Jay Allen Farrell
Department of Electrical and Computer Engineering
University of California, Riverside, CA 92521
v: (909) 754-8856, e-mail: farrell@ece.ucr.edu

EMPLOYMENT	UNIVERSITY OF CALIFORNIA AT RIVERSIDE	
	KA Endowed Professor of Electrical and Computer Engineering	2021 – Present
	Associate Dean, Academic Personnel, Bourns College of Engineering	2017 – 2021
	Chair of Electrical and Computer Engineering Department	7/2011 – 6/2017
	Professor, Electrical and Computer Engineering	2001 – Present
	Chair of Electrical Engineering Department	7/1998 – 6/2001
	Associate Professor, Electrical Engineering	1997 – 2001
	Assistant Professor, Electrical Engineering	1994 – 1997
	CHARLES DRAPER LABORATORY	
	Principal Member of Technical Staff	1989 – 1994

EDUCATION	UNIVERSITY OF NOTRE DAME	Notre Dame, IN 46556
	Doctor of Philosophy, Electrical Engineering	
	Major Area: Systems and Applied Mathematics	
	Minor Area: Mathematics	
	Master of Science, Electrical Engineering	
	IOWA STATE UNIVERSITY	Ames, IA 50010
	Bachelor of Science, Electrical Engineering	
	Degree Conferred With Distinction	
	Bachelor of Science, Physics	
	Degree Conferred With Distinction	

TEACHING	State and parameter estimation; Linear, nonlinear, or adaptive systems and control; Modeling, dynamics and simulation

RESEARCH	My research program focuses on advanced navigation, control, situation assessment, and planning technologies as necessary to enhance the demonstrated capabilities of autonomous vehicles.

AWARDS
- Engineering Vice President's Annual Award for Best Technical Publication, 1990
- Charles Draper Laboratory Recognition Award. For outstanding performance and achievement, 1991
- Charles Draper Laboratory Recognition Award. For outstanding performance and achievement, 1993
- GNSS Leader to Watch for 2009-2010, GPS World Magazine, May 2009
- IEEE CSS Distinguished Member Award, December 2009
- Winner of Connected Vehicle Technology Challenge -- sponsored by U.S. Department of Transportation's (DOT's) Research and Innovative Technology Administration (RITA), July 2011
- UCR Bourns Pioneering Faculty, 2015
- UCR 2020 Distinguished Campus Service Award
- IEEE Fellow, 2008; AAAS Fellow, 2011; IFAC Fellow 2020.

Selected Professional Society Leadership

- IEEE CSS Board of Governors, Elected member   2003 – 2006, 2012 – 2014
- IEEE CSS, Vice President of Financial Affairs   2005 – 2006
- IEEE CSS, Vice President of Technical Activities   2007 – 2008
- IEEE CSS, Executive Comm. Ad-hoc on New Technical Awards, Member   2008
- Task Force to negotiate and write-up an MOU with Papercept, member   11/2010 – 11/2011
- IEEE CSS Long Range Planning Committee   2005 – 2008, 2013 – 2017, 2020, 2021
- IEEE CSS, President Elect   2013
- IEEE CSS, President   2014
- IEEE Technical Activities Board, Member   2014
- IEEE CSS, Past President   2015
- IEEE CSS Nominating Comm.   ex-officio 2013, 2015; elected 2014, 2016, 2017, 2018, 2019, 2022
- IEEE Fellow Committee   2015, 2016, 2017
- IEEE Education Activity Board, Treasurer   2017
- IEEE Financial Committee, Member   2017
- ECEDHA Program Committee   16/17, 17/18
- ECEDHA Board of Directors   17/18 – 18/19
- American Automatic Control Council, Vice President   2018 – 2019
- American Automatic Control Council, President   2020 – 2021
- IFAC Adaptive and Learning Systems Award, Selection Committee Chair   2023
- Advisory Panel Member, Birkhauser/Springer Control Engineering Series   05/2023 - present

Selected Conference Organization & Journal Associate Editorship

- Associate Editor, IEEE Transactions on Neural Networks   1991 – 1994
- Financial Chair, IEEE Conf. on Decision and Control, 1995, New Orleans, LA   1993 – 1996
- Local Arrangements Chair, IEEE Conf. on Decision and Control, 1997, San Diego, CA   1994 – 1997
- Associate Editor, IEEE Transactions on Automatic Control   1997 – 1999
- Member, IEEE Control Systems Society Conf. Editorial Board   1994 – 1998
- Financial Chair, IEEE Conf. on Decision and Control, 2001, Orlando, FL   1999 – 2002
- Financial Chair, IEEE Conference on Decision and Control, 2003, Maui, HI   2001 – 2004
- Guest Editor for IEEE Control Systems Magazine Special Issue on Kalman Filtering   2010
- General Vice-Chair, Joint 50th IEEE Conf. on Decision and Control, European Control Conf.   2011
- General Chair of the 51st IEEE Conf. on Decision and Control, 2012   2009 – 2013
- IFAC World Congress, USA Proposal Committee   2015 – 2018
- Recent Program Committees: Associate Editor for IEEE CSS 2019 CCTA; 13th Int. Conf. on Marine Nav. and Safety of Sea Transp., 2019; Special Session Co-organizer CDC 2019; Workshop ACC 2020.

AACC – American Automatic Control Council (the US National Member Organization of IFAC); CSS – Control Systems Society; ECEDHA – Electrical and Computer Engineering Department Heads Association; IEEE – Institute of Electrical and Electronic Engineers; IFAC – International Federation of Automatic Control.

Plenary, Keynote and Panel Presentations

- Invited Panel Discussion Member on the Future on Neural Network Research at the International Symposium on Neural Networks, Nanjing, China, June 2007.

- Invited workshop on self-organizing on-line approximation-based control at the 2007 International Symposium on Neural Networks, June 3, 2007, in Nanjing China, June 2007.

- Plenary Panel Member at the 2007 International Symposium on Neural Networks, June 5, 2007, in Nanjing China. Plenary panelists: S. N. Balakrishnan, T. Basar, Tianyou Chai, J. A. Farrell, Deyi Li, T. Parisini, M. M. Polycarpou, Zengqi Sun, Jun Wang, P. Werbos, Zongben Xu, June 2007.

- Plenary presentation entitled "Vehicle Autonomy and Intelligent Control: Where are we and What Lies Ahead?" at the IEEE Multiconference on Systems and Control, San Antonio, TX, Sept. 2008.

- Member of moderated panel on the "50th Anniversary of the Kalman Filter" at the 2010 Institute of Navigation (ION) Global Navigation Satellite System (GNSS) conference. Participation included a 30 minute presentation by each panelist plus group discussion, questions, and answers. September 2010.

- Keynote Speaker, "Precision Mapping and Navigation for Intelligent Highway Systems", Chinese Control and Decision Conference, Chengsha, China, May 31, 2014.

- Plenary Speaker, "Precision Mapping and Vehicle State Estimation for Autonomous Highway Systems", Society of Instrumentation and Control Engineers (SICE), Sapporo, Japan, Sept. 11, 2014.

- Plenary Speaker, "Automated Sensor Based Precision Mapping for Autonomous Highway Systems", 15th International Conference on Control, Automation, and Systems, Busan, Korea, October, 2015.

- Plenary Speaker, "Automated Sensor Based Precision Mapping for Autonomous Highway Systems", International Automatic Control Conference, Yilan, Tiawan, November 2015.

- Keynote Speaker, "Precise and Reliable Mapping and Vehicle State Estimation for Autonomous Highway Vehicles," IFAC Large Scale Complex Systems Symposium, May 28, 2016.

- Plenary Speaker, "Contemplative Real-time Estimation in Autonomous Vehicle Applications," IEEE Multiconference on Decision and Control, Buenos Aires, Argentina, September 2016.

- Plenary Speaker, "Reliably Precise State Estimation for Autonomous Highway Vehicles," 10th International Conference on Human System Interactions (HIS 2017), Ulsan, Korea, July 18, 2017.

- Distinguished Lecture Seminar Speaker, "Reliably Accurate State Estimation for Autonomous Highway Vehicles", Iowa State University, March 2018.

- Distinguished Speaker, "Precise and Reliably State Estimation for Connected and Autonomous Highway Vehicles," Peking University, Beijing China, May 9, 2019.

- Plenary Speaker, "Reliably State Estimation for Connected and Autonomous Highway Vehicles," 2019 International Workshop on Frontiers of Autonomous Systems and Applications, Chengdu, China, May 12, 2019.

- Distinguished Speaker, "Precise and Reliably State Estimation for Connected and Autonomous Highway Vehicles," University of Electronic Science and Technology of China, Chengdu, China, May 14, 2019.

- Keynote Speaker, Int. Symposium on Autonomous Systems- ISAS, Guangzhou, China, May 28-30, 2020.

- Invited Speaker, "Reliably Accurate State Estimation for Connected and Autonomous Highway Vehicles," University of California, Berkeley, Institute of Transportation Studies, September 2019

- Keynote Speaker, Symposium, Southeastern University, Nanjing, China June 1, 2020.

- Speaker, "Precise and Reliably State Estimation for Connected and Autonomous Highway Vehicles," Southeast University, Nanjing, China, October 20, 2020 (Remotely presented).

Department Service

- **7/1995-6/1998:** EE Graduate Program Lead. *Wrote and guided the EE Graduate Program proposal through the UC approval process. MS and PhD programs started in September 1997.*

- **7/1998-6/2001**: EE Department Chair
  Established EE Department & Staff; Established joint Computer Engineering (CEN) Program with Department of Computer Science and Engineering; Negotiated and obtained EE Graduate Program block grant; Prepared ABET accreditation review materials (167 pages) for EE program; Prepared ABET accreditation review materials (249 pages) for CEN program; Passed ABET review for EE and CEN; Prepared graduate program review; Designed and planned second engineering building; Grew EE faculty from 6.1 to 12.6 FTE.

- **7/2001-6/2003**: Electrical Engineering & Computer Engineering, Undergraduate Advisor and Chair of UG Committee

- **7/2006-6/2007**: Electrical Engineering, Undergraduate Adviser and Chair of the UG Committee

- **7/2006-6/2007**: Chair, EE Workload Definition Committee

- **7/2011-6/2014, 7/2014-6/2017**: ECE Department Chair

  ECE won its first GAANN grant; Revised lower division curriculum to enhance linear algebra and programming skills and increase retention; Received 6 year ABET accreditation in Summer 2013; Installed Eta Kappa Nu honorary society chapter Fall 2014; Redesigned freshmen Intro. to EE course to be project based to enhance retention; Established and effectively managed new (international) Graduate Preparation Program with new external revenues of >$350k in 14/15; Established international MS with new external revenues of >$150k in 14/15; Established new Power Systems focus area; Introduced new required technical writing course. Increase number of EE degrees conferred by 119% and enrollment in EE courses by 124%; Doubled TA allocation to ECE; Grew faculty from 19.1 to 29.6 FTE.

College Service

- **7/2009-6/2012**: Chair of the Faculty of the Bourns College of Engineering.

- **7/2009- 6/2012**: Faculty adviser for the ION-UCR student club.

- **7/2017-Present**: Associate Dean – Academic Personnel. *In 18/19, BCOE is home to 125 tenure-track faculty with research funding of about $50M. The Associate Dean – Academic Personnel oversees the BCOE academic personnel processes (e.g., onboarding, development, recognition, retention, review, and search); advises the Dean on academic personnel matters; participates in the college senior leadership team advising and working with the Dean on space, budget, and advancement; and works with BCOE Chairs, UCR Divisional/Associate Deans, the UCR Vice Chancellor for Academic Personnel, and counterparts at other UC campuses to understand and enhance the UCR academic personnel processes.*

Campus Service

- **11/ 2002-1/2003**: Participant Chancellor's Planning Retreat

- **7/2003-6/2006**: Academic Senate Committee on Academic Personnel (CAP)

- **7/2007-6/2010**: Academic Senate Shadow CAP

- **7/2007-6/2009**: Academic Senate Planning and Budget

- **2/ 2009-6/2009**: UCR Budget Advisory Committee (BAC)
  EVC/P led committee. I was one of 6 original faculty. Later expanded to include several more.

