 2002, *Modeling Mechanism and Hand Impedances for Improved Control of Parallel Haptic Interfaces*, (co-advised with Dale A. Lawrence). Now at Algae Lab Systems, Boulder, CO as well as at Medical Simulation Corp., Denver, CO, 2002 – .
3. Craig F. Cutforth, 1999 – 2002, *Analysis and Design of Fast Input Shapers for the Control of Flexible Structures*. Now a Senior Servo Engineer at Seagate Technology, Longmont, CO, 2002– .
2. Michael K. Kalandros, 1998 – 2001, *Managing Multiple Sensor Resources using Covariance Control Techniques for Tracking Systems with Data Association*. Now a Senior Staff Member at the Johns Hopkins University Applied Physics Laboratory, Laurel, MD, 2001 – .
1. Mark A. Lau, 1997 – 2000, *Input Shaping and Time-Optimal Control of Flexible Structures*. Now a Professor at Turabo University, Puerto Rico, 2002 – . Formerly a Visiting Assistant Professor at the University of West Florida, Pensacola, FL, 2001-2002.

Member of dissertation committee or co-advisor for:

33. Bart Doekemeijer, 2019 – , Delft University of Technology (The Netherlands).
32. Jacob W. Cook, 2019 –
31. Marc Bromm, 2019, University of Oldenburg (Germany).
30. Herwig Koppauer, 2019, Technical University of Vienna (Austria).
29. Mehdi Vali, 2017 – 2019, University of Oldenburg (Germany).
28. Steffen Raach, 2016 – 2018, Universität Stuttgart (Germany).
27. Sachin Navalkar, 2016, Delft University of Technnology (The Netherlands).

26. Róbert Ungurán, 2016 – 2019, PhD exchange student from Oldenburg University (Germany), worked in my research laboratory during 2016.
25. Scott Rowe, 2015 – 2018.
24. Andrew Hoke, 2012 – 2016.
23. Doug Weibel, 2014 – 2015.
22. David Schlipf, 2012 – 2015, PhD exchange student from Universität Stuttgart (Germany), worked in my research laboratory during 2014-2015. David received the **European Academy of Wind Energy's 2016 Excellent Young Wind Doctor Award**.
21. Joshua Traube, 2012 – 2013.
20. Ivo Houtzager, 2011, Technical University of Delft (The Netherlands).
19. M. Elizabeth Saade, 2010 – 2013.
18. Kira Barton, 2009 – 2010, Mechanical Engineering, Univ. of IL at Urbana-Champaign.
17. Mariko Shirazi, 2007 – 2009.
16. Jason Jonkman, 2005 – 2007.
15. Yang Zhang, 2004 – 2007.
14. Richard A. Santos, 2004 – 2006.
13. Alex L. Matras, 2004 – 2005.
12. Sitthipong Angkititrakul, 2003 – 2006.
11. Maureen Hand, 2002 – 2003.
10. Jack T. Chow, 1999 – 2003.
9. Matthew K. Tucker, 1995 – 1998.
8. Richard E. Hindman, 1995 – 1998.
7. Gabriel Gruener, 1995 – 1998.
6. Adam D. Bennett, 1995 – 1998.
5. Gary Kalmanovich, 1995, Northwestern University.
4. Mary Beth Hribar, 1994, Northwestern University.
3. Li Jing He, 1994, Northwestern University.
2. Asad Khan, 1994, Northwestern University.
1. Michael Brokowski, 1994, Northwestern University.

M.S. Thesis Students

Primary advisor for:

3. Roman Y. Novoselov, 1999 – 2002, *Haptic Rendering of Data on Irregular and Unstructured Grids*, (co-advised with Dale A. Lawrence). Now at Numerica Corporation, Fort Collins, CO, 2002 – . Formerly at CDM Optics, Boulder, CO, 2001 – 2002.
2. Nathan T. Baltz, 1997 – 1999, *Allocation of Sensing Resources in Distributed Multiprocessor Systems*. Now President of Photosense, Boulder, CO, 1999 – .
1. Christian W. Frei, 1994 – 1995, *A Comparison of Parallel and Sequential Implementations of a Multisensor Multitarget Tracking Algorithm*. Now a Partner and Head of Hedge Funds at StepStone Group, Zurich, Switzerland, 2016 – . Was the Head of Portfolio Management at Swiss Capital Alternative Investments, Zurich, Switzerland, 2004 – 2016. Formerly Head of Quantitative Research at BT&T Asset Management, Urdorf, Switzerland, 2000 – 2004. Received Ph.D. in April 2000 from the Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.

