Jay Allen Farrell
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EMPLOYMENT UNIVERSITY OF CALIFORNIA AT RIVERSIDE
Professor, Electrical Engineering   2001 – Present
Chair of Electrical Engineering Department   1998 – 2001, 2011 – Present
Chair of Electrical Engineering Department   1998 – 2001
Associate Professor, Electrical Engineering   1997 – 2001
Assistant Professor, Electrical Engineering   1994 – 1997
Autonomous Vehicles. The objective of this research program is to develop the advanced navigation, control, and planning technologies necessary to enhance the demonstrated capabilities of autonomous vehicles. Support of this research includes: ONR, DARPA – guidance and planning algorithms for chemical plume tracing; DOT FHWA, PATH, CALTRANS – centimeter accuracy vehicle; ARO, NSF – On-line approximation based control.

CHARLES DRAPER LABORATORY
Principal Member of Technical Staff   1989 – 1994

EDUCATION   UNIVERSITY OF NOTRE DAME   Notre Dame, IN 46556
Doctor of Philosophy, Electrical Engineering   May 1989
Major Area: Systems and Applied Mathematics
Minor Area: Mathematics
Master of Science, Electrical Engineering   December 1987

IOWA STATE UNIVERSITY   Ames, IA 50010
Bachelor of Science, Electrical Engineering   May 1986
Degree Conferred With Distinction
Bachelor of Science, Physics   May 1986
Degree Conferred With Distinction

TEACHING   Linear, Nonlinear, or Adaptive Systems and Control; State and Parameter Estimation; Dynamics and Simulation.

RESEARCH   Intelligent autonomous vehicles; high precision vehicle state estimation; intelligent, nonlinear, adaptive control; cooperative, distributed control.

AWARDS
- Charles Draper Laboratory Recognition Award. For outstanding performance and achievement, 1991
- Charles Draper Laboratory Recognition Award. For outstanding performance and achievement, 1993
- Engineering Vice Presidents Annual Award for Best Technical Publication: 1990 "Connectionist Learning Systems for Control," *SPIE OE/Boston '90*
- IEEE Fellow, January 2008
- Named a GNSS Leader to Watch for 2009-2010 by GPS World Magazine, May 2009
- 2009 recipient of the CSS Distinguished Member Award, December 2009
- AAAS Fellow, February 2011
- A Winner of Connected Vehicle Technology Challenge -- sponsored by U.S. Department of Transportation's (DOT's) Research and Innovative Technology Administration (RITA), July 2011

Conference Organization & Journal Associate Editorship

- Financial Chair, 1995 IEEE Conf. on Decision and Control, New Orleans, LA
- Local Arrangements Chair, 1997 IEEE Conf. on Decision and Control, San Diego, CA
- Associate Editor, IEEE Transactions on Automatic Control, 1997 – 1999
- Member, IEEE Control Systems Society Conf. Editorial Board, 1994 – 1998.
- Financial Chair, 2001 IEEE Conf. on Decision and Control, Orlando, FL
- Financial Chair, 2003 IEEE Conference on Decision and Control
- Guest Editor for IEEE Control Systems Magazine Special Issue on Kalman Filtering, 2010.
- General Vice-Chair, 2011 Joint European Control Conf., IEEE Conference on Decision and Control
- General Chair of the 51st IEEE Conf. on Decision and Control, December 2012

Professional Society Leadership

- Elected member of the IEEE Control Systems Society Board of Governors   Jan. 2003 – Jan. 2006
- IEEE Control Systems Society Vice President of Financial Affairs   Jan. 2005 – Dec. 2006
- IEEE Control Systems Society Vice-President: Technical Activities   Jan. 2007 – Dec. 2008
- Chair of the Ad-hoc Committee on Web-based financial reporting appointed by the IEEE Control Systems Society Executive Committee   May 2008 – Jun. 2008
- Chair of the Ad-hoc Committee on New Technical Awards appointed by the IEEE Control Systems Society Executive Committee   Sep. 2008 – Dec. 2008
- Member of Task Force to negotiate and write-up of an MOU with Papercept   Nov. 2010 – Nov. 2011
- Elected member of the IEEE Control Systems Society Board of Governors   Jan. 2012 – Jan. 2014
- IEEE Control Systems Society President Elect   2013
- IEEE Control Systems Society President   2014
- IEEE Control Systems Society Past President   2015