- **3/2009-6/2009**: UCR BAC Steering Committee
  EVC/P led committee including heads of two administrative units, two Deans, and two faculty. Its objective was to consider the information provided from various campus sources to determine budgeting principles and recommendations for presentation to the UCR budget advisory committee and to Chancellor White.

- **7/2009-6/2010**: Academic Personnel Task Force
  Appointed by EVC/P: The charge to the Task Force is to examine and recommend on ways UCR might improve its academic personnel processes, starting from the preparation of academic personnel files in the Departments through to when they are signed off on by the EVC/P or Chancellor.

- **9/2009-6/2010**: Chair of the UCR Strategic Planning "Resources, Budget Planning and Infrastructure Subcommittee"
  This committee was appointed by the Executive Vice Chancellor and Provost with the charge: To evaluate and make recommendations on economic models, resource generation and cost structure and budgetary transparency. To examine and make recommendations on ways to increase the effectiveness and efficiency of the campus infrastructure, including administrative structure, business affairs, facilities, and services in support of the teaching and research missions.

- **1/2009-6/2010**: Member, UCR Strategic Planning Steering Committee

- **7/2009-8/2012**: Member, UCR Academic Senate Executive Committee

- **1/2011-12/2011**: Member, UCR's Chancellor's Budget Advisory Council

- **4/2013-10/2013**: Member, Vice Chancellor for Planning and Budget Search Committee

- **1/2018-6/2018**: Member, Associate Vice Chancellor and Chief Compliance Officer Search Committee

- **1/2020-3/2020**: Member, Unit 18 UC-AFT Contract Negotiation Advisory Group

- **7/2022-6/2023**: UCR Academic Senate Committee on Faculty Welfare

- **3/2023- 6/30/2023**: UCR Associate Chancellor Search Advisory Committee

- **7/2023** – 6/2024:   UCR Academic Senate Committee on Memorial Resolution

I. Typical Courses

<u>Undergraduate Courses</u>: Dynamic Systems Modeling and Simulation, Automatic Control, Linear Methods for Engineering Analysis and Design using MATLAB, Random variables and Stochastic processes.

<u>Graduate Courses</u>: State and Parameter Estimation, Nonlinear Systems and Control, Aided Navigation Systems, GPS/GNSS, Linear Systems, Stochastic Processes.

II. Graduate Student Instruction.

Student Name	Degree	My Role; Student Employer (year)	Date Completed
Kathryn Hammer	Ph.D.	Major Professor	Active
Mohammad Stas	Ph.D.	Major Professor	Active
Ashim Neupane	Ph.D.	Major Professor	September 2022
Bernard Jean Uwinez	Ph.D.	Major Professor	Active
Wang Hu	Ph.D.	Major Professor	January 2024
Zeyi Jiang	Ph.D.	Major Professor, MicroStar (2023)	December 2022
Farzana Sharmin Rahman	Ph.D.	Major Professor, Nuro Inc. (2020)	June 2020
Mohammad Billah	Ph.D.	Major Professor. Nauto Robotics (2019)	June 2019
Jesse Garcia	M.S.	Major Professor. SPAWAR (2018)	Summer 2018
Paul Roysdon	Ph.D.	Major Professor. US Government (2017).	Summer 2017
Elahe Aghapour	Ph.D.	Major Professor. Post-doc USC (2019), Illumina (2021)	June 2019
Jakob Mahler Hansen	Ph. D.	External Examiner, NTNU	March 2017
Axel Barrau	Ph. D.	External Committee Member for Mines ParisTech, visitor at UCR, Safran (2015), CTO at Offroad (2022)	March - September 2015
Rathavut Vanitsthian	M. S.	Major Professor; Start-up Thailand	Spring 2012
Haiyu Zhang	Ph.D.	Co-Major Professor; at Amazon (2015), Google, AirBnb	Fall 2014
Akshay Morye	Ph.D.	Major Professor; at Oxford Univ. (2015), Head of Metrics at Oxbotica 2018-present	Spring 2013
Sheng Zhao	Ph.D.	Major Professor; at Google (2015), Waymo (2018)	Fall 2014
Sarath Suvarna	M.S	Major Professor; Head of Software at Neato Robotics (2015-present)	Summer 2012
Dongfang Zheng	Ph.D.	Major Professor; at Google (2015), Tencent (2019), Dir. Of Localization and Mapping at Autel Robotics (2021)	Fall 2014
Yiming Chen	Ph.D.	Major Professor; at QualComm (2015); Head of Cloud Robotics at Alibaba (2018)	Fall 2014
Jeff Herrera	M.S.	Major Professor; at NGC (2014)	Spring 2011
Fred Lawton	M.S.	Research co-Chair. L3Harris Space and Airborne Systems (2023)	Fall 2011
Anh Vu	Ph.D.	Post-graduate Advisor, Volkswagen; Velodyne.	Spring 2012
Behlul Sutarwala	M.S.	Major Professor; at LSI, Intel, NVIDIA	Spring 2011
Arvind Ramanandan	Ph.D.	Major Professor; at QualComm (2011); Tesla (2017)	Spring 2011
Anning Chen	Ph.D.	Major Professor; at Broadcomm (2011) *Anning Chen is the Institute of Navigation Southern California Section 2010 Graduate Student scholarship winner. Anning Chen won a 2010-2011 UCTC Final Year Dissertation Fellowship.*	Spring 2011
Wenjie Dong	Ph.D.	Major Professor; Assoc. Prof. at U Texas RGV (2011-2022) *Mr. Dong won UCTC Ph.D. Dissertation Fellowship to support his research during the 08-09 academic year. He has also earned a six month internship with Xerox for a portion of the 08/09 academic year.*	Spring 2009
Vladimir Djapic	Ph.D.	Major Professor; at US Navy SSC Pacific (2008), Haval (2017) *Mr. Djapic won the best paper in his session award at the 2008 American Control Conference in Seattle WA.*	Fall 2008
Kevin Christopher	M.S.	Major Professor; at Boeing (2008)	Fall 2008
Yuanyuan Zhao	Ph.D.	Major Professor; at Western Digital (2007)	Winter 2007

Yu Lu	Ph.D.	Major Professor; Chinese Acad. Sci. (2009) *Yu Lu is the Institute of Navigation Southern California Section 2006 Graduate Student scholarship winner (announced March 21, 2006).*	Summer 2006
Elmer Thomas	M.S.	Major Professor; at SendGrid (2014)	Summer 2005
Jenna Cheng	Ph.D.	Major Professor; at NavCom (2005), Broadcomm (2011)	Spring 2005
Kelly Lynn Downey	M.S.	Major Professor	Summer 2004
Shuo Pang	Ph.D.	Major Professor; Professor at Embry-Riddle U. Daytona (2005-2022)	Fall 2004
Steve Hawkinson	M.S.	Major Professor; at NavCom (2003), Broadcom (2011)	Fall 2002
Yunchun Yang	Ph.D.	Major Professor; Founder IPO Company in Beijing	Spring 2001
Torsten Berger	Ph. D.	Major Professor, Boston Dynamics	Spring 1998

III. Other Teaching / Misc. Supervision.

Mentorship of Non-UCR Graduates

From	To	Name
March 2006	June 2006	Paul Miller *Paul enrolled in my Spring 2006 offering of EE260 Aided Navigation. After the class, we continued to interact to extended his groups course project to a real world application. Ultimately, he earned a Pentagon Top Navy Scientist or Engineer award for the extended project. His nomination lists me as his mentor. See supplementary item E.*

Mentorship of Undergraduates

From	To	Name
June 2000	June 2003	Elmer Thomas *UC Leads Mentor; Supervised his undergraduate research project*
April 2002	June 2004	June Fuller *UC LEADS*
January 2009	September 2011	Benjamin Wong, Jason Ramapuram, Jeff Herrera, Rathavut Vanitsthian
January 2011	May 2012	Devin Auclair, Dennis Kwon, Seyed Mortazavi, Amir Rustamzadeh, Daniela Gutierrez
January 2012	June 2013	Devin Auclair, Gevork Ashikyan, Tianchen Lu
June 2016	August 2016	Roman Chaar, Derek Sayler, Joel Borja HSI STEM Pathways Summer Bridge to Research Program
March 2019	June 2019	Sean Pickman, Shirin Massoumi
March 2020	June 2020	Kathryn Hammer
January 2023	April 2023	Kevin Urrutia Avila

Visiting Faculty

From	To	Name
September 2002	August 2003	Cai Yuan Li
February 2003	March 2003	Huai Xun Liu
February 2015	August 2015	Axel Barrau
August 2014	July 2015	Huaizhong (Norman) Hu
October 2018	September 2019	Felipe Oliveira Silva

Mentorship of High School Student Projects

Benjamin Yang (2017), Raina Yin (2019), Thomas Kleist (2021)

Technical Publications

a. Books

1. J. A. Farrell, M. Barth, "The Global Positioning System and Inertial Navigation: Theory and Practice," New York: McGraw-Hill Publishing, 370 pp, 1999.

2. J. A. Farrell, M. M. Polycarpou, "Adaptive Approximation Based Control: Unifying Neural, Fuzzy, and Traditional Approximation Based Approaches," *Adaptive and Learning Systems for Signal Processing, Communications and Control Series*, Hoboken, NJ, John Wiley, S. Haykin (Ed.), 436 pages, 2006.

3. J. A. Farrell, "Aided Navigation Systems: GPS and High Rate Sensors," *New York, NY*, McGraw-Hill, W. Rinaldi (Ed.), 552 pages, 2008.

b. Journal Articles (* indicates my students or post-docs directly supervised by JAF)

1. A. N. Michel, J. A. Farrell, W. Porod, "Qualitative analysis of neural networks. Information and Decision Technologies," *IEEE T. Circuits & Syst*, vol. 14, no. 3, pp. 169-194, 1988.

2. A. N. Michel, J. A. Farrell, W. Porod, "Qualitative analysis of neural networks," *IEEE T. Circuits & Syst.*, vol. 36, pp. 229-243, 1989.

3. R. K. Miller, A. N. Michel, J. A. Farrell, "Quantizer effects on steady-state error specifications of digital feedback control systems," *IEEE T. Automat. Contr.*, vol. 34, pp. 651-654, 1989.

4. J. A. Farrell, A. N. Michel, "Estimates of asymptotic trajectory bounds in digital implementations of linear feedback control systems," *IEEE T. Automat. Contr.*, vol 34, pp. 1319-1324, 1989.

5. A. N. Michel, J. A. Farrell, "Associative memories via artificial neural networks," *IEEE Contr. Syst. Mag.*, vol. 10, no. 3, pp. 6-17, 1990.

6. A. N. Michel, J. A. Farrell, H.F. Sun, "Analysis and synthesis techniques for Hopfield type synchronous discrete time neural networks with application to associative memory," *IEEE T. Circuits & Syst.*, vol. 37, pp. 1356-1366, 1990.

7. J. A. Farrell, A.N. Michel, "A synthesis procedure for Hopfield's continuous-time associative memory," *IEEE T. Circuits & Syst.*, 37, pp. 877-884, 1990.

8. J. Farrell, T. Berger*, B. Appleby, "Using learning techniques to accommodate unanticipated faults," *IEEE Contr. Syst. Mag., Special Issue on Intelligent Control, June*, vol 13, no. 3, pp. 40-49, 1993.

9. J. Farrell, B. Clauberg*, "Issues in the implementation of an indirect adaptive control system," *IEEE J. Oceanic Eng.*, vol. 18, pp. 311-318, 1993.

10. M. M. Livstone*, J. A. Farrell, M. A. Dahleh, "Comments on least squares methods for H_∞ control oriented system identification," *IEEE T. Automat. Contr.*, vol. 39, p. 1531, 1994.

11. J. Farrell, M. Livstone*, "Calculation of discrete-time process noise statistics for hybrid continuous/discrete-time applications," *Optimal Control: Application and Methods*, vol. 17, no. 2, pp. 151-155, 1996.

12. J. A. Farrell, "Motivations for local approximators in passive learning control," *J. of Intelligent Systems and Control*, vol. 1, no. 2, pp. 195-210, 1996.

