

Jay Allen Farrell

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EMPLOYMENT UNIVERSITY OF CALIFORNIA AT RIVERSIDE
Professor, Electrical Engineering July 2001 – present
Chair of Electrical Engineering Department July 1998 – June 2001
Associate Professor, Electrical Engineering July 1997 – June 2001
Assistant Professor, Electrical Engineering Jan. 1994 – June 1997
Intelligent Vehicles. The objective of this research program is to develop the advanced navigation, control, and planning technologies necessary to support intelligent vehicle deployment. Support of this research includes: ONR and DARPA -- guidance and planning algorithms for chemical plume tracing; PATH & CALTRANS – centimeter accuracy vehicle; NSF – On-line approximation based control.

CHARLES STARK DRAPER LABORATORY

Senior Member of Technical Staff June 1989 - January 1994
Planning, Situation Assessment, and Control for Autonomous Vehicles. This research combined robust estimation and control, adaptive and learning control, and artificial intelligence techniques to develop the perception, reasoning, and actuation capabilities required to support reliable, extended autonomous vehicle operation.

Connectionist Learning Control Systems. This research developed the theory for and demonstrated applications of *learning control systems* as a method to accommodate modeling uncertainty in nonlinear dynamic systems. The research developed improved learning algorithms, alternative function approximation networks, and new learning control architectures.

Charles Stark Draper Laboratory Recognition Award

For outstanding performance and achievement (May 1991).

For outstanding performance and achievement (Sept 1993).

Engineering Vice Presidents Annual Award for Best Technical Publication: 1990

"Connectionist Learning Systems for Control," *SPIE OE/Boston '90*.

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

Recent University Activity and Public Service

Department

- **Jul. 1998-Jun. 2001:** Electrical Engineering Department Chair
- **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

College

- **Jan. 2003-Jun. 2003:** Member Mechanical Engineering Faculty Search Committee
- **Sep. 2006-Jun. 2007:** Member, COE Workload Definition Committee
- **Sep. 2006:** CAP Subcommittee to Beta test the Academic Personnel e-file system

Campus

- **Mar. 2002-Apr. 2002:** Attended and served as a panel member at the UC LEADS symposium
- **Nov. 2002-Jan. 2003:** Participant Chancellor's Planning Retreat
- **Apr. 2003:** University honors program presentation to the Honors First-Year Colloquium
- **Sep. 2003-Jun. 2006:** Committee on Academic Personnel
- **Sep. 2006:** Presentation on faculty review process at the UCR New Faculty Workshop.
- **Jul. 2007-To Present:** Planning and Budget
- **Aug. 2007-Jul. 2008:** Shadow Committee on Academic Personnel

Recent Professional Activity and Service

Program Committees and Organization

- **Apr. 2000-Aug. 2004:** Financial Chair, 2003 IEEE Conference on Decision and Control
- **Apr. 1998-Aug. 2002:** Financial Chair, 2001 IEEE Conference on Decision and Control
- **Jan. 2004-Jun. 2005:** Member of the Program Committee for the 2005 International Symposium on Intelligent Control
- **Mar. 2005-Sep. 2006:** Member of the Program Committee for the 2006 IEEE International Symposium on Intelligent Control, Munich.
- **Jun. 2006:** Session Chair ThB17 Direct Adaptive Control II, American Control Conference, Minneapolis, MN
- **Nov. 2006-Oct. 2007:** Member of the 2007 IEEE International Symposium on Intelligent Control Program Committee, Singapore
- **May 2007-Jul. 2008:** International program committee for the 2008 International Symposium on Intelligent Control, San Antonio, TX
- **Jan. 2008-Jan. 2012:** General Vice-Chair, 2011 Joint European Control Conference, IEEE Conference on Decision and Control
- **Jul. 2008-Jun. 2009:** International Program Committee for the 17th Mediterranean Conference on Control and Automation (MED'09), June 24 - 26, 2009, Thessaloniki, Greece (<http://www.med09.org>).
- **Oct. 2008-To Present:** Advisory Committee for the Sixth International Symposium on Neural Networks (ISNN 2009) to be held in Wuhan in 2009