Plenary and Panel Presentations

- Invited Member of Panel Discussion 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.
- Member of the Plenary Panel at the 2007 International Symposium on Neural Networks, June 5, 2007, in Nanjing China. Plenary panelists: S. N. Balakrishnan, Tamer Basar, Tianyou Chai, Jay A. Farrell, DeyiLi, Thomas Parisini, Marios M. Polycarpou, Zengqi Sun, Jun Wang, Paul Werbos, Zongben Xu, June 2007.
- Plenary presentation entitled "Vehicle Autonomy and Intelligent Control: Where are we and What Lies Ahead?" at the IEEE Control Systems Society (CSS), 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. The participation included a 30 minute presentation by each panelist plus group discussion, questions, and answers. September 2010.

Industrial Collaborations

- Booz, Allen, Hamilton; Barron Associates; Boeing; IAC; MSA; NGC.

Department

- **Jul. 1998-Jun. 2001**: EE Department Chair
  Accomplishments for 1998-1999: Hired 3 new faculty, Established joint Computer Engineering Program with Department of Computer Science and Engineering, Established EE Department Staff;
  Accomplishments for 1999-2000: Hired 3 new faculty, 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 CE program.
  Accomplishments for 2000-2001: Hired 2 new faculty, passed ABET review, prepared graduate program review, designed and planned second engineering building.

- **Sep. 2001-Jun. 2003**: Electrical Engineering & Computer Engineering, Undergraduate Advisor and Chair of UG Committee
- **Jul. 2006-Jun. 2007**: Electrical Engineering, Undergraduate Adviser and Chair of the UG Committee
- **Sep. 2006-Jun. 2007**: Chair, EE Workload Definition Committee
- **Jul. 2011-Present**: EE Department Chair
  Goals: Initiate endowment funds for chaired faculty and student support, enhance revenues, grow the research faculty, revise lower division undergraduate curriculum, led IGERT and motivated GAANN proposals, led and managed the 2012 ABET evaluation.

College

- **Sep. 2009-Aug. 2012**: Chair of the Faculty of the Bourns College of Engineering.
- **Oct. 2009-To Present**: Faculty adviser for the ION-UCR student club.

Campus

- **Nov. 2002-Jan. 2003**: Participant Chancellor's Planning Retreat
- **Sep. 2003-Jun. 2006**: Academic Senate Committee on Academic Personnel (CAP)
- **Aug. 2007-Jul. 2010**: Academic Senate Shadow CAP
- **Jul. 2007-Jun. 2009**: Academic Senate Planning and Budget
- **Feb. 2009-Jun. 2009**: UCR Budget Advisory Committee
  EVC/P led committee. I was one of 6 faculty. Later expanded to include several more.
- **Mar. 2009-Jun. 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 principles and recommendations for implementation of the required budget cuts. Those principles and recommendations were presented to the UCR budget advisory committee and to Chancellor White.
- **Jun. 2009-Jun. 2010**: Academic Personnel Task Force
  Appointed by EVC/P: The charge to the Task Force is to examine and recommend on ways we might improve the academic personnel process, 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.
- **Sep. 2009-Jun. 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.
- **Sep. 2009-Jun. 2010**: Member, UCR Strategic Planning Steering Committee
- **Sep. 2009-Aug. 2012**: Member, UCR Academic Senate Executive Committee
- **Jan. 2011-Dec. 2011**: Member of UCR's Chancellor's Budget Advisory Council

Jay A. Farrell   June 2012

I. Typical Courses

Undergraduate Courses: Dynamic Systems and Simulation, Automatic Control, Linear Methods for Engineering Analysis and Design using MATLAB

