Darren Dawson
Professional Summary

- **Education:**

  Ph.D., Electrical Engineering, Georgia Institute of Technology, 1990

  B.S., Electrical Engineering, Highest Honors, Georgia Institute of Technology, 1984

- **Work Experience:**

  Westinghouse, Bettis Atomic Power Laboratory, Electrical Engineer, 1985-1987

  Georgia Institute of Technology, School of Electrical Engineering, Graduate Research Assistant and Post Doctoral Research, 1987-1990

- Clemson University, Department of Electrical and Computer Engineering

  Assistant Professor - 1990, Associate Professor - 1993, Professor - 1996, Department Chair - 2007

- **Prestigious Honors: i)** *Office of Naval Research Young Investigator Awardee*, **ii)** *National Science Foundation Young Investigator Awardee*, **iii)** *McQueens Quattlebaum Faculty Achievement Awardee*, **iv)** *Georgia Institute of Technology Council of Outstanding Young Engineering Alumni,* **v)** *Provost's Award for Scholarly Achievement*, and **vi)** *Alumni Award for Outstanding Achievement in Research* (**For a complete list of honors see enclosed resume**)

- **Research Publication Activities:** Research has culminated in over 165 journal papers, over 300 conferences papers, eight books, and five book chapters.

- **Graduate Student Advisement: i)** Supervised 32 Ph.D. and 51 MS thesis student graduations and **ii)** Currently advising 6 Ph.D. students and 4 MS thesis students.

- **Professional Recognition: i)** Invited addresses at over ten universities, and **ii)** twenty invited presentations at national and international conferences

- **Research and Teaching Funding:** PI, Co-PI, Co-In of over 20 million dollars of funded activity from federal, state and industrial sources (Estimated Expenditures of over 4 million dollars for Dr. Dawson).

- **Participation in Professional Societies: i)** Over 300 Faculty/Graduate Student Conference Presentations, **ii)** Over 20 Faculty/Graduate Student Invited Conference Presentations, **iii)** Co-Chaired and organized seven conference sessions at national and international conferences, and **iv)** Served on four program committees for international conferences.

- **Editorial Service: i)** Associate Editor, *Automatica, The International Federation of Automatic Control (IFAC) Journal*, 1992 — 1996, and **ii)** Associate Editor, *IEEE Transactions on Control Systems Technology*, 1997 — 2002.

- **Service to Professional, Public, and Private Sectors: i)** Served on the Methode Board of Directors 2004-Present, **ii)** Reviewer for over 15 journals and two book publishers, **iiii)** Served on five NSF review panels, **iv)** Performed three book reviews for journal publications.

Contributions to Control Engineering

- Darren Dawson has attacked and solved several of the open problems associated with important and/or benchmark nonlinear control applications. Specifically, he was the first scholar to design a control theoretic, nonlinear adaptive position tracking controller for induction motors that compensates for unknown rotor resistance effects without measuring rotor flux (see *Automatica* Vol. 32, No 8. pp. 1127-1143, 1996). In addition, he illustrated how a nonlinear control scheme could be designed and analyzed to facilitate the practical use of induction motors as actuators for robot manipulators (See journal paper #2 below). His work in generalized mechanical systems (see journal paper #6 below) is often cited by other researchers as being the first paper to present a global adaptive output feedback tracking control solution for a general class of Lagrange Euler systems. He was also the first scholar to design, analyze, and implement rigorously developed nonlinear algorithm for important application area of sensorless control of induction motors (see journal paper #12 below). His work in underactuated systems (See journal paper #13 below) is recognized by other researchers as being one of the earliest solutions to the tracking control problem for systems with nonintegrable dynamics.