13. J. Chen, J. A. Farrell, C. Nett, K. Zhou, "H_∞ identification of multivariable systems by tangential interpolation methods," *IEEE T. Automatic Control*, vol 41, no. 12, pp. 1822-1827, 1996.

14. J. A. Farrell, "Persistence of excitation conditions in passive learning control," *Automatica*, vol 33, no. 4, pp. 699-703, 1997. DOI: 10.1016/S0005-1098(96)00203-8.

15. J. Farrell, M. Djodat*, M. Barth, M. Grewel, "Latency compensation for differential GPS," *Navigation: The Institute of Navigation*, vol. 44, no. 1, pp. 99-107, 1997.

16. J. Farrell, "On performance evaluation in on-line approximation for control," *IEEE T. Neural Networks*, vol 9, no. 5, pp. 1001-1007, 1998. DOI: 10.1109/72.712180.

17. J. Farrell, "Stability and approximator convergence in nonparametric nonlinear adaptive control," *IEEE T. Neural Networks*, vol. 9, no. 5, pp. 1008-1020, 1998. DOI: 10.1109/72.712182.

18. A. Wistrom, J. Farrell, "Simulation and system identification of dynamic models for flocculation control," *IAWQ Journal Water Science and Technology*, vol 37, no. 12, pp. 181-192, 1998.

19. N. Sureshbabu*, J. A. Farrell, "Wavelet based system identification for nonlinear control applications," *IEEE T. Automatic Control*, vol. 44, no. 2, pp. 412-417, 1999. DOI: 10.1109/9.746278.

20. J. Y. Choi, J. A. Farrell, "Nonlinear adaptive control using networks of piecewise linear approximators," *IEEE T. Neural Networks*, vol 11, no. 2, pp. 390-401, 2000. DOI: 10.1109/72.839009.

21. J. Farrell, T. Givargis*, "Differential GPS reference station algorithm: Design and analysis," *IEEE T. Control Systems Technology*, vol 8, no. 3, pp. 519-531, 2000.

22. J. Farrell, T. Givargis*, M. Barth, "Real-time differential carrier phase GPS-aided INS," *IEEE T. Control Systems Technology*, vol 8, no. 4, pp. 709-721, 2000. DOI: 10.1109/87.852915.

23. W. Li*, X. G. Chang, F. Wahl, J. Farrell, "Tracking control of a manipulator under uncertainty by FUZZY P+I D controller," *Fuzzy Sets and Systems, Elsevier Science: North Holland*, vol 122, pp. 125-137, 2001.

24. W. Li*, X. G. Chang, J. A. Farrell, F. M. Wahl, "Design of an Enhanced Hybrid Fuzzy P+ID Controller For a Mechanical Manipulator," *IEEE Systems, Man, and Cybernetics - Part B: Cybernetics*, 31, 6, 938-945, 2001.

25. W. Li*, J. A. Farrell, R.T. Cardé, "Tracking of Fluid-Advected Odor Plumes: Strategies Inspired by Insect Orientation to Pheromone," *Adaptive Behavior*, 9, 3/4, 143-170, 2001.

26. J.Y. Choi, J. A. Farrell, "Adaptive observer based backstepping control using neural networks," *IEEE T. Neural Networks*, vol 12, no. 5, pp. 1103-1112, 2002. DOI: 10.1109/72.950139.

27. J. Stoev, J.-Y. Choi, J. A. Farrell, "Adaptive control for output feedback nonlinear systems in the presence of modeling errors," *Automatica*, 38, 10, 1761-1767, 2002. DOI: 10.1016/S0005-1098(02)00067-5.

28. J. A. Farrell, J. Murlis, W. Li*, R.T. Carde, "Filament-Based Atmospheric Dispersion Model to Achieve Short Time-Scale Structure of Odor Plumes," *Environmental Fluid Mechanics*, vol. 2 2002, pp. 143-169, 2002.

29. Y. Yang*, J. A. Farrell, "Magnetometer and Differential Carrier Phase GPS aided INS for Advanced Vehicle Control," *IEEE T. Robotics and Automation*, 19, 2, 269-183, 2003.

30. Y. Yang*, J. A. Farrell, "Two Antenna GPS aided INS for Attitude Determination," *IEEE T. Control Systems Technology*, 11, 6, 905-918, 2003. DOI: 10.1109/TCST.2003.815545.

31. J. A. Farrell, S. Pang*, W. Li*, "Plume Mapping via Hidden Markov Methods," *IEEE T. SMC-B*, 33, 6, 850-863, 2003. DOI: 10.1109/TSMCB.2003.810873.

32. J. A. Farrell, H.S. Tan, Y. Yang*, "Carrier Phase GPS-aided INS based Vehicle Lateral Control," *ASME J. of Dynamics Systems, Measurement, & Control*, 125, 3, 339-353, 2003. DOI: 10.1115/1.1592190.

33. J. A. Farrell, M. Polycarpou, M. Sharma, "Longitudinal Flight Path Control using On-line Function Approximation," *AIAA J. of Guidance, Control and Dynamics*, 26, 6, 885-897, 2003.

34. J. Nakanishi, J. A. Farrell, S. Schaal, "Composite Adaptive Control with Locally Weighted Statistical Learning," *Neural Networks*, 18, 1, 71-90, 2005.

35. J. A. Farrell, S. Pang*, W. Li*, "Chemical Plume Tracing via an Autonomous Underwater Vehicle," *IEEE J. Oceanic Engineering*, 30, 2, 428-442, 2005. DOI:10.1109/JOE.2004.838066.

36. J. A. Farrell, M. Sharma, M. Polycarpou, "Backstepping-Based Flight Control with Adaptive Function Approximation," *AIAA J. of Guidance, Control and Dynamics*, 28, 6, 1089-1102, 2005. DOI:10.2514/1.13030

37. W. Li*, J. A. Farrell, S. Pang*, R. M. Arrieta, "Moth-Inspired Chemical Plume Tracing on an Autonomous Underwater Vehicle," *IEEE T. Robotics*, 22, 2, pp. 292-307, 2006.

38. S. Pang*, J. A. Farrell, "Chemical Plume Source Localization," *IEEE Systems, Man, and Cybernetics - Part B: Cybernetics*, 36, 5, 1068-1080, 2006.

39. Y. Zhao*, J. A. Farrell, "Locally Weighted Online Approximation Based Control for Nonaffine Systems," *IEEE T. Neural Networks*, 18, 6, 1709-1724, 2007. DOI: 10.1109/TNN.2007.895908

40. Y. Zhao*, J. A. Farrell, "Self-organizing Approximation Based Control for Higher Order Systems," *IEEE T. Neural Networks*, 18, 4, 1220-1231, 2007. DOI: 10.1109/TNN.2007.899217.

41. W. Dong*, J. A. Farrell, "Cooperative Control of Multiple Nonholonomic Mobile Agents," *IEEE T. Automatic Control*, 53, 6, 1434-1448, 2008.

42. W. Dong*, J. A. Farrell, "Formation Control of Multiple Underactuated Surface Vessels," *IET Control Theory and Applications*, 2, 12, 1077-1085, 2008.

43. Y. Zhao*, J. A. Farrell, "Localized Adaptive Bounds for Approximation Based Backstepping," *Automatica*, 44, 10, 2607-2613, 2008.

44. J. A. Farrell, M. Polycarpou, M. Sharma, W. Dong*, "Command Filtered Backstepping," *IEEE T. Automatic Control*, 54, 6, 1391-1395, 2009. DOI: 10.1109/TAC.2009.2015562

45. W. Dong*, J. A. Farrell, "Decentralized Cooperative Control of Multiple Nonholonomic Dynamic Systems with Uncertainty," *Automatica*, 45, 3, 706-710, 2009.

46. P. Miller*, J. A. Farrell, Y. Zhao*, V. Djapic*, "Autonomous Underwater Vehicle Navigation," May, *IEEE J. of Ocean Engineering*, 35, 3 663-678, 2010. DOI: 10.1109/JOE.2010.2052691.

> *Miller won a 2008 Navy Top Scientists and Engineers Award for his efforts on research related to this article. His nomination for that award cites Farrell as his mentor.*

47. B. Song, A. Kamal, C. Soto, C. Ding, A. Roy-Chowdhury, J. A. Farrell, "Tracking and Activity Recognition through Consensus in Distributed Camera Networks," *IEEE T. Image Proc.*, 19, 10, 2564 - 2579, 2010.

48. B. Song, C. Ding, A.T. Kamal, J. A. Farrell, A.K. Roy-Chowdhury, "Distributed Camera Networks: Integrated Sensing and Analysis for Wide Area Scene Understanding," *IEEE Signal Processing Magazine*, 20-31, 2011.

49. W. Dong*, J.A. Farrell, M.M. Polycarpou, V. Djapic, M. Sharma, "Command Filtered Adaptive Backstepping," *IEEE T. Control Systems Technology*, 20, 3, 566 – 580, 2012. DOI: 10.1109/TCST.2011.2121907.

50. W. Dong*, Y. Zhao*, Y. Chen*, J. A. Farrell, "Tracking Control for Nonaffine Systems: A Self-organizing Approximation Approach," *IEEE T. Neural Networks and Learning Systems*, 23, 2, 223 - 235, 2012. DOI: 10.1109/TNNLS.2011.2178509.

51. A. Ramanandan*, A. Chen*, J. A. Farrell, "Inertial Navigation Aiding by Stationary Updates," *IEEE T. Intelligent Transportation Systems*, 13, 1, 235 – 248, 2012.

52. A. Vu*, A. Ramanandan*, A. Chen*, J. A. Farrell, M. Barth, "Real-Time Computer Vision/DGPS-Aided Inertial Navigation System for Lane-Level Vehicle Navigation," *IEEE T. Intelligent Transportation Systems*, 13, 2, 899-913, 2012. DOI: 10.1109/TITS.2012.2187641.

53. C. Ding, B. Song, A. Morye*, J. A. Farrell, and A. Roy-Chowdhury, "Collaborative Sensing In A Distributed PTZ Camera Network," *IEEE T. Image Processing,* 21, 7, 3282-3295, 2012.

54. A. T. Kamal, J. A. Farrell, A. K. Roy-Chowdhury, "Information Weighted Consensus Filters and their Application in Distributed Camera Networks," *IEEE T. Automatic Control*, 58, 12, 1-14, 2013. DOI: 10.1109/TAC.2013.2277621.

55. A. Vu*, J. A. Farrell, and M. Barth, "Centimeter-Accuracy Smoothed Vehicle Trajectory Estimation," *IEEE Intelligent Transportation Systems Magazine,* Special Issue on Workshops-IV12, 5, 4, 121-135, 2013. DOI: 10.1109/MITS.2013.2281009.

56. A. A. Morye*, C. Ding, A. K. Roy-Chowdhury, J. A. Farrell, "Distributed Constrained Optimization for Bayesian Opportunistic Visual Sensing." *IEEE T. Control Systems Technology*, 22, 6, 2302-2318, 2014. DOI: 10.1109/TCST.2014.2300416.

57. A. Vu* and J. A. Farrell, "Feature Mapping and State Estimation for Highly Automated Vehicles," *Journal of Control and Decision*, Taylor & Francis, Eds. Guang-Hong Changyun and Zhong-Ping Jiang, Special Issue: 2014 CCDC Keynotes and Distinguished Lectures, 2:1, 1-25, 2015, DOI: 10.1080/23307706.2015.100756.

58. Y. Chen*, D. Zheng*, P. A. Miller and J. A. Farrell, "Underwater Inertial Navigation with Long Base Line Transceivers: A Near-Real-Time Approach," *IEEE T. Control Systems Technology*, 24, 1, 240-251, 2016.

59. Y. Chen*, S. Zhao*, and J. A. Farrell, "Computationally Efficient Carrier Integer Ambiguity Resolution in GPS/INS: A Common-Position-Shift Approach," *IEEE T. Control Systems Technology*, 24, 5, 1541-1556, 2016. DOI: 10.1109/TCST.2015.2501352.