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

II. Graduate Student Instruction.

Student Name	Degree	Role	Date Completed (Expected)
Rathavut Vanitsthian	Ph.D.	Major Professor	Expected Spring 2015
Qichi Yang	Ph.D.	Committee Member	Expected Spring 2014
Haiyu Zhang	Ph.D.	Committee Member	Expected Spring 2014
Akshay Morye	Ph.D.	Major Professor	Expected Spring 2014
Sheng Zhao	Ph.D.	Major Professor	Expected Spring 2014
Sharat Suvarna	Ph.D.	Major Professor	Expected Spring 2014
Dongfang Zheng	Ph.D.	Major Professor	Expected Spring 2014
Yiming Chen	Ph.D.	Major Professor	Expected Spring 2014
Curtiss Pro	Ph.D.	Committee Member	Expected Spring 2013
Ahmed Kamal	Ph.D.	Committee Member	Expected Spring 2013
Yingshuo Fu	Ph.D.	Committee Member	Expected Spring 2013
Kaiyun Cui	Ph.D.	Committee Member	Expected Spring 2013
Chong Ding	Ph.D.	Committee Member	Expected Spring 2013
Barbara Herzog*	Ph.D.	Committee Member	Expected Spring 2013
Jeff Herrera*	M.S.	Major Professor	Expected Spring 2012
Scott Boskovich	Ph.D.	Committee Member	Expected Spring 2012
Yiqian Li	Ph.D.	Oral Exam	Expected Spring 2011
Smruti Parichha*	Ph.D.	Oral Exam	Expected Spring 2011
Anh Vu	Ph.D.	Committee Member	Expected Spring 2011
Behlul Sutarwala	M.S.	Major Professor	Expected Spring 2011
Utuk Celikan	Ph.D.	Committee Member	Expected Spring 2011
Arvind Ramanandan	Ph.D.	Major Professor	Expected Spring 2011
Anning Chen*	Ph.D.	Major Professor *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.*	Expected Spring 2011
Lingfei Zhou*	Ph.D.	Committee Member	Spring 2010
Qian Gao	Ph.D.	Committee Member	Winter 2010
Sindhura Mandava*	M.S.	Committee Member	Spring 2010
Lili Huang*	Ph.D.	Committee Member	Expected Fall 2010
Yilei Xu	Ph.D.	Committee Member	Spring 2009
Wenjie Dong	Ph.D.	Major Professor *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
Ning Liu	Ph.D.	Oral Exam	Spring 2009
Ning Mi	Ph.D.	Oral Exam	Spring 2009
Teddy Yap	Ph.D.	Committee Member	Spring 2009
Weihua Zhu	Ph.D.	Oral Exam	Spring 2009
Vladimir Djapic	Ph.D.	Major Professor *Mr. Djapic won the best paper in his session award at the 2008 American*	Fall 2008

		Control Conference in Seattle WA.	
Kevin Christopher	M.S.	Major Professor	Fall 2008
Yuanyuan Zhao*	Ph.D.	Major Professor	Winter 2007
Yu Lu	Ph.D.	Major Professor *Yu Lu is the Institute of Navigation Southern California Section 2006 Graduate Student scholarship winner (announced March 21, 2006).*	Summer 2006
Zheng Fang	Ph.D.	Thesis defense	Fall 2006
Jin Tang	Ph.D.	Thesis defense	Fall 2006
Huaying Xu	Ph.D.	Committee Member	Summer 2006
Elmer Thomas*	M.S.	Major Professor	Summer 2005
Jenna Cheng*	Ph.D.	Major Professor	Spring 2005
John Napier	M.S.	Committee Member	Fall 2004
Kelly Lynn Downey*	M.S.	Major Professor	Summer 2004
Shuo Pang	Ph.D.	Major Professor	Fall 2004
Kirill Shabunov	Ph.D.	Oral Exam	Winter 2004
Chuanjun Zhang	Ph.D.	Oral Exam	Spring 2004
Patrick Leang	M.S.	Committee Member	Fall 2003
Jason Masters	M.S.	Committee Member	Fall 2003
Steve Hawkinson	M.S.	Major Professor	Fall 2002
Gang Chen	Ph.D.	Committee Member	Summer 2002
Yunchun Yang	Ph.D.	Major Professor	Spring 2001
Tony Givargis	Ph.D.	Committee Member	Spring 2001
Torsten Berger	Ph. D.	Major Professor	Spring 1998

III. Other Teaching / Misc. Supervision.

Mentorship of 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*

Undergraduate Student Supervision

From	To	Name
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	Present	Devin Auclair, Gevork Ashikyan, Tianchen Lu

Visiting faculty

From	To	Name
September 2002	August 2003	Cai Yuan Li
February 2003	March 2003	Huai Xun Liu

* Names marked with an asterisk indicate students who fall into one or more underrepresented category.

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

1. A.N. Michel, J.A. Farrell, W. Porod, "Qualitative analysis of neural networks. Information and Decision Technologies," *IEEE Trans. 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 Trans. 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 Trans. 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 Trans. 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 Trans. 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 Trans. 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 Trans. 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," *Journal 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 Transactions on 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.