- Dawson's contributions are evidenced by the depth and breadth of his research as well as the relevance of his research to applications. First, his research has illustrated in a novel fashion how Lyapunov-based control design tools (e.g., integrator backstepping, boundary control, adaptive update law synthesis, nonlinear observer/filter design) can be handcrafted to attack difficult nonlinear control applications involving modeling uncertainty or a lack of state measurements (i.e., partial-state feedback (PSFB) and output feedback (OFB) controllers). For example, he cleverly designed a novel nonlinear filter to facilitate the global result in journal paper #6 below; furthermore, he illustrated how a dynamic oscillator technique used for induction motors could be redesigned to solve the underactuated mechanical system tracking problem addressed in the journal paper #8 below. Second, his major research interest, the design of nonlinear controllers for electrical and mechanical systems, has been pursued by some of the most well respected control researchers including Marino, Ortega, Kanellakopoulos, Bodson, and Khalil. Dawson's work has been cited by this group of researchers for his fundamental and original contributions as mentioned above. For example, Dawson's contribution in nonlinear control of electric machines is highly regarded as evidenced by his citation in the premier nonlinear control textbook that is used by almost every control researcher in the world (i.e., the research monograph #A is cited in **Nonlinear Systems** 3rd edition by Khalil). Third, his research standouts from the typical control researcher in that the performance gains associated with his control theoretic work has been verified experimentally by his research group (See the research monograph's #A and #B and many of his journal papers). Indeed, his research group facilitated this experimental work by developing several real-time software packages that are being used by several research groups throughout the world (see his paper in the *IEEE Control Systems Magazine Applications*, Vol. 19, No. 3, pp. 68-76, Jun., 1999).

- Dawson's other important contributions include: 1) design, analysis, and implementation of nonlinear control schemes for mobile robotic systems (see his research monograph **Nonlinear Control of Wheeled Mobile Robots**, Springer-Verlag London Ltd, 2001), 2) design of a broad class of boundary controllers for regulating the vibration of many types of mechanical systems (see the research monograph #B below and journal paper #5 below), 3) synthesis of novel visual servo controllers and vision-based estimators (see journal paper #14 in Part 2

below), 4) design, analysis, and implementation of novel adaptive controllers for compensating for frictional effects (see journal paper #14 below), 5) development of real-time MATLAB based software control education (see his journal paper in the *IEEE Transactions on Education*, Vol. 45, No. 3, pp. 218-226, August 2002), 6) development of real-time QNX-based software for control research (see his paper in the *IEEE Control Systems Magazine*, Vol. 22, No. 3, pp. 12-26, June, 2002), 7) promotion of research via graduate textbook writing (see his textbook **Control of Robot Manipulators**, Graduate Textbook, Marcel Dekker, 1st edition 1992, 2nd edition, 2004), and 8) primary advisor of 29 completed Ph.D. dissertations and 51 completed master's theses.

Technical Accomplishments

Most Important Accomplishments - (Boldface co-authors denote students of Dawson)

- A) D. Dawson, **J. Hu**, and **T. Burg**, Nonlinear Control of Electric Machinery, Marcel Dekker, 1998, ISBN 0-8247-0180-1. This 437 page monograph presents Professor Dawson's research from 1991-1998 in the field of nonlinear control design and analysis for electric machines. Specifically, this book presents the mathematical foundation for designing feedback/feedforward algorithms that account for the nonlinearities and modeling uncertainties associated with controlling mechanical systems driven by electric machines.

- B) **M. de Queiroz**, D. Dawson, **S. Nagarkatti**, and **F. Zhang**, Lyapunov-Based Control of Mechanical Systems, Birkhauser, 1999, ISBN 0-8176-4086-X. This 316 page monograph presents Professor Dawson's research from 1994-1999 in the field of nonlinear control design and analysis for mechanical systems. This book illustrates, in a unified framework, how Lyapunov-based techniques can be applied to a variety of control problems that can be modeled by ordinary and/or partial differential equations.

- C) **W. Dixon**, **A. Behal**, D. Dawson, and **S. Nagarkatti**, Nonlinear Control of Engineering Systems: A Lyapunov-Based Approach, Birkhäuser, 2003, ISBN 0-8176-4265-X. This 394 page monograph presents Professor Dawson's research from 1987-2003 in the field of nonlinear control design and analysis for a variety of systems (e.g. mechanical, electrical, robotic, aerospace, and underactuated systems). This book provides a practical yet rigorous development of nonlinear Lyapunov-based tools and their use in the solution of control-theoretic problems. Rich in new design techniques, this monograph details how adaptive feedforward algorithms can be utilized to compensate for parametric uncertainty associated with types of nonlinear plants.

Important Accomplishments - (Boldface co-authors denote students of Dawson)
Nonlinear Control of Mechanical Systems

- 1) D. Dawson and Z. Qu, "On the Uniform Ultimate Boundedness of a DCAL-Like Robot Controller", *IEEE Transaction on Robotics and Automation*, Vol. 8, No. 3, Jun. 1992, pp. 409-413.