Reviewing Activity

Automatica, American Control Conference, European Journal of Control, 2005 IEEE CDC/ECC, IEEE Conference on decision and Control, IEEE Transactions on Circuits and Systems, Part I, IEEE Control Systems Magazine, IEEE Transactions on Aerospace and Electronic Systems, IEEE Transactions on Automatic Control, IEEE Transactions on Control Systems Technology, IEEE ITS Transactions, IEEE Transactions on Neural Networks, IEEE Transactions on Robotics, IEEE Transactions on Vehicular Technologies, IE Proc. Control Theory and Applications, International Journal of Robotics Research, International Journal of Systems Science, International Journal of Vehicle Mechanics and Mobility, Journal of Advanced Transportation, Journal of Dynamic Systems, Measurement, and Control, Journal of Guidance, Control, and Dynamics, Journal of Marine Science and Environment, Part C, NSF COPN Review Panel, misc. proposal reviewer National Science Foundation, External research proposal review for National University of Singapore

Presentations/Talks

- **Apr. 2003:** "Chemical Plume Tracing via Autonomous Underwater Vehicles", University of Notre Dame, April 5, 2003.
- **Aug. 2003:** "Chemical Plume Tracing Experimental Results with a REMUS AUV", MTS/IEEE Oceans 2003
- **Jun. 2004:** "Localized Adaptive Bounds for Online Approximation Based Control," American Control Conference, Boston, MA
- **Jun. 2004:** "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
- **Sep. 2004:** "On-line Planning and Mapping for Chemical Plume Tracing" ONR Chemical Sensing in the Marine Environment Project Review, September 2004, Annapolis, MD.
- **Oct. 2004:** "Biologically Inspired Chemical Plume Tracing Demonstrated on an Autonomous Underwater Vehicle", IEEE Systems, Man, and Cybernetics Conference, Hague, Netherlands
- **Jun. 2006:** Presented "Self-organizing Approximation Based Control" at the American Control Conference, Minneapolis, MN.
- **Jun. 2007:** Research presentation on Command Filtered Back-stepping for Autonomous Vehicles at Key Laboratory for Autonomous Underwater Vehicles at Harbin Engineering University.
- **Jun. 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.
- **Jun. 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, Deyi Li, Thomas Parisini, Marios M. Polycarpou, Zengqi Sun, Jun Wang, Paul Werbos, Zongben Xu.
- **Jun. 2007:** Invited Member of Panel Discussion on the Future on Neural Network Research at the International Symposium on Neural Networks, Nanjing, China
- **Jun. 2007:** Research presentation on Self-organizing Approximation Based Control at Key Laboratory for Autonomous Underwater Vehicles at Harbin Engineering University.
- **Jun. 2007:** Research presentation on Self-organizing Approximation Based Control at Xi'an Jiaotong University.
- **Dec. 2007:** Presented , "Self-organizing Approximation for Controllable Nonaffine Systems," at the IEEE Conference on Decision and Control, New Orleans, LA
- **Jun. 2008:** Presented "Command Filtered Backstepping," at the American Control Conference
- **Jun. 2008:** Presented "Tracking Control of Nonaffine System: A Self-organizing Approximation Approach" at the American Control Conference
- **Jun. 2008:** Presented "Formation Control of Multiple Mobile Robots with Uncertainty" at the American Control Conference, Seattle, WA.
- **Sep. 2008:** 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

- **Sep. 2008:** Presented the paper, "Hybrid Control Design Applied in Land Vehicle Behavior-Based Switching Controller," at the 2008 IEEE Multi-conference on Systems and Control, San Antonio.
- **Sep. 2008:** Presented the paper "Optimal Regulation of Unknown Nonlinear Systems Based on Locally Weighted Learning," Multiconference on Systems and Control: International Symposium on Intelligent Control, San Antonio, TX
- **Nov. 2008:** Presentation as part of the UCSB Center for Control, Dynamical Systems, and Computations (CCDC) seminar series
- **Nov. 2008:** Presentation as part of the UCR CSE Seminar Series

Consultant Services

- **May 2006-Sep. 2007:** Mentor/Consultant: Three students in my Spring 2006 EE260 offering took their course project and implemented it onboard an autonomous underwater vehicle. I worked with them to get it and other aspects of the vehicle working reliably. Ultimately, they wrote a few papers; demonstrated the vehicle at AUVfest where their performance earned invitations to demonstrate at VIP day and Media day; and Paul Miller was selected for a Department of Navy Top Scientists and Engineers Award that was presented to him at the Pentagon (See supporting materials).
- **Dec. 2007-To Present:** Consultant services to Mine Safety Appliances corporation providing technical advice and services related to a personnel tracking system for use by miners or first responders in GPS denied environments (indoors or in mines).
- **Mar. 2008-Jun. 2008:** Consultant to Intelligent Automation Corporation providing technical advice on the design of a GPS aided inertial navigation product for helicopter applications.

Editorial Service

- **Apr. 2006- 2010:** Guest Editor for IEEE Control Systems Magazine Special Issue on Kalman Filtering to appear in 2010.