60. A. T. Kamal, J. A. Farrell, and A. Roy-Chowdhury, "Distributed Multi-target Tracking and Data Association in Vision Networks," *IEEE T. Pattern Analysis and Machine Intelligence,* 38, 7, 1397 – 1410, 2016. DOI: 10.1109/TPAMI.2015.2484339.

61. S. Zhao*, Y. Chen*, J. A. Farrell, "High Precision Vehicle Navigation in Urban Environments using a MEM's IMU and Single-frequency GPS Receiver," *IEEE T. Intelligent Transportation Systems*, 7, 10, 2854-2867, 2016. DOI: 10.1109/TITS.2016.2529000.

62. C. Ding, J. Bappy, J. A. Farrell, A. Roy-Chowdhury, "Opportunistic Image Acquisition of Individual and Group Activities in a Distributed Camera Network," *IEEE T. Circuits and Systems for Video Technology*, Special Issue on Group and Crowd Behavior Analysis for Intelligent Multi-camera Video Surveillance, 27, 3, 664-672, 2016. DOI: 10.1109/TCSVT.2016.2593620.

63. D. Zheng*, G. Chen, and J. A. Farrell, "Joint Measurement and Trajectory Recovery in Visible Light Communication," *IEEE T. Control Systems Technology*, 25, 1, 247-261, 2017. DOI: 10.1109/TCST.2016.2554062.

64. P. Lin, W. Ren, J. A. Farrell, "Distributed Continuous-time Optimization: Nonuniform Gradient Gains, Finite-time Convergence, and Convex Constraint Set," *IEEE T. Automatic Control*, 62, 5, 2239-2253, 2017. DOI: 10.1109/TAC.2016.2604324.

65. J. R. Garcia*, J. A. Farrell, Z. M. Kassas, M. Ouimet, "Autonomous surface vehicle measurement location planning for optimal underwater acoustic transponder localization," *IEEE T. on Aerospace and Electronic Systems*, 55, 6, pp. 2836 – 2849, 2019. DOI: 10.1109/TAES.2019.2909253.

66. M. S. Billah*, J. A. Farrell, "Bucket Wheel Reclaimer Extrinsic Parameter Calibration", *IEEE T. Control System Technology*, 28, 6, pp. 2092-2103, 2020. DOI: 10.1109/TCST.2019.2928503

67. E. Aghapour*, F. Rahman*, J. A. Farrell, "Outlier Accommodation in Nonlinear State Estimation: A Risk-Averse Performance-Specified Approach," *IEEE T. Control System Technology*, 29, 2, 567-579, March 2021. DOI: 10.1109/TCST.2019.2952529.

68. E. Aghapour*, J. A. Farrell, "Outlier Accommodation in Moving Horizon State Estimation: A Risk-Averse Performance-Specified Approach," International Journal of Adaptive Control and Signal Processing, Special Issue on Moving Horizon Estimation and New Application Perspectives, 34, 777-795, 2020. DOI: https://doi.org/10.1002/acs.3055

70. F. Rahman*, E. Aghapour*, J. A. Farrell, "Vehicle ECEF Position Accuracy and Reliability in the Presence of DGNSS Communication Latency," IEEE Intelligent Transportation Systems Magazine, vol. 13, no. 4, pp. 262-272, Winter 2021, DOI: 10.1109/MITS.2019.2953500.

70. J. A. Farrell, F. O. Silva, F. Rahman*, J. Wendel, "IMU Error State Modeling for State Estimation and Sensor Calibration: A Tutorial," IEEE CSM. Acceptance September 2021. Revised for EIC edits August 16, 2022. Pp. 2-28. DOI: 10.1109/MCS.2022.3209059

71. S. Sun, Y. Zhang, P. Lin, W. Ren, J. A. Farrell, "Distributed Time-Varying Optimization with State-Dependent Gains: Algorithms and Experiments," IEEE Transactions on Control Systems Technology. Accepted 2/8/2021. DOI: 10.1109/TCST.2021.3058845.

72. F. Rahman*, F. O. Silva, Z. Jiang*, J. A. Farrell, "Low-Cost Real-Time PPP-Aided INS for CAV Applications", IEEE Trans. on Intelligent Transportation Systems, In Press, Accepted September 12, 2022. DOI 10.1109/TITS.2022.3208849

73. W. Hu*, A. Neupane*, J. A. Farrell, "Using PPP Information to Implement a Global Real-Time Virtual Network DGNSS Approach", IEEE Trans. on Vehicular Technology, 71, 10, pp. 10337-10349, 2022. DOI: 10.1109/TVT.2022.3187416.

75. J.-B. Uwineza*, J. A. Farrell, "RAIM and Failure Mode Slope: Effects of Increased Number of Measurements and Number of Faults," Sensors. 2023; 23(10):4947. https://doi.org/10.3390/s23104947.

76. Z. Jiang, X. Liu, M. Ma, J. A. Farrell, "Lidar-based Hatch Localization," Remote Sensing (IF5.349). DOI: https://doi.org/10.3390/rs14205069

77. W. Hu and J. A. Farrell, "Derivation of the Earth-Rotation Correction (Sagnac Effect) and Analysis of its Accuracy for GNSS Applications," submitted to GPS Solutions, Nov. 11, 2023.

78. W. Hu, H. Mohsenian-Rad, and J. A. Farrell, "Optimization-Based Outlier Accommodation using Linear Performance Constraints for CAV State Estimation in Urban Environments," submitted to IEEE T. on Vehicular Technology, March 1, 2024.

79. M. Stas, W. Hu, and J. A. Farrell, "Lane Determination using Hidden Markov Model Methods with GNSS," Submitted to IEEE. T. - ITS 2/12/2024.

c. Symposia/Conference Proceedings

1. A. Michel, J. Farrell, W. Porod, "Qualitative analysis of neural networks," *Int. Symp. Mathematical Theory of Networks and Systems*, Phoenix, Arizona, 1-8, 1987.

2. A. Michel, J. Farrell, W. Porod, "Qualitative analysis of neural networks: Local theory," *25th Ann. Allerton Conf., University of Illinois*, Urbana, Illinois, pp. 989-992, 1987 (Non-Refereed).

3. A. Michel, W. Porod, J. Farrell, "Stability results for neural networks," *IEEE Conf. Neural Inform. Proc. Syst.*, Denver, Colorado, pp. 51-55, 1987 (Non-Refereed).

4. J. Farrell, A. N. Michel, "Asymptotic trajectory bounds in digital implementations of linear feedback control systems," *22nd Ann. Conf. Inform, Sciences & Systems*, Princeton, New Jersey, pp. 1877-1881, 1988 (Non-Refereed).

5. A. N. Michel, J. A. Farrell, W. Porod, "Qualitative analysis of neural networks," *IEEE Int. Symp. Circuits & Syst.*, Helsinki, Finland, pp. 989-992, 1988.

6. J. Farrell, A. Michel, "New estimates of asymptotic trajectory bounds for digital filters: Improved results," *26th Annual Allerton Conf. Communication, Control, & Computing*, University of Illinois, Urbana, Illinois, pp. 852-861, 1988 (Non-Refereed).

7. R. K. Miller, A. N. Michel, J. A. Farrell, "Quantizer effects on steady-state error specifications of digital feedback control systems," *27th IEEE Conf. Decision & Control*, Austin, Texas, pp. 1897-1901, 1988.

8. J. A. Farrell, A. N. Michel, "Estimates of asymptotic trajectory bounds in digital implementations of linear feedback control systems," *27th IEEE Conf. Decision & Control*, Austin, Texas, pp. 1877-1882, 1988.

9. A. N. Michel, J. A. Farrell, H. F. Sun, "Analysis techniques for Hopfield type synchronous discrete time neural networks," *1989 Conf. Information Sciences & Systems*, Baltimore, Maryland, pp. 597-602, 1989 (Non-Refereed).

10. A. N. Michel, J. A. Farrell, D. L. Gray, W. Porod, "Some results on the modeling, analysis, and design of neural networks," *IEEE Int. Symp. Circuits & Systems*, Portland, Oregon, pp. 482-485, 1989.

11. J. A. Farrell, A. N. Michel, "A synthesis procedure for Hopfield's continuous time content addressable memory," *IEEE Int. Symp. Circuits & Systems*, Portland, Oregon, pp. 2173-2176, 1989.

12. A. N. Michel, J. A. Farrell, "Design techniques of neural networks for associative memories," *28th IEEE Conf. Decision & Control*, Tampa, Florida, pp. 252-259, 1989.

13. A. N. Michel, J. A. Farrell, H. F. Sun, "Synthesis techniques for discrete time neural network models,"," *28th IEEE Conf. Decision & Control*, Tampa, Florida, pp. 773-778, 1989.

14. A. N. Michel, J. A. Farrell, "Digital implementations of linear feedback controllers: Qualitative properties and limitations," *28th IEEE Conf. Decision & Control*, Tampa, Florida, pp. 2233-2237, 1989.

15. W. Goldenthal, J. Farrell, "Application of neural networks to automatic control," *AIAA Guidance, Navigation, & Control Conf.*, Portland Oregon, pp. 1108-1112, 1990.

16. W. L. Baker, J. A. Farrell, "Connectionist learning systems for control," *SPIE Int. Soc. of Optical Eng.*, Boston, Massachusetts, pp.181-198, 1990 (Non-Refereed).

17. J. Farrell, B. Goldenthal, K. Govindarajan, "Connectionist learning control systems: Submarine depth control," *29th Ann. IEEE Conf. Decision & Control*, Honolulu, Hawaii, pp. 2362-2367, 1990.

18. J. S. Alexander, L. C. Baird, W. L. Baker, J. A. Farrell, "A design & simulation tool for connectionist learning control systems: Application to autonomous underwater vehicles," *SCS Summer Computer Simulation Conf.*, Baltimore, Maryland, pp. 771-776, 1991 (Non-Refereed).

19. W. L. Baker, J. A. Farrell, "Learning augmented flight control for high performance aircraft," *AIAA Conf. Guidance, Navigation, & Control*, New Orleans, Louisiana, pp. 347-358, 1991.

20. J. Farrell, W. Baker, "Learning augmented control for advanced autonomous underwater vehicles," *18th Ann. Symp. & Exhibit Assoc. Unmanned Vehicle Systems*, Washington, DC, pp. 462-468, 1991 (Non-Refereed).

21. M. M. Livstone*, J. A. Farrell, W. L. Baker, "A computationally efficient algorithm for training recurrent connectionist networks," *Amer. Control Conf.*, Chicago, Illinois, pp. 555-561, 1992.

22. J. Farrell, B. Appleby, T. Berger*, "On the detection and accommodation of unanticipated faults," *AIAA Conf. Guidance, Navigation, & Control*, Hilton Head, South Carolina, pp. 1045-1054, 1992.

23. B. Clauberg*, J. Farrell, "Issues in the implementation of an indirect adaptive control system," *1st IEEE Conf. Control Applications*, Dayton, Ohio, pp. 1068-1075, 1992.

24. R. Mangoubi, B. Appleby, J. Farrell, "Robust estimation in fault detection," *31st IEEE Conf. Decision & Control*, Tucson, AZ, pp. 2317-2322, 1992.

25. J. Farrell, J. Plump, "Adaptive ballast control," *20th Ann. Symp. & Exhibit Assoc. Unmanned Vehicle Systems*, Washington, DC, pp. 322-329, 1993 (Non-Refereed).

26. J. Farrell, M. Livstone*, "Exact calculation of discrete-time process noise statistics for hybrid continuous/discrete time applications," *32nd IEEE Conf. Decision & Control*, San Antonio, Texas, pp. 857-858, 1993.

27. M. M. Livstone*, M. A. Dahleh, J. A. Farrell, "A framework for robust control based model invalidation," *Amer. Control Conf.*, Baltimore, Maryland, pp. 3017-3020, 1994.

28. W. D. Hall, J. A. Farrell, "Activity-based mission planning and plan management for autonomous vehicles," *IEEE Symp. Autonomous Underwater Vehicle Tech.*, Cambridge, Massachusetts, pp. 45-53, 1994 (Non-Refereed).