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 Transactions on Neural Networks*, vol 9, no. 5, pp. 1001-1007, 1998.

17. J. Farrell, "Stability and approximator convergence in nonparametric nonlinear adaptive control," *IEEE Transactions on Neural Networks*, vol. 9, no. 5, pp. 1008-1020, 1998.

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 Trans. Automatic Control*, vol. 44, no. 2, pp. 412-417, 1999.

20. J.Y. Choi, J.A. Farrell, "Nonlinear adaptive control using networks of piecewise linear approximators,"," *IEEE Transactions on Neural Networks*, vol 11, no. 2, pp. 390-401, 2000.

21. J. Farrell, T. Givargis, "Differential GPS reference station algorithm: Design and analysis," *IEEE Transactions on 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 Transactions on Control Systems Technology*, vol 8, no. 4, pp. 709-721, 2000.

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 Transactions on Neural Networks*, vol 12, no. 5, pp. 1103-1112, 2002.

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.

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 Trans. Robotics and Automation*, 19, 2, 269-183, 2003.

30. Y. Yang, J.A. Farrell, "Two Antenna GPS aided INS for Attitude Determination," *IEEE Trans. on Control Systems Technology*, 11, 6, 905-918, 2003.

31. J.A. Farrell, S. Pang, W. Li, "Plume Mapping via Hidden Markov Methods," *IEEE Trans. SMC-B*, 33, 6, 850-863, 2003.

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

33. J.A. Farrell, M. Polycarpou, M. Sharma, "Longitudinal Flight Path Control using On-line Function Approximation," *AIAA Journal 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. of Oceanic Engineering*, 30, 2, 428-442, 2005.

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

37. W. Li, J.A. Farrell, S. Pang, R.M. Arrieta, "Moth-Inspired Chemical Plume Tracing on an Autonomous Underwater Vehicle," *IEEE Transactions on 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 Transactions on Neural Networks*, 18, 6, 1709-1724, 2007.

40. Y. Zhao, J.A. Farrell, "Self-organizing Approximation Based Control for Higher Order Systems," *IEEE Transactions on Neural Networks*, 18, 4, 1220-1231, 2007.

41. W. Dong, J.A. Farrell, "Cooperative Control of Multiple Nonholonomic Mobile Agents," *IEEE Transactions on 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, April, 1077-1085, 2008.

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

44. J.A. Farrell, M. Polycarpou, M. Sharma, W. Dong, "Command Filtered Backstepping," *IEEE Transactions on Automatic Control*, 54, 6, 1391-1395, 2009.

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 Journal of Ocean Engineering*, 35, 3 663-678, 2010.

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. As of Sept. 2008, this paper is accepted subject to minor modifications. The paper ID is TCST-2008-0250.

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 Transactions on Image Processing*, 19, 10, September 2010, 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," May, *IEEE Signal Processing Magazine*,, May 2011, 20-31, 2011.

49. W. Dong, J.A. Farrell, M.M. Polycarpou, V. Djapic, M. Sharma, "Command Filtered Adaptive Backstepping," February, *IEEE Trans. on Control Systems Technology*, 20,3, 566 – 580, 2012.

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

51. A. Ramanandan, A. Chen, J.A. Farrell, "Inertial Navigation Aiding by Stationary Updates," August, *IEEE Transactions on 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," December, *IEEE Transactions on Intelligent Transportation Systems*, 13, 2, 899-913, 2012.

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

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, June 1987, 1-8, 1987.

2. A. Michel, J. Farrell, W. Porod, "Qualitative analysis of neural networks: Local theory," *Proc. 25th Ann. Allerton Conf., University of Illinois*, Urbana, Illinois, September 1987, 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, November 1987, pp. 51-55, 1987 **(Non-Refereed)**.

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

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

6. J. Farrell, A. Michel, "New estimates of asymptotic trajectory bounds for digital filters: Improved results," *Proc. 26th Annual Allerton Conf. Communication, Control, & Computing*, University of Illinois, Urbana, Illinois, September 1988, 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," *Proc. 27th IEEE Conf. Decision & Control*, Austin, Texas, December 1988, pp. 1897-1901, 1988.

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

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

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

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

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

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

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

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

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

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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.