Member of thesis committee for:

7. Bart Doekemeijer, 2015 – 2016, MS exchange student from Delft University of Technology (The Netherlands), worked in my research laboratory during 2015 – 2016.
6. Floris Teeuwisse, 2012 – 2013, MS exchange student from Delft University of Technology (The Netherlands), worked in my research laboratory during 2012 – 2013.
5. Andrew Scholbrock, 2011.
4. Sutha Aphanuphong, 2006-2008.
3. UnKyong Hand, 1999-2000.
2. J. Michael Brown, 1995, Northwestern University.
1. Beeling Chang, 1994, Northwestern University.

M.S. Project Students

Primary advisor for:

23. Kaitlyn Garifi, 2016 – 2018 (co-advised with Behrouz Touri). Project topic: “Model Predictive Control of Tape Drive Systems.” Recipient of an ECEE Department Graduate Teaching Award in April 2016.
22. Anil Damle, 2010 – 2011, Project topic: “Impulse Optimization for Data Association in Impulsive Hybrid Systems.” **Recipient of the 2011 CU-Boulder College of Engineering and Applied Science Outstanding Graduate for Research Award.** Completed Ph.D. in the Institute for Computational & Mathematical Engineering at Stanford University, 2011 – 2016. Now an Assistant Professor at Cornell University, 2017 – . Was an NSF Post-Doctoral Fellow at the University of California at Berkeley, 2016 – 2017.
21. Eric J. Simley, 2010, Project topic: “Lidar Modeling for Preview Control of Wind Turbines.”
20. Marian P. Chaffe, 2009 – 2011, Project topic: “High-Bandwidth Precision Control of Near Field Scanning Optical Microscopes.”
19. Fiona M. Dunne, 2009, Project topic: “Combined Feedforward/Feedback Control of Wind Turbines.”
18. Mathew A. Merkow, 2007, Project topic: “Pitch Control for Horizontal Axis Wind Turbines.”
17. Sutha Aphanuphong, 2004-2005, (co-advised with Dale A. Lawrence), Project topic: “Precision Control of Low-Cost Stepper Motors with Hysteresis Nonlinearities.”
16. Weibin Xu, 2003 – 2004, (co-advised with Dale A. Lawrence), Project topic: “Low-Cost Real-Time Control of Multi-Degree-of-Freedom Haptic Interfaces.”
15. Aleksandr M. Arustamyan, 2002 – 2003, (co-advised with Dale A. Lawrence), Project topic: “Synergistic Visual/Haptic Rendering Modes for Tensor Data.”
14. Yegor Plam, 2002 – 2003 (co-advised with Dale A. Lawrence), Project topic: “Performing Three-Dimensional Tasks Using a Combined Visual/Haptic/Audio Interface.”
13. Brian P. Reichenberger, 2001 – 2002 (co-advised with Dale A. Lawrence), Project topic: “Three-Dimensional Drawing Using a Combined Visual/Haptic/Audio Interface.”
12. Kathryn E. Johnson, 2000 – 2002, Project topic: “Comparison of Control Techniques for Wind Turbines.” Completed Ph.D. degree in July 2004 (see Ph.D. Students above).
11. Farid Infed, 1998 – 1999 (co-advised with Dale A. Lawrence), Project topic: “Combined Visual/Haptic Rendering Modes for Understanding Stress Data.”