Awards

- **Jan. 2008-To Present:** Elevated to IEEE Fellow

Moderator

- **May 2008-Jun. 2008:** I was asked to moderate one half of an NSF CDI Initiative Workshop organized by Karlene Hoo for NSF Program Director Ed Misawa.

Professional Society Leadership

- **Jan. 2003-Jan. 2006:** Elected member of the IEEE Control Systems Society Board of Governors

Two six hour meetings per year plus misc. issues discussed and voted on via e-mail between meetings.

- **Jan. 2005-Dec. 2006:** IEEE Control System Society Vice President of Financial Affairs

Responsible for overseeing the societies \$4M budget. This executive committee position is by nomination and election from the members of the Board of Governors. Members of the executive committee have 4 full day meetings per year plus 4 partial day meetings at society conferences. Between meetings this position requires an average of six hours work per week.

- **Jan. 2007-Dec. 2008:** IEEE Control Systems Society Vice-President: Technical Activities

This executive committee position is by nomination and election from the members of the Board of Governors. Members of the executive committee have 4 full day meetings per year plus 4 partial day meetings at society conferences. The VP-TA oversees the operations of the Tech. Activities Board which is comprised of the Chairs of the Control Systems Societies 17 technical committees.

- **May 2008-Jun. 2008:** Chair of the Ad-hoc Committee on Web-based financial reporting appointed by the IEEE CSS Executive Committee.

- **Sep. 2008-Dec. 2008:** Chair of the Ad-hoc Committee on New Technical Awards appointed by the IEEE CSS Executive Committee.

Teaching Data

I. Undergraduate Instruction

Modeling and Simulation of Dynamic Systems, Automatic Control, Circuit Theory, Senior Design

II. Graduate Instruction

State and Parameter Estimation, Aided Navigation Systems, Nonlinear Control, Linear Systems Theory

III. Graduate Student Supervision.

Student Name	Degree	Role	Date Completed (Expected)
Behlul Sutarwala	M.S.	Major Professor	Expected Spring 2011
Akshay Morye	M.S.	Major Professor	Expected Spring 2011
Arvind Ramanandan	Ph.D.	Major Professor	Expected Spring 2011
Anning Chen	Ph.D.	Major Professor	Expected Spring 2011
Wenjie Dong	Ph.D.	Major Professor <i>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.</i>	Expected Spring 2009
Vladimir Djapic	Ph.D.	Major Professor <i>Mr. Djapic won the best paper in his session award at the 2008 American Control Conference in Seattle WA.</i>	Expected Fall 2008
Kevin Christopher	M.S.	Major Professor	Expected Fall 2008
Yuanyuan Zhao	Ph.D.	Major Professor <i>Now at Western Digital</i>	Winter 2007
Paul Miller	none	Mentor <i>Paul enrolled in my Spring 2006 offering of EE260 Aided Navigation. After the class, we continued to interact to extended his group's 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.</i>	Spring 2006
Yu Lu	Ph. D.	Major Professor <i>Now at a start-up working on GPS receiver firmware.</i>	Summer 2006
Jenna Cheng	Ph. D.	Major Professor <i>Now at Navcom</i>	Spring 2005
Elmer Thomas	M.S.	Major Professor <i>Principal of a start-up company in Riverside, CA</i>	Summer 2005

Shuo Pang	Ph.D.	Major Professor <i>Now an Assistant at Embry-Riddle Aeronautical University in Daytona Beach, FL.</i>	Fall 2004
Kelly Lynn Downey	M.S.	Major Professor	Summer 2004
Steve Hawkinson	M.S.	Major Professor <i>Now at Navcom</i>	Fall 2002
Yunchun Yang	Ph. D.	Major Professor <i>Formerly at Navcom, now a Principal at a GPS product company in Beijing</i>	Spring 2001
Torsten Berger	Ph. D.	Major Professor	Spring 1998

Extramural Grant Activity (Total = \$3,101,957)