29. J. Chen, J. Farrell, C. N. Nett, K. Zhou, "H_∞ identification of multivariable systems by tangential interpolation methods," *32nd IEEE Conf. Decision & Control*, Lake Buena Vista, Florida, pp. 4158-4163, 1994.

30. J. A. Farrell, T. Berger*, "On the effects of the training sample density in passive learning control," *American Control Conf.*, Portland, Oregon, pp. 872-877, 1995.

31. M. M. Livstone*, M. A. Dahleh, J. A. Farrell, "A new framework for iterative identification and control," *IEEE American Control Conference*, Seattle, Washington, pp. 3546-3550, 1995.

32. N. Sureshbabu*, J. A. Farrell, "Wavelet based system identification for nonlinear control applications," *10th IEEE Int. Symp. Intelligent Control*, Monterey, California, pp. 236-241, 1995.

33. M. Grewal, J. Farrell, M. Barth, "Application of DGPS/INS to automobile navigation with latency compensation," *IEEE Position Location & Navigation Symp*, Atlanta, Georgia, pp. 433-436, 1996 (Non-Refereed).

34. J. A. Farrell, "Persistence of excitation conditions in passive learning control," *Int. Federation Automatic Control Conf.*, San Francisco, California, pp. 313-318, 1996.

35. A. Wistrom, J. Farrell, "Automatic control of flocculation processes," *ASCE Proc. North American Water Environ. Congress '96*, Anaheim, California, 997-1002, 1996.

36. J. A. Farrell, "Approximator characteristics and their effect on training misbehavior in passive learning control," *IEEE Int. Symp. Intelligent Control*, Detroit, Michigan, pp. 181-187, 1996.

37. J. Farrell, M. Grewal, M. Djodat*, M. Barth, "Differential GPS with latency compensation for autonomous navigation," *IEEE Int. Symp. Intelligent Control*, Detroit, Michigan, pp. 20-25, 1996.

38. J. Farrell, "Exponential convergence conditions for passive learning control," *American Control Conference*, New Mexico, pp. 1809-1813, 1997.

39. J. Farrell, "On performance evaluation in on-line approximation based control: methods and pitfalls," *Proc. 1997 IEEE CDC*, New Mexico, June 1997, pp. 1585-1590, 1997.

40. J. Farrell, A. Wistrom, "Flocculation control: System identification - experimental results," *Proc. 7th IAWQ ICA Workshop*, Brighton, United Kingdom, pp. 373-380, 1997.

41. A. Wistrom, J. Farrell, "Simulation of dynamic models for automatic flocculation control," *Proc. 7th IAWQ ICA Workshop*, Brighton, United Kingdom, pp. 381-386, 1997.

42. W. Li, F. M. Wahl, B. Krebs, J. A. Farrell, "Extraction of line and step edges by fuzzy reasoning," *Int. Conf. on Computational Intelligence for Modeling Control, and Automation*, Vienna, Austria, pp. 507-512, 1999.

43. X. G. Chang, W. Li, J. A. Zhou, J. A. Farrell, "Dynamic behavior modeling of stoker-fired boilers by recurrent fuzzy-neuro networks," *Int. Conf. on Computational Intelligence for Modeling Control, and Automation*, Vienna, Austria, pp. 190-195, 1999.

44. J. Farrell, T. Givargis*, "Experimental differential GPS reference station evaluation," *American Control Conference*, San Diego, California, pp. 3645-3649, 1999.

45. J. Farrell, T. Givargis*, M. Barth, "Differential carrier phase GPS-aided INS for automotive applications," *American Control Conference,*, San Diego, California, pp. 3660-3664, 1999.

46. J. Y. Choi, J. A. Farrell, "Adaptive observer for a class of nonlinear systems using neural networks," *IEEE International Symposium on Intelligent Control*, Cambridge, Massachusetts, pp. 114-119, 1999.

47. J. Y. Choi, J. A. Farrell, "Nonlinear adaptive control using networks of piecewise linear approximators," *38th IEEE Conference on Decision and Control*, Phoenix, Arizona, pp. 1671-1676, 1999.

48. Y. Yang*, J. Farrell, M. Barth, "High-accuracy, high frequency differential carrier phase GPS aided low-cost INS," *IEEE PLANS*, San Diego, California, pp. 148-155, 2000.

49. X. Chang, W. Li*, J. Farrell, "A C-means clustering based fuzzy modeling method," *IEEE International Conference on Fuzzy Systems*, San Antonio, Texas, pp. 937-40, 2000.

50. J. Choi, J. Farrell, "Observer-based backstepping control using on-line approximation," *American Controls Conference*, Chicago, Illinois, pp. 3646-3650, 2000.

51. W. Williamson, J. Min, J. Speyer, J. Farrell, "A comparison of state space, range space, and carrier phase differential GPS/INS relative navigation," *American Controls Conference*, Chicago, Illinois, pp. 2932-2938, 2000.

52. W. Li*, J. Farrell, F. M. Wahl, K. R. Kozlowski, "A nonholonomic mobile robot navigation in uncertain environments based on behavior control," *Proceedings of World Automation Congress*, Maui, Hawaii, 7 pgs., 2000.

53. Y. Yang*, J. Farrell, H. S. Tan, "Carrier Phase Differential GPS-aided INS based Vehicle Control: Experimental Results," *ION National Technical Meeting*, Long Beach, CA, pp. 679-689, 2001.

54. Y. Yang*, J. Farrell, "Magnetometer and Carrier Phase GPS aided INS for Automotive Control," *ION National Technical Meeting*, Long Beach, CA, pp. 690-695, 2001.

55. Y. Yang*, J. A. Farrell, H.S. Tan, "GPS-aided INS Based Control State Calculation for AHS," *American Control Conference*, Arlington, VA, pp. 2321-2326, 2001.

56. S. Pang*, J. Farrell, J. Du, M. Barth, "Battery State-of-Charge Estimation," *American Control Conference*, Arlington, VA, pp. 1644-1649, 2001.

57. W. Li, X. Chang, J. Farrell, "Stability and performance analysis of an enhanced hybrid fuzzy p+id controller," *American Control Conference*, Arlington, VA, pp. 3855-3860, 2001.

58. J. Stoev, J. Y. Choi, J. A. Farrell, "Adaptive neuro control for output feedback nonlinear systems," *2001 American Control Conference*, Arlington, VA, pp. 3097-3102, 2001.

59. V. K. Gazi, M. Passino, J. A. Farrell, "Adaptive Control of Discrete Time Nonlinear Systems Using Dynamic Structure Approximators," *2001 American Control Conference*, Arlington, VA, pp. 3091-3096, 2001.

60. Y. Yang*, J. Farrell, "Fast Ambiguity Resolution for GPS/IMU Attitude Determination," *ION GPS 2001*, Salt Lake City, UT, pp. 2990-2997, 2001.

61. Y. Yang*, J. Farrell, "Two-Antenna GPS and Low Cost INS Tight Integration for Attitude Determination," *ION GPS 2001*, Salt Lake City, UT, pp. 2960-2971, 2001.

62. J. Nakanishi, J. A. Farrell, S. Schaal, "A Locally Weighted Learning Composite Adaptive Controller with Structure Adapatation," *IEEE/RSJ International Conference on Intelligent Robots and Systems*, Lausanne, Switzerland, 882-889, 2002.

63. M. Polycarpou, J. A. Farrell, M. Sharma, "On-Line Approximation Control of Uncertain Nonlinear Systems: Issues with Control Input Saturation," *American Control Conference*, Denver, CO, 543-548, 2003.

64. J. A. Farrell, M. Polycarpou, M. Sharma, "Adaptive backstepping with magnitude, rate, and bandwidth constraints: Aircraft longitude control," *American Control Conference*, Denver, CO, 3898-3903, 2003.

65. H.-S. Tan, B. Bougler, J. A. Farrell, Y. Yang*, "Automated Steering Controls: DGPS/INS and Magnetic Markers," *American Control Conference*, Denver, CO, 60-65, 2003.

66. J. A. Farrell, M. Sharma, M. M. Polycarpou, "On-line Approximation Based Aircraft Longitudinal Control," *American Control Conference*, Denver, CO, 1011-1015, 2003.

67. R. M. Arrieta, J. A. Farrell, W. Li*, S. Pang*, "Initial Development and Testing of an Adaptive Mission Planner for a Small Unmanned Underwater Vehicle," *Proc. Of the 22nd Int. Conf. On Offshore Mechanics and Artic Engineering*, Cancun, Mexico, OMEA2003-37273, 2003 (Non-Refereed).

68. M. Sharma, J. A. Farrell, M. Polycarpou, N. D. Richards, D. G. Ward, "Backstepping Flight Control using On-Line Function Approximation," *AIAA Guidance, Navigation, and Control Conference*, AIAA 2003-5713, Austin, TX, 10 pgs., 2003 (Partially-Refereed), DOI: 10.2514/6.2003-5713.

69. J. A. Farrell, W. Li*, S. Pang*, R. Arrieta, "Chemical Plume Tracing Experimental Results with a REMUS AUV," *MTS/IEEE Oceans*, San Diego, CA, 962-968, 2003 (Partially-Refereed).

70. S. Pang*, J. A. Farrell, R. M. Arrieta, W. Li, "AUV Reactive Planning: Deepest Point," *MTS/IEEE Oceans 2003*, San Diego, CA, 2222-2226, 2003 (Non-Refereed).

71. J. Cheng*, J. A. Farrell, L. Yu*, E. Thomas*, "Aided Integer Ambiguity Resolution Algorithm," *IEEE Position, Location, and Navigation Conference*, Monterey, CA, 740-745, 2004.

72. M. M. Polycarpou, J. A. Farrell, M. Sharma, "Robust On-Line Approximation Control of Uncertain Nonlinear Systems Subject to Constraints," *9th IEEE International Conference on Engineering of Complex Computer Systems*, Florence, Italy, 66-74, 2004.

73. J. Nakanishi, J. A. Farrell, S. Schaal, "Learning Composite Adaptive Control for a Class of Nonlinear Systems," *IEEE International Conference on Robotics and Automation*, New Orleans, LA, 2647-2652, 2004.

74. J. A. Farrell, M. Polycarpou, M. Sharma, "On-Line Approximation Based Control of Uncertain Nonlinear Systems with Magnitude, Rate and Bandwidth Constraints on the States and Actuators," *American Control Conference*, Boston, MA, 2557-2562, 2004.

75. Y. Zhao*, J. A. Farrell, M. M. Polycarpou, "Localized Adaptive Bounds for Online Approximation Based Control," *American Control Conference*, Boston, MA, 590-595, 2004.

76. J. A. Farrell, S. Pang*, W. Li*., R. Arrieta, "Biologically Inspired Chemical Plume Tracing Demonstrated on an Autonomous Underwater Vehicle," *IEEE Systems, Man, and Cybernetics Conference*, Hague, Netherlands, 5991-5996, 2004.

77. Y. Lu*, J. Cheng*, J. A. Farrell, "A New Method to Enhance GPS SNR its Application in Fast Signal Acquisition," *61st annual meeting of the Institute of Navigation*, Cambridge, MA, June, 535-542, 2005 (Partially-Refereed).

78. Y. Zhao*, J. A. Farrell, "A Locally Weighted Learning Method for Online Approximation Based Control," *IEEE CDC/ECC 2005*, Seville, Spain, 2694-2701, 2005.

79. Y. Zhao*, J. A. Farrell, "Localized Adaptive Bounds for Online Approximation Based Control," *IEEE CDC/ECC 2005*, Seville, Spain, 789-795, 2005.

80. J. A. Farrell, Y. Zhao*, "Self-organizing Approximation Based Control," *Proceedings of the American Control Conference*, Minneapolis, MN, 3378-3384, 2006.

81. W. J. Dong*, Y. Guo, J. A. Farrell, "Formation Control of Nonholonomic Mobile Robots," *Proceedings of the American Control Conference*, Minneapolis, MN, 5602-5607, 2006.

82. Y. Zhao*, J. A. Farrell, "A Locally Weighted Learning Method for Nonaffine-in-Control Systems," *IEEE Conference on Decision and Control*, San Diego, CA, 3454-3460, 2006.