10. Shane W. Brown, 1997 – 1999 (co-advised with Dale A. Lawrence), Project topic: “Combined Visual/Haptic Rendering Modes for Understanding Fluid Flow Data.”
9. Craig F. Cutforth, 1997 – 1999, Project topic: “A Comparison of Time-Domain and Frequency-Domain Input Shaping Control Methods for Flexible Structures.” Completed Ph.D. degree in May 2002 (see Ph.D. Students above).
8. Weerawat Khawsuk, 1997 – 1998, Project topic: “An Analysis of Distributed Multisensor Fusion Algorithms.” Completed Ph.D. degree in Feb. 2004 (see Ph.D. Students above).
7. Yiannis Pavlou, 1996 – 1998 (co-advised with Dale A. Lawrence), Project topic: “Perceptual Studies of Hardness and Friction in Haptic Interfaces.” Now an engineer at National Instruments, Austin, TX, 1998 – .
6. Neil A. Duchane, 1996 – 1998, Project topic: “Hybrid Force and Position Control of a Multi-fingered Robotic Hand.” Now at Raytheon in El Segundo, CA, 2002 – . Worked at Raytheon in Marlboro, MA, 2001 – 2002. Formerly an engineer at the Laboratory for Atmospheric and Space Physics (LASP) in Boulder, CO from 1998 – 2000.
5. Vimal Patel, 1996, Project topic: “Force Control of the Utah/MIT Robotic Hand.” Now a principal at Sierra Ventures, Menlo Park, CA.
4. Matthew Leoni, 1996, Project topic: “A Modified Approach for Multi-Input Command Shaping for Flexible Structures.”
3. Michael K. Kalandros, 1995 – 1998, Project topic: “Control of Sensor Information in Centralized Multisensor Systems.” Completed Ph.D. degree in May 2001 (see Ph.D. Students above).
2. Mark A. Salada, 1995 – 1997 (co-advised with Dale A. Lawrence), Project topic: “Haptic Exploration of Mammography Data.” Now a Senior Engineer at BMT WBM, 2007 – . Formerly a postdoctoral researcher at Boston University, Boston, MA, 2004-2006. Ph.D. student at Northwestern University, Evanston, IL, 1999-2004.
1. Robert N. Itschner, 1994 – 1995, Project topic: “Development of a Control System for the Utah/MIT Dextrous Robotic Hand.” Now CEO of ABB-Switzerland, Zurich, Switzerland.

B.S. Project Students

Primary Advisor for:

18. Tanner Cordova, 2017, co-advised by PhD student R. Arnold Braker, Project topic: “Embedded System Identification of Dynamical Systems.”
17. Michael Fromandi, 2016 – 2017, co-advised by PhD student R. Arnold Braker, Project topic: “Fast Set-Point Tracking of an Atomic Force Microscope.”
16. Matthew Spydell, 2016, co-advised by PhD student R. Arnold Braker, Project topic: “Embedded Control of an Atomic Force Microscope.”
15. Benjamin Spencer, 2016, co-advised by PhD student R. Arnold Braker, Project topic: “Tutorial Animation of Time-Optimal Control of a Harmonic Oscillator.”
14. Cassandra Noice, 2015 – 2016, co-advised by PhD student R. Arnold Braker, Project topic: “Real-time Control of an Atomic Force Microscope.”
13. Alec C. Martin, 2015, advised by PhD student R. Arnold Braker during Spring Break for Research program, Project topic: “Analog Circuit Emulators for Atomic Force Microscopy System.”
12. Daniel B. Kopelove, 2006 – 2007, (co-advised with Dale A. Lawrence), Project topic: “Integration of a High-Performance, Low-Cost Haptic Interface.”