Recent Extramural Grant Activity

Dates	Agency	Title	Amount	Role	Status
Nov. 2002-Sep. 2004	Caltrans	Carrier Phase Differential GPS aided INS for Snowplow Guidance - Phase I	228,500	PI	Closed
Jul. 2001-Oct. 2003	California PATH	Magnetometer/GPS/INS Demo 2002 Support and Rapid Integer Ambiguity Resolution Research	193,889	PI	Closed
Jul. 2001-Oct. 2004	ONR	Chemical Plume Tracing	365,185	PI	Closed
Aug. 2003-Dec. 2006	NSF	Stability and Performance Guarantees for Self-Organizing On-Line Approximation Based Control	222,670	PI	Closed
Jul. 2004-Jun. 2006	Caltrans	Carrier Phase Differential GPS aided INS for Snowplow Guidance	237,786	PI	Closed
Jan. 2008-Jun. 2010	California Department of Transportation	Carrier Phase Differential GPS aided INS for Snowplow Guidance	178,423	PI	Closed
May 2007-Apr. 2012	NSF	Self-organizing Approximation-based Control	267,548	PI	Current
Apr. 2009-Mar. 2012	Office of Naval Research	Distributed Dynamic Scene Analysis in a Self-Configuring Multimodal Sensor Network **Other Co-PIs:** A. Roy-Chowdhury	524,000	Co-PI	Current
Apr. 2010-Mar. 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 PATH	Current
Jan. 2009-Dec. 2015	UC MRPI Program	UC-Light **Other Co-PIs:** D. Xu (PI), A. Wang	3,586,215 *My portion is $280,000 total.*	Co-PI	Current
Oct. 2008-Mar. 2009	Caltrans	Skymeter evaluation	22,947	PI	Current
Oct. 2009-Sep. 2012	DOT FHWA	Innovative Approaches for Next Generation Vehicle Positioning **Other Co-PIs:** M. Barth	619,937	Co-PI	Current
Submitted: May 2011 Jul. 2011-Jun. 2012	FHWA IRDQ	Mapping Technology Assessment **Other Co-PIs:** Barth (co-PI)	578,000	PI	Current

Research

My research program focuses on developing advanced real-time reasoning capabilities in the areas of estimation and control. My main area of application interest is enhancing the capabilities of intelligent autonomous agents (e.g., vehicles). My research program addresses both theory and practice, leading to significant industrial interaction and consulting. I strive to have each publication contain a rigorous theoretical solution to an open problem and an application of the new solution either in practice or simulation. Building on this research approach, I have several sustained and emerging research directions. My research on real-time function approximation for control started in the early 1990's and continues to the present, having produced 19 journal and 46 conference articles and one book. The book and several publications are the result of international collaborations. Recent innovations in this research include: development and analysis of a performance driven, Lyapunov based, self-organized function approximation method; and, development and analysis of the command filtered backstepping method and its application to aircraft and underwater vehicles. My research in precision vehicle navigation, achieving decimeter position accuracy in real-time for highway "where in lane" applications, has been ongoing with continuous funding since the mid 1990's, yielding 8 journal and 28 conference articles as well as two well received books. This research yielded the first demonstrations of centimeter accuracy differential GPS aided INS and the uses of that method for car control, bus control, and snowplow guidance. For this work, I was identified as a 2009/2010 GNSS Leader to Watch by *GPS World Magazine*. This research has recently expanded to include funded work on precision automated roadway mapping, which is identified as a necessary technology for future intelligent transportation applications by the FHWA. From 1997-2000, a DARPA effort had 10 teams, each with at least one biologist and one engineer, compete to extend biological chemical plume tracing (CPT) to autonomous vehicles. I collaborated on this interdisciplinary effort with Ring Carde of UCR's entomology department. Other teams were from Sandia, U. of Arizona, Georgia Tech, CalTech, Stanford, UCB, Cornell, Boston U., etc. UCR was the only team selected to continue from 2000-2004 with ONR funding to develop, implement, and demonstrate a working system with the US Navy on a small submersible vehicle. The UCR system was successfully demonstrated in near-shore ocean conditions at Duck NC to trace a plume for 975m and estimate the source location with an accuracy of 13 m. This is by far the largest successful CPT test and demonstration ever by an engineered system. In addition to the demonstration success, the research effort generated 6 well-cited journal and 5 conference articles, a lot of fun, and learning about new fields by biologists, engineers, and naval personnel, one of whom subsequently came to UCR to complete his Ph.D. A recent new direction of research is developing collaborative multiagent camera networks to enable and enhance system performance for security applications. Since 2006, this research direction has yielded 7 journal and 12 conference articles.