83. W. Dong*, J. A. Farrell, "Decentralized Cooperative Control of Multiple Nonholonomic Systems," *IEEE Conference on Decision and Control*, New Orleans, LA, 1486-1491, 2007.

84. Y. Zhao*, J. A. Farrell, "Performance-Based Self-Organizing Approximation for Scalar State Estimation and Control," *American Control Conference*, New York, NY, 3913-3918, 2007.

85. P. Miller*, Y. Zhao*, V. Djapic*, J. A. Farrell, "Advanced Navigation Algorithms applied to Autonomous Underwater Vehicles," *15th International Symposium on Unmanned Untethered Submersible Technology*, U. New Hampshire, August, 8 pgs, 2007 (Partially-Refereed).

Miller won a 2008 Navy Top Scientists and Engineers Award for his efforts on research related to this article. His nomination for that award cites Farrell as his mentor.

86. V. Djapic*, J. A. Farrell, P. Miller*, R. Arrieta, "Advanced non-linear control algorithms applied to design highly maneuverable Autonomous Underwater Vehicles," *15th International Symposium on Unmanned Untethered Submersible Technology*, University of New Hampshire, 8 pgs, 2007 (Partially-Refereed).

87. W. Dong* and J. A. Farrell, "Decentralized Cooperative Control of Multiple Nonholonomic Systems," *IEEE Conference on Decision and Control*, New Orleans, LA, 1486-1491, 2007.

88. Y. Zhao* and J.A. Farrell, "Self-organizing Approximation for Controllable Nonaffine Systems," *IEEE Conference on Decision and Control*, New Orleans, LA, 1281-1287, 2007.

89. B. Song, C. Soto, A. K. Roy-Chowdhury, J. A. Farrell, "Decentralized Camera Control using Game Theory," *Workshop on Smart Camera and Visual Sensor Networks at ICDSC* 2008, pp. 1-8, 2008.

90. W. Dong*, J. A. Farrell, "Consensus of multiple uncertain mechanical systems and its application in cooperative control of mobile robots," *IEEE International Conference on Robotics and Automation*, Pasadena, CA, 1954-1959, 2008.

91. W. Dong*, J. A. Farrell, "Formation Control of Multiple Mobile Robots with Uncertainty," *American Control Conference*, Seattle, WA, June 2008, 1412-1417, 2008.

92. W. Dong*, Y. Zhao*, J. A. Farrell, "Tracking Control of Nonaffine System: A Self-organizing Approximation Approach," *American Control Conference*, Seattle, WA, 69-74, 2008.

93. J. A. Farrell, M. Polycarpou, M. Sharma, W. Dong*, "Command Filtered Backstepping," *American Control Conference*, Seattle, WA, 1923-1928, 2008.

94. V. Djapic*, J. A. Farrell, W. Dong*, "Land Vehicle Control Using Command Filtered Backstepping Approach," *American Control Conference*, Seattle, WA, 2461-2466, 2008.

95. W. Dong*, J. A. Farrell, "Optimal Regulation of Unknown Nonlinear Systems Based on Locally Weighted Learning," *Multiconference on Systems and Control: International Symposium on Intelligent Control*, San Antonio, TX, 1079-1084, 2008.

96. V. Djapic*, J. A. Farrell, W. Dong*, "Hybrid Control Design Applied in Land Vehicle Behavior-Based Switching Controller," *2008 IEEE Multi-conference on Systems and Control*, San Antonio, 648-653, 2008.

97. W. Dong*, J. A. Farrell, "Consensus of Multiple Nonholonomic Systems," *47th IEEE Conference on Decision and Control*, Cancun, Mexico, 2270--2275, 2008.

98. W. Dong*, J. A. Farrell, "Optimal Tracking Control for Unknown Nonlinear Systems Based on Locally Weighted Learning," *47th IEEE Conference on Decision and Control*, Cancun, Mexico, 2148-2153, 2008.

99. W. Dong* and J. A. Farrell, "Adaptive Approximately Optimal Control of Unknown Nonlinear Systems Based on Locally Weighted Learning," *IEEE Conf. on Decision and Control*, Shanghai, China, 345-350, 2009.

100. V. Djapic*, J. A. Farrell, W. Dong*, "Unifying Behavior-Based Control Design and Hybrid Stability Theory," *American Control Conference*, St. Louis, 3650-3655, 2009.

101. A. Chen*, A. Ramanandan* and J. A. Farrell, "Improved Integer Ambiguity Resolution by Combining LAMBDA and LMS," *Proceedings of the 22nd International Technical Meeting of the Satellite Division of the Institute of Navigation*, Savannah, GA, 963-969, 2009 (Partially-Refereed).

102. A. Chen*, A. Ramanandan*, J. A. Farrell, "High-precision lane-level road map building for vehicle navigation: nodal approach," *IEEE/ION PLANS*, Indian Wells CA, 1035-1042, 2010 (Partially-Refereed).

103. W. Dong*, J. A. Farrell, M. M. Polycarpou, M. Sharma, "Command Filtered Adaptive Backstepping," *American Control Conference*, Baltimore, MD, 105-110, 2010.

104. A. Ramanandan*, A. Chen*, J. A. Farrell, S. Suvarna, "Detection of Stationarity in an Inertial Navigation System," *Proceedings of the ION GNSS*, Portland, OR, 238 - 244, 2010 (Partially-Refereed).

105. A. Ramanandan*, A. Chen*, J. A. Farrell, "Observability analysis of INS and lever-arm error states with CDGPS-Camera aiding," April, *IEEE Position Location and Navigation Symposium (PLANS)*, Indian Wells CA, April 2010, 1197--1203, 2010 (Partially-Refereed).

106. A. Morye*, C. Ding, B. Song, A. K. Roy-Chowdhury, J. A. Farrell, "Optimized Imaging and Target Tracking within a Distributed Camera Network," *American Control Conference*, San Francisco, 474-480, 2011.

107. A. Ramanandan*, A. Chen*, J. A. Farrell, "Observability Analysis of an Inertial Navigation System with Stationary Updates," *American Control Conference*, San Francisco, 5292-5299, 2011.

108. Y. Chen*, J. A. Farrell, "Self-organizing Approximation Based Control with L1 Transient Performance Guarantees," *American Control Conference*, San Francisco, 1169-1175, 2011.

109. A. Vu*, J. A. Farrell, M. Barth, "Landmark Surveying Using an Integrated Camera, Carrier-Phase DGPS, and Inertial Navigation System," *Proceedings of the ION GNSS*, Portland OR, 2287-2293, 2011 (Partially-Refereed).

110. A. Ramanandan*, A. Chen*, J. A. Farrell, "Improving Robustness of Aided Inertial Navigation Systems with Near Real Time Processing," *Proceedings of the ION GNSS*, Portland OR, 3868-3893, 2011 (Partially-Refereed).

111. Y. Chen*, W. Dong*, J. A. Farrell, "Self-Organized Locally Linearized Optimal Regulation for Unknown Nonlinear Systems," *IEEE Multiconference on Systems and Control*, Denver, CO, 1276-1281, 2011.

112. D. Zheng*, K. Cui, B. Bai, G. Chen, J. A. Farrell, "Indoor navigation based on LEDs," *IEEE Multiconference on Systems and Control*, Denver, CO, 573-578, 2011.

113. A. Chen*, D. Zheng*, A. Ramanandan, J. A. Farrell, "INS Aided GPS Integer Ambiguity Resolution," *2011 IEEE Multiconference on Systems and Control*, Denver, CO, 567-572, 2011.

114. A. Chen*, D. Zheng*, A. Ramanandan, J. A. Farrell, "GPS Integer Ambiguity Validation with GPS Modernization," Int. Tech. Mtng. of the Satellite Division of the Institute of Navigation, Portland, OR, 2011.

115. A. Ramanandan*, J. A. Farrell, A. Chen*, "A Near-Real Time Nonlinear State Estimation Approach with Application to Initialization of Navigation Systems," *50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, FL, 3184-3191, 2011.

116. A. Chen*, D. Zheng, * A. Ramanandan*, J. A. Farrell, "Near-real-time GPS Integer Ambiguity Resolution," *50th IEEE Conference on Decision and Control and European Control Conference*, Orlando FL, 7281-7286, 2011.

117. Y. Chen*, W. Dong*, J. A. Farrell, "Self-Organized Locally Linearized Optimal Tracking Control for Unknown Nonlinear Systems," *50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, FL, 5401-5406, 2011.

118. S. Zhao*, J. A. Farrell, "Optimization-based Road Curve Fitting," *50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, FL, 5293-5298, 2011.

119. A. Kamal, C. Ding, J. A. Farrell, A. K. Roy-Chowdhury, "A Generalized Kalman Consensus Filter for Wide-Area Video Networks," *50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, FL, 7863-7869, 2011.

120. W. Dong*, M. B. Ghalia, J. A. Farrell, "Tracking Control of Multiple Nonlinear Systems via Information Interchange," *50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, FL, 5076-5081, 2011.

121. W. Dong*, M. B. Ghalia, J. A. Farrell, "Distributed Control of Multiple Wheeled Mobile Robots," *50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, FL, 1373-1378, 2011.

122. M. Barth, J. A. Farrell, M. Todd, "Innovative Approaches for Next-Generation Vehicle Positioning," *90th Transportation Research Board Annual Meeting*, poster, Washington, DC, 2011. (Non-Refereed).

123. C. Ding, A. Morye*, J. A. Farrell, A. K. Roy-Chowdhury, "Coordinated Sensing and Tracking for Mobile Camera Platforms," June, *2012 American Control Conference*, Montreal, CA, 5114-5119, 2012.

124. A. Vu*, J. A. Farrell, R. Vanitsthian*, M. Barth, "Improved Vehicle Trajectory and State Estimation Using Raw GPS and IMU Data Smoothing," *IEEE Intelligent Vehicle Symp.*, Alcala de Henares, Spain, 6 m.s., 2012.

125. C. Ding, A. Morye*, J. A. Farrell, A. K. Roy-Chowdhury. Opportunistic Sensing in a Distributed PTZ Camera Network. *6th ACM/IEEE International Conference on Distributed Smart Cameras (ICDSC 2012)*. Hong Kong. 166-171, 2012.

126. A. T. Kamal, J. A. Farrell, A. K. Roy-Chowdhury, Consensus-based Distributed Estimation in Camera Networks, *IEEE International Conference on Image Processing*, 1109-1112, 2012.

127. A. Kamal, J. A. Farrell, A. K. Roy-Chowdhury, "Information Weighted Consensus," *IEEE Conference on Decision and Control*, 2732-2737, 2012.

128. S. Zhao*, J. A. Farrell, "Quaternion-based Trajectory Tracking Control of VTOL-UABs using Command Filtered Backstepping," *American Control Conference*, Washington, DC, 1018-1023, 2013.

129. D. Zheng*, R. Vanitsthian, G. Chen, J. A. Farrell, "LED-based Initialization and Navigation," *American Control Conference*. Washington, DC, 6199-6205, 2013.

130. A. A. Morye*, C. Ding, A. K. Roy-Chowdhury, J. A. Farrell, "Constrained Optimization for Opportunistic Distributed Visual Sensing", *American Control Conference*, 6294-6301, 2013.

131. A. T. Kamal, J. A. Farrell, A. K. Roy-Chowdhury, Information Consensus for Distributed Multi-Target Tracking, *IEEE Conf. on Computer Vision and Pattern Recognition*, 2403-2410, 2013.

132. A. Vu*, Q. Yang, J. A. Farrell, M. Barth, "Traffic Sign Detection, State Estimation, and Identification Using Onboard Sensors," *16th International IEEE Intelligent Transportation Systems Conference*, The Hague, Netherlands, 875-880, 2013.

133. Y. Chen*, D. Zheng*, P.A. Miller, J.A. Farrell., Underwater Inertial Navigation with Long Base Line Tranceivers: A Near-Realtime Approach, *52nd IEEE Conference on Decision and Control,* Florence, Italy, 5042—5047, 2013.

134. Y. Chen*, D. Zheng*, P.A. Miller, J.A. Farrell, "Underwater Vehicle Near-Real-Time State Estimation," *IEEE Multi-Conference on Systems and Control*, Hyderabad, India, 545-550, 2013.