11. Jeffrey Swetnam, 2004, Project topic: "Luenberger Observer Design and Simulation Studies for Automobile Advance Warning System Applications."
10. Andrew C. White, 2003 – 2004, (co-advised with Dale A. Lawrence), Project topic: "Actuator Design and Calibration for a New Six Degree-of-Freedom Haptic Interface."
9. Aleksandr M. Arustamyan, 2001 – 2002, (co-advised with Dale A. Lawrence), Project topic: "Synergistic Visual/Haptic Rendering Modes for Fluid Flow Data." Completed M.S. degree in May 2003 (see M.S. Students above).
8. Bryan A. Montross, 1999 – 2000 (co-advised with Dale A. Lawrence), Project topic: "Efficient Data Formats for Real-Time Interpolation of Finite Element Model Data on Irregular Grids."
7. Flor Shirzadian, 1998 – 1999 (co-advised with Dale A. Lawrence), Project topic: "Combined Visual/Haptic Rendering Modes for Understanding Gradients." Now an engineer at Hewlett Packard, 1999 – .
6. Roman Y. Novoselov, 1998 – 1999 (co-advised with Dale A. Lawrence), Project topic: "Interfacing Visualization Software to Enable Combined Visual/Haptic Rendering Modes for Understanding Multi-dimensional Data." Completed M.S. thesis in Aug. 2002 (see M.S. Thesis Students above).
5. Craig S. Lindqvist, 1996, Project topic: "Evaluations of a Modified Approach for Multi-Input Shaping for the Control of Flexible Structures." Now an engineer at Boeing, Seattle, WA, 1996– .
4. Darrell L. Barnhart, 1996, Project topic: "Real-Time Position Control of a Robotic Hand." Received Ph.D. from the University of Utah, Salt Lake City, UT in 2002.
3. Radu C. Frangopol, 1995 – 1996, Project topic: "A Comparison of Multi-Input Shaping with Traditional Single-Input Shaping for the Control of Flexible Structures." Now an engineer at Motorola, Ft. Lauderdale, FL, 1998 – . Completed M.S. in ECE at the University of Colorado Boulder in 1998.
2. Nathan V. Le, 1995, Project topic: "Multi-Input Command Shaping for Flexible Structures." Now an engineer at Motorola, Phoenix, AZ, 1995 – .
1. Kheong S. Chan, 1995, Project topic: "A Greedy Algorithm for Efficiently Evaluating the Time-Optimal Control Solutions of High-Order Systems." Received Ph.D. from the National University of Singapore in 2001.

Summary of Evaluations of Courses Taught

Fall 2019: ECEN 4138/5138, Control Systems Analysis, Instructor rating: mean 4.9/6 (median 6/6), Course rating: mean 4.9/6 (median 5/6)

Spring 2019: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: 5.5/6.0, Course rating: 5.2/6.0

Fall 2018: ECEN 4138/5138, Control Systems Analysis, Instructor rating: 5.6/6, Course rating: 4.9/6

Spring 2018: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: 5.5/6.0, Course rating: 5.0/6.0

Spring 2016: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: 5.9/6.0, Course rating: 5.5/6.0

Fall 2015: ECEN 4138/5138, Control Systems Analysis, Instructor rating: 5.1/6, Course rating: 4.6/6

Spring 2015: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: 4.8/6, Course rating: 4.7/6

Fall 2014: ECEN 1500, Sustainable Energy, Instructor rating: 4.6/6, Course rating: 4.1/6. (These are above average ratings for this service course for Arts and Sciences.)

Spring 2014: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: 5.9/6, Course rating: 5.4/6

Fall 2013: ECEN 1500, Sustainable Energy, Instructor rating: 3.8/6, Course rating: 3.8/6. (These are average ratings for this service course for Arts and Sciences.)

Fall 2012: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: 5.3/6, Course rating: 5.2/6

Spring 2012: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: 5.7/6, Course rating: 5.7/6

Spring 2011: ECEN 5418, Automatic Control Systems, Instructor rating: 5.7/6, Course rating: 5.6/6

Spring 2010: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: 4.6/6, Course rating: 4.5/6

Fall 2007: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: A, Course rating: A

Spring 2007: ECEN 5418, Automatic Control Systems, Instructor rating: A+, Course rating: A

Fall 2006: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: A+, Course rating: A

Fall 2005: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: A, Course rating: A

Spring 2005: ECEN 3300, Linear Systems, Instructor rating: A, Course rating: A- (These are very high ratings for this junior-level core required course.)

Fall 2004: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: A+, Course rating: A+

Spring 2004: ECEN 5418, Automatic Control Systems, Instructor rating: A+, Course rating: A+

Fall 2003: ECEN 5448, Advanced Linear Systems, Instructor rating: A, Course rating: A+

Fall 2002: ECEN 3300, Linear Systems, Instructor rating: B-, Course rating: B- (These are average ratings for this junior-level core required course.)

Spring 2001: ECEN 4138, Control Systems Analysis, Instructor rating: A, Course rating: A

Fall 2000: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: A, Course rating: A

Fall 1999: ECEN 5448, Advanced Linear Systems, Instructor rating: A+, Course rating: A+

Fall 1998: ECEN 3300, Linear Systems, Instructor rating: A-, Course rating: B (These are high ratings for this junior-level core required course.)