The quality and quantity of my research is demonstrated to be exceptional by various metrics.
- In the previous three year review period, I have (co-)authored ten journal articles, two book chapters, and twenty two conference articles.
- Since promotion to Professor (July 2001), I have (co-)authored two books, 28 journal articles, 7 book chapters, and 60 conference articles.
- The majority of these publications are in the top venues for my field (i.e., IEEE Transactions, Automatica, Proc. AIAA GNC, Proc. ACC, Proc. CDC, Proc. ICRA). All venues are well-respected and standard for my areas of research. All conference involved at least one round of anonymous reviews of the full paper, followed by revisions, unless the paper is marked as "Non-Refereed" or "Partially-Refereed."
- The h-index for my publications is 33 and the i10-index is 72 (computed with google scholar link on my web page). These indices compare favorably with my eighteen years in academia.

Funding in the area of control systems research is extremely competitive; nevertheless, I have a well-funded research program. As demonstrated by my funding record, I very much enjoy collaborative,

multi-PI, cross-disciplinary research.

Teaching

I thoroughly enjoy both undergraduate and graduate teaching and research collaboration. I strive for rigor, very high quality, and extensive student interaction. I promote an interactive class environment by asking students questions during lecture, discussing with them outside of class, and by revising labs each year to be synchronized with differences in the lecture pace and with student interests. As my teaching evaluations show, most students greatly appreciate this effort. According to the UCR BCOE teaching policy, I am teaching in overload (i.e., above the level required). For example, in 11/12, I should be teaching one course – four courses is the standard load, my supervision of eight Ph.D. students counts as one course, and EE chair earns two course relief – yet I agree to teach two courses. Similar analysis applies to each year. In the last three year period, I have supervised ten Ph.D., four M.S, and ten UG's students. I officially co-supervise one additional Ph.D. student. Unofficially I have been actively collaborating on the research of Ding and Kamal with Prof. Roy-Chowdhury and Huang and Vu with Prof. Barth. My supervision approach is extremely interactive on a daily basis. Some students have won awards.

Diversity

While engineering careers offer great merit-based potential, students from different precollege backgrounds have different understandings of these engineering career paths and opportunities. Early in my career at UCR I participated in UC organized programs to enhance undergraduate diversity, such as UC Leads with Elmer Thomas and June Fuller. Since obtaining more significant research funds, I have continued this practice by hosting teams of undergraduates in my research lab each year. Names of students who fall into one or more under-represented category are marked with an asterisk in the teaching section of my C.V.

Service

I am exceptionally active both professionally and within UCR. Professionally, in addition to numerous smaller items, my highest profile activities include: IEEE Control Systems Society (CSS) VP Finance, IEEE CSS VP Technical Activities, CSS General Vice Chair for the 50th IEEE Conference on Decision and Control (CDC), and General Chair for the 51st IEEE CDC. The IEEE CDC is the most prestigious conference in my research area. Finally, in June 2012 I was elected to lead the IEEE CSS in the following sequence of offices: President Elect (2014), President (2014), and Past President (2015) At UCR, my major activities include: two terms as Chair of EE; UCR Committee on Academic Personnel; UCR Planning and Budget; faculty representative to the UCR Budget Advisory Committee and its steering committee; Chair of the UCR Strategic Planning Committee on Resources, Budget Planning, and Infrastructure; member of the UCR Strategic Planning Steering Committee; and, member of the UCR Chancellor's Budget Advisory Council.

Awards and Recognition

Following are a few items that recognize my academic distinction:
1. **IEEE Fellow** (2008): "*for contributions to intelligent, autonomous vehicle analysis and design*"
2. **CSS Distinguished Member Award** (2009): This award recognizes significant technical contributions and outstanding long-term service to the Control Systems Society.
3. Named One of 50 "**GNSS Leaders to Watch 2009/2010**" by *GPS World Magazine*
4. **AAAS Fellow** (2011): "*For distinguished research, educational, and service contributions to the field of intelligent, autonomous vehicle analysis and design*"

Jay A. Farrell June 2012