135. D. Zheng*, G. Chen, J.A. Farrell, "Navigation Using Linear Photo Detector Arrays," *IEEE Multi-Conference on Systems and Control*, Hyderabad, India, 533-538, 2013.

136. S. Zhao*, J.A. Farrell, "2D LIDAR Aided INS for Vehicle Positioning in Urban Environments," *IEEE Multi-Conference on Systems and Control*, Hyderabad, India, 376-381, 2013.

137. A. A. Morye*, E. Franco, A. K. Roy-Chowdhury, J. A. Farrell, "Distributed Camera Control via Moving Horizon Bayesian Optimization," *American Control Conference*, Portland, OR, pp. 2083 - 2089, 2014.

138. P. Lin, W. Ren, D. Song, J. A. Farrell, "Distributed Optimization with the Consideration of Adaptivity and Finite-Time Convergence," *American Control Conference*, Portland, OR, pp. 3177 – 3182, 2014.

139. D. Zheng*, G. Chen*, J. A. Farrell, "LED path recovery in a moving sensor," *IFAC World Congress*, Cape Town, South Africa, pp. 8965 - 8970, 2014.

140. S. Zhao*, Y. Chen*, H. Zhang*, J. A. Farrell, "Differential GPS aided Inertial Navigation: A Contemplative Realtime Approach," *IFAC World Congress*, Cape Town, South Africa, pp. 8959 - 8964, 2014.

Finalist for IFAC Conference Best Application Paper Prize.

141. S. Zhao*, Y. Chen*, J. A. Farrell, "High Precision Vehicle Navigation in Urban Environments using Low-cost Single-frequency RTK GPS Receiver," IROS 6th Workshop on Planning, Perception, and Navigation for Intelligent Vehicles, Chicago, 5 pgs., 2014.

142. D. Zheng*, G. Chen*, J. A. Farrell, "An algorithm to recover an LED path", *European Control Conference,* Strasbourg, France, pp. 1631 - 1636, 2014.

143. Y. Chen*, S. Zhao*, D. Zheng, J. A. Farrell, "High Reliability Integer Ambiguity Resolution of 6DOF RTK GPS/INS," *53rd IEEE Conference on Decision and Control,* Los Angeles, pp. 6609 - 6614, 2014.

144. P. F. Roysden*, J. A. Farrell, D. Kelley, "Enhanced State Estimation for Wheeled Vehicles," Proc. 28th Int. Tech. Meeting of the Sat. Div. of the Inst. of Navigation, pp. 2275 - 2281, 2015.

145. E. Aghapour*, J. A. Farrell, "Human Action Prediction for Human Robot Interaction," American Control Conference, Boston, MA, pp. 5407-5412, 2016. DOI: 10.1109/ACC.2016.7526517

146. P. Roysdon*, J. A. Farrell, "GPS-INS Outlier Detection & Elimination using a Sliding Window Filter," American Control Conference, Seattle, WA, pp. 1244-1249, May 2017. DOI: 10.23919/ACC.2017.7963123

147. M. Billah*, A. Maskooki*, F. Rahman*, J. A Farrell, "Roadway Feature Mapping from Point Cloud Data: A Graph-Based Clustering Approach," IEEE Intelligent Vehicles Symposium, pp. 475-480, June 2017. DOI: 10.1109/IVS.2017.7995763

148. J. A. Farrell, P. Roysdon*, "Advanced Vehicle State Estimation: A Tutorial and Comparative Study," IFAC World Congress, pp. 15971-15976, July 2017. DOI: 10.1016/j.ifacol.2017.08.1751.

149. P. Roysdon*, J. A. Farrell, "Robust GPS-INS Outlier Accommodation: A Soft-Thresholded Optimal Estimator," IFAC World Congress, pp. 3574-3579, July 2017. DOI: 10.1016/j.ifacol.2017.08.682.

150. J. Garcia*, J. A. Farrell, Z. Kassas, "Optimal Range-Aided Navigation for Underwater Vehicles," IEEE/ION PLANS, Monterey, CA, pp. 480-486, April 2018. DOI: 10.1109/PLANS.2018.8373416

151. E. Aghapour*, F. Rimi*, J. A. Farrell, "Outlier Accommodation for Meter-level Positioning: Risk-Averse Performance-Specified State Estimation," IEEE/ION PLANS, Monterey, CA, pp. 627-633, April 2018 DOI: 10.1109/PLANS.2018.8373436.

152. F. Rimi*, E. Aghapour*, J. A. Farrell, "ECEF Position Accuracy and Reliability for Connected and Autonomous Vehicle Requirements," IEEE/ION PLANS, Monterey, CA, p. 583 - 588, April 2018, DOI: 10.1109/PLANS.2018.8373430.

153. E. Aghapour*, J. A. Farrell, "Performance-Specified Moving-Horizon State Estimation with Minimum Risk," European Control Conference, Cyprus, pp.2818-2823, 2018, DOI: 10.23919/ECC.2018.8550605.

154. E. Aghapour*, J. A. Farrell, "Performance-Specified State Estimation with Minimum Risk," American Control Conference, pp. 1114-1119, 2018. DOI: 10.23919/ACC.2018.8431239.

155. E. Aghapour*, F. Rahman*, J. A. Farrell, "Outlier Accommodation by Risk-Averse Performance-Specified Linear State Estimation," IEEE Conf. on Decision and Control, pp. 2310-2315, 2018, DOI: 10.1109/CDC.2018.8619401.

156. F. Rahman*, E. Aghapour*, J. A. Farrell, "Risk-Averse Performance-Specified Nonlinear State Estimation: GNSS Aided INS," IEEE Conf. on Decision and Control, pp. 5922-5927, 2018, DOI: 10.1109/CDC.2018.8618876.

157. M. S. Billah*, J. A. Farrell, "Bucket Wheel Reclaimer Calibration," American Control Conference, pp. 3149-3154, 2019, DOI: 10.23919/ACC.2019.8814966.

158. M. S. Billah*, J. A. Farrell, "Real-time Time-varying Surface Reconstruction and Edge Point Extraction For Bucket Wheel Reclaimers," IEEE Conference on Control Technology and Applications (CCTA), pp. 47-52, Hong Kong, China, 2019, pp. 47 – 52, DOI: 10.1109/CCTA.2019.8920559.

159. F. Rimi*, J. A. Farrell, "ECEF Vehicle State Estimation Performance," IEEE Conference on Control Technology and Applications (CCTA), Hong Kong, China, 2019, pp. 27-32, DOI: 10.1109/CCTA.2019.8920628.

160. E. Aghapour*, J. A. Farrell, "Outlier Accommodation in Sensor Rich Environments: Moving Horizon Risk-Averse Performance-Specified State Estimation," IEEE Conf. on Decision and Control, 2019, pp. 7917-7922, DOI: 10.1109/CDC40024.2019.9029826.

161. W. Hu*, David Oswald, Guoyuan Wu, J.A. Farrell, "Assessment of U.S. Department of Transportation Lane-Level Map for Connected Vehicle Applications," http://arxiv.org/abs/2206.13774.

162. J.B. Uwineza*, J.A. Farrell, "Cooperative Estimation of Local Atmospheric Delay in Precise Point Positioning with GNSS," IEEE Conference on Control Technology and Applications (CCTA), Trieste, Italy, pp. 102-108, 2022, http://dx.doi.org/10.1109/CCTA49430.2022.9966162.

163. F. O. E. Silva, W. Hu, J. A. Farrell, "Real-Time Precise Point Positioning for Connected Autonomous Vehicles: A Case Study over Brazilian Territory," Submitted on 11/ 7/2022 to the 2023 IFAC World Congress. Accepted March 3, 2023.

164. I. Ramos, F. Silva, L. Oliveira, D. Lima and J. A Farrell, "On the Performance Degradation of GPS Positioning due to Outdated RT-PPP Products," SBAI-SBSE-2023 (XVI Simpósio Brasileiro de Automação Inteligente e X Simpósio Brasileiro de Sistemas Elétricos). Accepted 8/7/2023.

165. V. M. G. B. Cavalcanti, F. O. Silva, Á. H. A. Maia, D. A. de Lima, A. C. Leite and J. A. Farrell, "Evolutionary Optimization for Tuning Barometer-aided Inertial Navigation System Vertical Channel

Mechanization," SBAI-SBSE-2023 (XVI Simpósio Brasileiro de Automação Inteligente e X Simpósio Brasileiro de Sistemas Elétricos). Accepted 08/07/2023.

166. M. V. O. Pacheco, F. O. Silva, and J. A. Farrell, "GPS-Aided Odometry Navigation for IARs: Comparison Between Loosely and Tightly Coupled Integrations Under Restricted Satellite Visibility Conditions," 20th IEEE Latin American Robotics Symposium - LARS 2023, Salvador, Bahia, Brazil, Oct 9-11, 2023. Accepted 08/23/2023.

167. W. Hu*, J.-B. Uwineza*, J. A. Farrell, "Outlier Accommodation for Multi-GNSS Precise Point Positioning using Risk-Averse Performance-Specified Approach," accepted to ACC 2024 on 1/23/2024, 7 M.S.

168. W. Hu*, Zeyi Jiang*, Hamed Mohsenian-Rad, J. A. Farrell, "Convex Reformulation of Risk-Averse Linear State Estimation with Mixed-Binary Variables for Outlier Accommodation," submitted to CDC 2024.

Book Chapters

1. A. Michel, J. Farrell, W. Porod, "Stability Results for Neural Networks," *In Neural Information Processing Systems*, American Institute of Physics, D.Z. Anderson (ed.), pp. 554-563, 1988.

2. A.N. Michel, J.A. Farrell, W. Porod, "Qualitative Analysis of Neural Networks," *Analysis and Control of Nonlinear Systems*, Elsevier Science Publishers B. V, North Holland, C.I. Byrnes, C.F. Martin, R.E. Saeks (eds.), pp. 349-358, 1988.

3. W.L. Baker, J.A. Farrell, "Chapter 2: An Introduction to Connectionist Learning Control Systems," *Handbook of Intelligent Control: Neural Network, Fuzzy Logic, and Adaptive Implementations*, Van Nostrand Reinhold Publishers, D. White, D. Sofge (eds.), pp. 35-63, 1992.

4. J. Farrell, W. Baker, "Chapter 10: Learning Control Systems," *An Introduction to Intelligent & Autonomous Control*, Kluwer Academic Publishers, P. Antsaklis, K. Passino (eds.), pp. 237-262, 1992.

5. J. Farrell, W. Baker, "Chapter 17: Learning Control Systems: Motivation and Implementation," *Intelligent Control Systems: Theory & Practice*, IEEE Press, M. Gupta, N. Sinha (eds.), pp. 445-478, 1995.

6. J. Farrell, "Chapter 57.11: Neural Control," *The Controls Handbook*, CRC Press, W.S. Levine (Ed.), pp. 1017-1030, 1996.

7. W. Li*, F.M. Wahl, B. Krebs, J. Farrell, "Extraction of Line and Step Edges by Fuzzy Reasoning, Computational Intelligence for Modeling, Control and Automation," *In Evolutionary Computation & Fuzzy Logic for Intelligent Control, Knowledge Acquisition & Information Retrieval*, IOS Press, Netherlands, M. Mohammadian (ed.), pp. 507-512, 1999.

8. X. Chang, W. Li*, J.Z. Zhou, J. Farrell, "Dynamic Behavior Modeling of Stoker-Fired Boilers by Recurrent Fuzzy-Neuro Networks," *Computational Intelligence for Modeling, Control and Automation. In Neural Networks & Advanced Control Strategies*, IOS Press, Netherlands, M. Mohammadian (eds.), pp. 190-195, 1999.

9. J. Farrell, M. Polycarpou, "Chapter 6: Neural, Fuzzy, and Approximation-Based Control," *In Perspectives in Control Engineering Technologies, Applications, and New Directions (ISBN 0-7803-5356-0)*, IEEE Press, T. Samad (ed.), pp. 134-164, 2000.