Spring 1998: ECEN 5418, Automatic Control Systems, Instructor rating: A-, Course rating: A-

Fall 1997: ECEN 5458, Sampled-Data and Digital Control Systems, Instructor rating: A+, Course rating: A

Fall 1996: ECEN 4138, Control Systems Analysis, Instructor rating: A+, Course rating: A

Spring 1996: ECEN 4138, Control Systems Analysis, Instructor rating: A+, Course rating: A

Professional Society Involvement

IEEE Control Systems Society

- Nominating Committee, 2017
- Fellow Nominations Chair, 2016 – 2019; Member Activities Board, 2016 – 2019
- Distinguished Lecturer Nomination Committee, 2015 – 2018
- Distinguished Lecturer, 2008 – 2014
- Member on the Board of Governors, 2003 (Appointed), 2005 – 2007 (Elected), 2011 – 2013 (Elected), and 2015 (Appointed)
- Associate Editor on the Conference Editorial Board, 1995 – 1997

Organizing Committees

- IFAC Symposium on Mechatronic Systems, Los Angeles, CA, 2022
- American Control Conference, General Chair, Washington, DC, 2013
- American Control Conference, Program Chair, Boston, MA, 2004
- American Control Conference, Vice Chair for Invited Sessions, Denver, CO, 2003
- International Symposium on Motion and Vibration Control, Las Vegas, NV, 1999
- Pioneering International Symposium on Motion and Vibration Control in Mechatronics, Tokyo, Japan, 1999

American Automatic Control Council (AACC)

- IFAC Advisory Committee, 2017 –
- IFAC2023 Steering Committee, 2014 – 2016
- IFAC2020 Steering Committee, 2011 – 2013
- Editor of the AACC Newsletter, 1995 – 2001

Associate Editorships

- International Journal of Control, Automation, and Systems, 2003 – 2010

International Program Committees

- WindTech 2017, Boulder, Colorado, October 2017
- IFAC World Congress, Toulouse, France, July 2017
- IFAC Symposium on Mechatronic Systems, Loughborough, UK, September 2016
- Indian Control Conference, January 2016
- International Conference on Information Fusion, July 2006
- IFAC Symposium on Mechatronic Systems, Berkeley, CA, December 2002
- IEEE Conference on Decision and Control, Sydney, Australia, 2000
- Japan/USA/Vietnam Workshop on Research and Education in Systems, Computation, and Control Engineering, Ho Chi Minh City, Vietnam, June 2000

Program Committees

- American Control Conference, Boston, MA, 2004
- American Control Conference, Denver, CO, 2003
- American Control Conference, Arlington, VA, 2001
- American Control Conference, Chicago, IL, 2000
- American Control Conference, Albuquerque, NM, 1997
- American Control Conference, Seattle, WA, 1995

International Federation of Automatic Control (IFAC) Committees

- Chair of the IFAC Policy Committee, IFAC Executive Board Member, 2017 – 2020
- Member of the IFAC Nichols Medal Selection Committee, 2017 – 2020
- Member, IFAC Fellow Selection Committee, 2014 – 2017 and 2017 – 2020
- IFAC World Congress International Program Committee, 2014 – 2017
- Chair of the IFAC Young Author Prize Committee, 2008 – 2011
- Member of the IFAC Young Author Prize Committee, 2006 – 2008
- Member of the IFAC Committee on the Past, Present, and Future of Control Education, 2003 – 2005

Technical Committees:

- Member of IEEE-CSS Power Generation Technical Committee, 2013 – .
- IFAC Technical Committee on Mechatronics, 2006 – .
- Primary member of the ASME Dynamic Systems and Control Division (DSCD) Mechatronics Technical Committee, 2005 – .

Publication Reviews: Regularly review papers for:

Journals:

- AIAA Journal of Guidance, Control, and Dynamics
- AMS Mathematics of Computation
- ASME Journal of Dynamic Systems, Measurement, and Control
- ASME Press Series on Advances in Information Storage Systems
- Asian Journal of Control
- Automatica
- Control Engineering Practice
- IEE Proceedings – Control Theory and Applications
- IEEE Control Systems Letters
- IEEE Control Systems Magazine
- IEEE/ASME Transactions on Mechatronics
- IEEE Transactions on Aerospace and Electronic Systems
- IEEE Transactions on Automatic Control
- IEEE Transactions on Automation Science and Engineering
- IEEE Transactions on Control of Network Systems