- 2) **J. Hu**, D. Dawson, and **Y. Qian**, "Position Tracking for Robot Manipulators Driven by Induction Motors without Flux Measurements", *IEEE Transactions on Robotics and Automation*, Vol. 12, No. 3, 1996, pp. 419 - 438.

- 3) **T. Burg**, D. Dawson, **J. Hu**, and **M. de Queiroz**, "An Adaptive Partial State Feedback Controller for RLED Robot Manipulators", *IEEE Transactions on Automatic Control*, Vol 41, No. 7, pp. 1024-1031, July, 1996.

- 4) **S. Lim**, D. Dawson, and **K. Anderson**, "Re-examining the Nicosia-Tomei Robot Observer-Controller from a Backstepping Perspective," *IEEE Transactions on Control Systems Technology*, Vol. 4, No. 3, May 1996, pp. 304-310.

- 5) **M. de Queiroz**, D. Dawson, **M. Agarwal**, and **F. Zhang**, "Adaptive Nonlinear Boundary Control of a Flexible Link Robot Arm", *IEEE Transactions on Robotics and Automation*, Vol. 15, No. 4, Aug., 1999, pp. 779-787.

- 6) **F. Zhang**, D. Dawson, **M. de Queiroz**, and **W. Dixon**, "Global Adaptive Output Feedback Tracking Control of Robot Manipulators", *IEEE Transactions on Automatic Control*, Vol. 45, No. 6, June 2000, pp. 1203-1208.

- 7) **B. Xian**, **M. de Queiroz**, **D. Dawson**, and I. Walker, "Task-Space Tracking Control of Robot Manipulators via Quaternion Feedback", *IEEE Transactions on Robotics and Automation*, Vol. 20, No. 1, pp. 160-167, 2004.

- 8) **A. Behal**, **W. Dixon**, D. Dawson, and **Y. Fang**, "Tracking and Regulation Control of an Underactuated Surface Vessel with Nonintegrable Dynamics", *IEEE Transactions on Automatic Control*, Vol. 47, No. 3, pp. 495-500, March, 2002.

Nonlinear Control of Electric Machines

- 9) D. Dawson, **J. Carroll**, and **M. Schneider**, "Integrator Backstepping Control for a Brush dc Motor Turning a Robotic Load", *IEEE Transactions on Controls Systems Technology*, Vol. 2, No. 3, Sept., 1994, pp. 233-244.

- 10) **M. de Queiroz** and D. Dawson, "Nonlinear Control of Active Magnetic Bearings: A Backstepping Approach", *IEEE Transactions on Control Systems Technology*, Vol. 4, No. 5, Sept., 1996, pp. 545-552.

- 11) **P. Vedagarbha**, D. Dawson, and **M. Feemster**, "Tracking Control of Mechanical Systems in the Presence of Nonlinear Dynamic Friction Effects", *IEEE Transactions on Control Systems Technology*, Vol. 7, No. 4. Jul., 1999, pp. 446-456.

- 12) **M. Feemster**, **P. Aquino**, D. Dawson, and **A. Behal**, "Sensorless Rotor Velocity Tracking Control for Induction Motors," *IEEE Transactions on Control System Technology*, Vol. 9, No. 4, pp. 645-653, July, 2001.

- 13) **A. Behal**, **M. Feemster**, and D. Dawson, "An Improved Indirect Field Oriented Controller for the Induction Motor", *IEEE Transactions on Control Systems Technology*, Vol. 11, No. 2, pp. 248-252, March 2003.

Nonlinear Control and Nonlinear Estimation for General Classes of Systems

- 14) **W. Dixon**, **Y. Fang**, D. Dawson, and T. Flynn, "Range Identification for Perspective Vision Systems", *IEEE Transactions on Automatic Control*, Vol. 48, No. 12, Dec., 2003, pp. 2232-2237.

- 15) **B. Xian**, D.M. Dawson, **M. de Queiroz**, and **J. Chen**, "A Continuous Asymptotic Tracking Control Strategy for Uncertain Nonlinear Systems", *IEEE Trans. on Automatic Control*, Vol. 49, No. 7, pp. 1206-1211, July 2004.