10. J. Farrell, "Control Systems," *Embedded System Design: a unified hardware/software introduction*, Chapter 9, New York:Wiley, F. Vahid, T. Givargis (authors), pp. 245-267, 2002.

11. J. A. Farrell, M. Sharma, M. Polycarpou, "Online Approximation-Based Aircraft State Estimation," *Stability and Control of Dynamical Systems with Applications*, Birkhauser, Boston, D. Liu, P. J. Antsaklis (eds.), 229-246, 2003 (Partially-Refereed).

12. J. Farrell, "State Estimation," *Electrical Engineering Handbook*, Elsevier Academic Press, W.-K. Chen (Ed.), 1049--1060, 2005 (Partially-Refereed).

13. Y. Zhao*, J. A. Farrell, "Robust Adaptive Approximation Based Backstepping Via Localized Adaptive Bounding," *Ch. 13 in Advances in Computational Intelligence: Theory and Applications*, World Scientific, F.-Y. Wang, D. Liu, 381-412, 2005 (Partially-Refereed).

14. J. Cheng*, L. Yu*, E. R. Thomas*, J. A. Farrell, "Data Fusion via Kalman Filter: GPS & INS," *Autonomous Mobile Robots: Sensing, Control, Decision-Making, and Applications*, Taylor and Francis, S. S. Ge, F. Lewis (Eds.), 99-148, 2006.

15. B. Song, C. Ding, A. Roy-Chowdhury J. Farrell, "Persistent Observation of Dynamic Scenes in An Active Camera Network," *Distributed Video Sensor Networks* 2010, Springer, 2010 (Non-Refereed).

16. M. M. Polycarpou, J. A. Farrell, "Neural Control," February, *The Control Handbook: Control System Advanced Methods, Second Edition.* Chapter 56, CRC Press, W. Levine, 1-20, 2011 (Invited, Non-Refereed).

17. A. T. Kamal**,** C. Ding, A. A. Morye*, J. A. Farrell, A. K. Roy-Chowdhury, An Overview of Distributed Tracking and Control in Camera Networks, in *Augmented Vision and Reality,* V. K. Asari Ed., Springer, pp. 207 – 234, 2013.

18. J. A. Farrell and J. Wendel, "GNSS/INS Integration," Handbook for Global Navigation Satellite Systems (GNSS), Switzerland: Springer AG, P. Teunissen and O. Montenbruck Eds., Chapter 28, pp. 811-840, 2017.

Patents

1. "Multiple Epoch GNSS Carrier Phase Integer Resolution," International Patent Number: WO 2017/031236 A1, February 23, 2017. Applicant: Regents of the University of California.   Inventors: Yiming Chen, Sheng Zhao, Jay A. Farrell

Technical Reports For Public Distribution

1. J. A. Farrell, F. O. Silva, F. Rahman, and J. Wendel, "IMU Error State Modeling for State Estimation and Sensor Calibration: A Tutorial" Draft manuscript posted at escholarship.org/uc/item/1vf7j52p on July 29, 2020. Authored on May 6, 2019.

2. F. Rahman, E. Aghapour, J. A Farrell, "ECEF Position Accuracy and Reliability in the Presence of Differential Correction Latency," Phase B Technical Report for Sirius XM. UC Riverside: Bourns College of Engineering. (2019) Retrieved from https://escholarship.org/uc/item/135578mw

3. F. Rahman, F. Silva, Z. Jiang, J. A. Farrell, "ECEF Position Accuracy and Reliability: Continent Scale Differential GNSS Approaches," Phase C Report, UC Riverside: Bourns College of Engineering, 2019. Retrieved from https://escholarship.org/uc/item/05p9p3c9

4. W. Hu, J. A. Farrell, "Technical Note: Derivation of Earth-Rotation Correction (Sagnac)and Analysis of the Effect of Receiver Clock Bias." UC Riverside: Bourns College of Engineering, (2019). Retrieved from https://escholarship.org/uc/item/1bf6w7j5

5. J. A. Farrell, G. Wu, W. Hu, D. Oswald, P. Hao, "Lane-Level Localization and Map Matching for Advanced Connected and Automated Vehicle (CAV) Applications," A Research Report from the National Center for Sustainable Transportation. March 2023. Available at https://escholarship.org/uc/item/1f7661b4 and https://ncst.ucdavis.edu/project/lane-level-localization-and-map-matching-advanced-connected-and-automated-vehicle-cav.

Non-Technical Publications

a. Magazine Articles

1. S. Pang*, J. A. Farrell, W. Li, "AUV-Based Chemical Plume Tracing," *Sea Technology Magazine*, 48, 7, 43-46, 2007.

b. Review of Articles/Books

1. J. A. Farrell, "Review of 'Stable Adaptive Control and Estimation for Nonlinear Systems: Neural and Fuzzy Approximation Techniques' by J. T. Spooner, M. Maggiore, R. Ordonez, and K. M. Passino, New York, NY: Wiley-Interscience 2002," *International Journal of Robust and Nonlinear Control*, 15, 53-54, 2005 **(Partially-Refereed)**.

2. J. A. Farrell, "Review of 'Handbook of Learning and Approximate Dynamic Programming' by Si, Barto, Powell, and Wunsch, Piscataway, NJ: IEEE 2004," *IEEE Transactions on Automatic Control*, 51, 10, 1730-1731, 2006 **(Partially-Refereed)**.

c. Other Miscellaneous

1. J. A. Farrell, "Technical Committee Activities: Technical Committee on Automotive Control," *IEEE Control Systems Magazine*, 28, 2, April 2008, 20, 2008.

2. J. A. Farrell, "Technical Committee Activities: Systems Biology Technical Committee," *IEEE Control Systems Magazine*, 28, 3, June 2008, 22, 35, 2008.

3. J. A. Farrell, "Technical Committee Activities: Technical Committee on Hybrid Systems," *IEEE Control Systems Magazine*, 28, 4, August 2008, 24-25, 2008.

4. J. A. Farrell, "Technical Committee Activities: Technical Committee on Intelligent Control," *IEEE Control Systems Magazine*, 28, 5, October 2008, 19-20, 2008.

5. Camacho, E. F., Chong, E., Farrell, J. A., Polycarpou, M. M., Editorial. *European Journal of Control*. Vol. 17: 5-6 p.447-448, 2011.

6. J. A. Farrell, "People in Control: Jay A. Farrell," *IEEE Control Systems Magazine,* Vol. 33: 6, p.24-28, 2013.

7. J. A. Farrell, "A Society of Volunteers," *IEEE Control Systems Magazine,* Vol. 34: 1, p.10-11, 2014.

8. J. A. Farrell, "Prediction is Very Difficult, Especially About the Future (Niels Bohr)" *IEEE Control Systems Magazine,* Vol. 34: 2, p.10, 13, 2014.

9. J. A. Farrell, "Impact of Control," *IEEE Control Systems Magazine,* Vol. 34: 3, p.10, 12, 16, 2014.

10. J. A. Farrell, "CSS Governance: Theory and Practice," *IEEE Control Systems Magazine,* Vol. 34: 4, p.12-13, 2014.

11. J. A. Farrell, "Control Ambassadors," *IEEE Control Systems Magazine,* Vol. 34: 5, p.12, 13, 98, 2014.

12. J. A. Farrell, "The Perspective One Year Later," *IEEE Control Systems Magazine,* Vol. 34: 6, 2 m.s. pgs., 98, 2014.

Commercialized Research Results

Two software prototypes that were outputs of my research program have been licensed for commercialization. This software processes Lidar and GNSS data in real-time for pile surface reconstruction in relation to port automation. Those two licenses have blossomed into eight commercial products that entered the market in 2021.

Selected Research Projects

Dates	Agency	Title	Amount $	Role	Status
2001 - 2003	California PATH	Magnetometer/GPS/INS Demo 2002 Support and Rapid Integer Ambiguity Resolution Research	193,889	PI	Closed
2001 - 2004	ONR	Chemical Plume Tracing, Other Co-PI: R. Carde (Entomology)	365,185	PI	Closed
2003 - 2006	NSF	Stability and Performance Guarantees for Self-Organizing On-Line Approximation Based Control	222,670	PI	Closed
2004 - 2006	Caltrans	Carrier Phase Differential GPS aided INS for Snowplow Guidance	237,786	PI	Closed
2008 - 2010	California Department of Transportation	Carrier Phase Differential GPS aided INS for Snowplow Guidance	178,423	PI	Closed
2007 - 2012	NSF	Self-organizing Approximation-based Control	267,548	PI	Closed
2009 - 2012	Office of Naval Research	Distributed Dynamic Scene Analysis in a Self-Configuring Multimodal Sensor Network, Other Co-PI: A. Roy-Chowdhury	524,000	Co-PI	Closed
2010 - 2012	Federal Transit Administration (FTA)	Pilot Program to Demonstrate the Benefits of Vehicle-Assist and Automation (VAA) Applications for Full-Size Public Transit Buses	287,549 (My portion)	PI joint w/ UCB	Closed
2009 - 2014	UC MRPI Program	UC-Light, Other Co-PIs: D. Xu (PI), A. Wang	280,000 (My portion)	Co-PI	Closed
2008 - 2009	Caltrans	Skymeter evaluation	22,947	PI	Closed
2009 - 2012	DOT FHWA	Innovative Approaches for Next Generation Vehicle Positioning Other Co-PI: M. Barth	619,937	Co-PI	Closed
2011 - 2012	FHWA IRDQ	Mapping Technology Assessment Other Co-PI: Barth	578,000	PI	Closed
2011 – 2015	ARO w/ UT-PA	Distributed Cooperative Control of Multiple Nonlinear Systems with Nonholonomic Constraints and Uncertainty	126000 (My portion)	UCR PI	Closed
2013 – 2018	NSF-NRI	Multirobot-Human Coordination for Visual Scene Understanding Other Co-PIs: A. K. Roy-Chowdhury, A. Mourikis	696k total 232k my portion	Co-PI	Closed
2014 – 2015	CALIFORNIA ENERGY COMMISSION	PEV-based Active and Reactive Power Compensation in Distribution Networks, Other Co-PIs: Hamid Mohsenian-Rad, R. Chomko	60k Total	Co-PI	Closed
2014 – 2015	FHWA	Best Practices for Surveying/Mapping Roadways and Intersections for Connected Vehicle Applications, Other Co-PI: M. Barth	150k Total 75k my portion	PI	Closed
2014 – 2014	CALTRANS	Precision Mapping of the California Connected Vehicle Testbed Corridor, Other Co-PI: M. Barth	25,000	Co-PI	Closed
2015 – 2015	US Navy NEEC	Autonomous Surface Vehicle Sensor Stabilization	56,000	PI	Closed
2016 – 2019	ONR	Collaborative Navigation	75,000	Co-PI	Closed
2017 – 2022	RAYS	Port Automation: Construction of Time Varying Surfaces from LIDAR	389,919	PI	Current
2017 – 2018	Sirius XM	DGPS Error Versus Latency and Position	253,345	PI	Closed
2020	Caltrans DRI	Network Differential GNSS Corrections for Connected and Autonomous Vehicles	100,000	PI	Closed
2021 – 2022	NCST	Lane-Level Localization and Map Matching for Advanced Connected and Automated Vehicle (CAV) Applications	85,000	PI	Closed
2021 – 2025	NSF	ADVANCE Partnership: Promoting Equity and Inclusion to Facilitate Retention of Faculty through Evidence- and Place-Based Intervention Training	802k 101k my portion	Co-PI	Current
2023 – 2025	CALTRANS	Vulnerable Road User (VRU): Accurate and Reliable Detection for Roadside-Assisted Cooperative Driving	$150k	Co-PI	Current
2023 – 2028	US DOT	CARNATION Tier 1 Research Center	$1.8 M $900k my portion	UCR PI	Current
Recommend	NSF CSR Medium	Attention-Driven Software Architecture for Integrated Perception and Planning in Autonomous Agents	1.2M $300k my portion	Co-PI	Current

Industrial Collaborations: Barron Associates; Boeing; Booz, Allen, Hamilton; IAC; MSA; NGC; RAYS; Sirius XM

Jay A. Farrell

March 2024