- IEEE Transactions on Control Systems Technology
- IEEE Transactions on Education
- IEEE Transactions on Energy Conversion
- IEEE Transactions on Industrial Electronics
- IEEE Transactions on Magnetics
- IEEE Transactions on Nanotechnology
- IEEE Transactions on Robotics/ IEEE Transactions on Robotics and Automation
- IEEE Transactions on Systems, Man, and Cybernetics
- International Journal of Robotics Research
- Journal of Control Theory and Advanced Technology
- Journal of Optimal Control Applications & Methods
- Journal of Renewable and Sustainable Energy
- Journal of Sound and Vibration
- Journal of Vibration and Control
- Meteorologische Zeitschrift
- Remote Sensing
- Systems and Control Letters
- Wind Energy
- Wind Energy Science

Conferences:

- American Control Conference
- AIAA Guidance, Navigation, and Control Conference
- AIAA Aerospace Sciences Meeting
- AIAA/ASME Wind Energy Symposium
- ASME Dynamic Systems and Control Conference
- ASME International Mechanical Engineering Congress and Exposition
- European Control Conference
- IEEE Conference on Decision and Control
- IEEE Conference on Control Applications
- IEEE International Conference on Robotics and Automation
- IEEE Multi-Conference on Systems and Control
- IEEE Virtual Reality Conference
- International Conference on Information Fusion
- IFAC Symposium on Mechatronic Systems
- IFAC World Congress
- The Science of Making Torque from Wind

Book Review:

- Feedback Control of Dynamic Systems, 4th edition, by G. F. Franklin, J. D. Powell, and A. Emami-Naeini, published by Prentice-Hall in 2002.

Funding Agency Reviews:

- NSF Panel Reviews in March 1994, April 1995, July 1996, December 1997, May 2000, April 2002, April 2003, May 2005, August 2006, June 2008, November 2009, and May 2011
- NSF Dynamic Systems and Control Workshop, September 1995
- NSF, ARO, AFOSR, and ONR Mail Reviews

Panels:

- Invited panelist, "Preparing Tomorrow's Scientists and Engineers for the Challenges for the 21st Century," IFAC World Congress, July 2017.
- Invited panelist, "Math, Science, and Technology in Control Education," an evening round table panel session on Control Education, American Control Conference, June 2006.
- Invited participant in study on "Making the Implicit Explicit: An Approach for Assessing the Outcomes of Doctoral Education," funded by the Alfred P. Sloan Foundation, Jan. 2004.
- Invited panelist, "Women as Leaders: The Challenges, the Opportunities, and the Rewards," IEEE Conference on Decision and Control, Dec. 2003.
- Invited panelist, "Writing a Winning NSF CAREER Proposal," American Control Conference, May 2002.

Society Memberships:

- IEEE (Student Member, 1987; Member, 1991; Senior Member, 1998; Fellow, 2012)
- AIAA (Member, 1993; Lifetime Member, 2010)
- Tau Beta Pi
- Phi Beta Kappa

Consulting Activities:

- Institute for Defense Analysis
US Defense Science Study Group
1/2010 – 12/2011
- Signal Processing, Inc.
Sensor Management Technologies
3/2009 – 9/2009
- CACI, Inc., Defense Advanced Research Projects Agency (DARPA)
Sensor Resource Allocation and Sensor Fusion Techniques for Homeland Defense
9/2001 – 12/2001
- John A. Levin & Co., Inc.
Command Shaping Technologies
8/2000
- Integral Peripherals, Inc.
Input Shaping Control of Disk-Drive Servomechanisms
11/1995 – 5/1997
- Prentice Hall, Inc.
Simulation Laboratory Development
11/1995 – 1/1996

Outreach Activities:

- Host family for high school exchange student from Alajuela, Costa Rica, 2012 – 2013
- Volunteer Alumni Interviewer for Prospective Freshmen at Stanford University, 2009 – 2012
- Math Olympiads coach at Bear Creek Elementary School, Boulder, CO, 2005 – 2009

Other Volunteer Activities:

- Stanford University Class of 1987 30th Reunion Campaign Committee Member, 2017

Languages:

- Chinese (fluent)
- Russian (good)
- French (fair)
- German (beginner)