<u>Agency</u>	<u>Title</u>	<u>Amount</u>	<u>Period</u>	<u>PI Status</u>	<u>Status</u>
SC-AQMD (AB2766)	“Hydrogen Powered Advanced Hybrid Electric Vehicle” (with Co-PI Matt Barth)	\$637,284	6/28/96- 12/28/97	P.I.	Closed
PATH	“GSP/INS-Based Lateral and Longitudinal Control Demonstration” (with Co-PI Matt Barth)	\$40,937	10/1/96- 9/30/97	P.I.	Closed
PATH	“Integration of GPS-aided INS into AVCSS” (with Co-PI Matt Barth)	\$104,923	9/98-9/00	P.I.	Closed
PATH	“Differential Global Position/Inertial Navigation Systems (DDGPS/INS) for Advanced Vehicle Control” (with Co-PI Matt Barth)	\$50,000	10/1/98- 6/30/99	P.I.	Closed
ISE Research	“ICE Instrumentation and Control” (with Co-PI Matt Barth)	\$10,000	1/197- 6/30/97	P.I.	Closed
UCLA/NASA	“GPS/INS for SPFF Flight Control”	\$24,750	3/1/97- 9/30/97	P.I.	Closed
UCLA/NASA	“GPS/INS for SPFF Flight Control”	\$25,000	10/1/97- 9/30/98	P.I.	Closed
California Department of Transportation	“Construction of the California Speedway Test Track and On-Site Laboratory” (with PI Matt Barth)	\$125,000	8/98-9/00	Co-P.I.	Closed
ONR	“Chemical Plume Tracing” (Funding reflects Jay Farrell’s Portion) (with PI Ring Carde)	\$109,922 \$106,479	8/1/98- 7/31/99 8/1/99- 12/31/00	Co-P.I.	Closed Closed
PATH	“Integration of GPS/INS and Magnetic Markers for Advanced Vehicle Control” (with Co-PI Matt Barth)	\$38,494 \$79,455	11/1/99- 6/30/00 7/1/00- 6/30/01	P.I.	Closed Closed
ONR	“Chemical Plume Tracing” (Funding reflects Jay Farrell’s Portion) (with PI Ring Carde)	\$57,000	7/1/00- 12/31/00	Co-P.I.	Closed
PATH	Magnetometer/GPS/INS Demo 2002 Support and Rapid Integer Ambiguity Resolution Research	\$193,889	7/1/01- 12/30/03	P.I.	Closed
CALTRANS	Carrier Phase Differential GPS aided INS for Snowplow Guidance	\$228,000	9/30/02- 9/30/04	P.I.	Closed
ONR	Chemical Plume Tracing	\$365,185	7/1/01- 6/30/04	P.I.	Closed

CALTRANS	Carrier Phase Differential GPS aided INS for Snowplow Guidance	\$237,000	1/1/04-10/1/06	P.I.	Current
NSF	Stability and Performance Guarantees for Self-Organizing On-line Approximation Based Control	\$222668	7/1/03-6/30/06	P.I.	Current
CALTRANS	Carrier Phase Differential GPS aided INS for Snowplow Guidance	\$178423	Jan. 2008-Jun. 2010	P.I.	Current
NSF	Self-organizing Approximation-based Control	\$267548	May 2007-Apr. 2010	P.I.	Current
Federal Transit Administration	Pilot Program to Demonstrate the Benefits of Vehicle-Assist and Automation (VAA) Applications for Full-Size Public Transit Buses	\$287549	Submitted: Mar. 2008	Subcontract P.I.	Pending
CALTRANS	Skymeter evaluation.	\$3528	Submitted: Sep. 2008	P.I.	Pending
NSF	Scene Analysis in A Reconfigurable Camera Network	\$550000	Submitted: October. 2008	Co- P.I.	Pending

Bibliography of Publications

Technical Publications

Books

1. J.A. Farrell, M. Barth, "The Global Positioning System and Inertial Navigation: Theory and Practice," , seven chapters, 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.

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-Advection 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, "On-line Approximation Based Fixed-Wing Aircraft Control," *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, November 2006, 1220-1231, 2007.
41. W. Dong, J. A. Farrell, "Cooperative Control of Multiple Nonholonomic Mobile Agents," *IEEE Transactions on Automatic Control*, 53, 6 2008, 1434-1448, 2008.

Journal Articles (In Press)

42. Y. Zhao, J. A. Farrell, "Localized Adaptive Bounds for Approximation Based Backstepping," February, *Automatica*, 44 2008, 2607-2613, 2008.
43. W. Dong, J. A. Farrell, "Formation Control of Multiple Underactuated Surface Vessels," June, *IET Control Theory and Applications*, April 2008, 19 ms, 2008.
44. J. A. Farrell, M. Polycarpou, M. Sharma, W. Dong, "Command Filtered Backstepping," September, *IEEE Transactions on Automatic Control*, 8 ms, 2008.
45. W. Dong, J. A. Farrell, "Decentralized Cooperative Control of Multiple Nonholonomic Dynamic Systems with Uncertainty," September, *Automatica*, September 2008, 6 ms, 2008.

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.
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.
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.
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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.
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.
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.
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