

## Research Interests

Robotics, Flexible Manipulators, Linear Multivariable Control, Nonlinear Systems, Shape Memory Alloys, Hysteretic Systems, Virtual Reality Haptic Interfaces

## EDUCATION

- Ph.D., (Electrical Engineering), University of Waterloo, 1986 to 1989  
*Thesis title:* Modelling and Control of Multi-Link Manipulators with One Flexible Link  
 (Supervisor: Dr. M. Vidyasagar). Faculty of Engineering Best Ph.D. Thesis Award
- M.A.Sc., (Electrical Engineering), University of Waterloo, 1984 to 1986  
*Thesis title:* Modelling and Control of a Flexible Beam Using the Stable Factorization Approach (Supervisor: Dr. M. Vidyasagar)
- B.E., (Engineering Physics), University of Saskatchewan, 1980 to 1984

## SCHOLARSHIPS AND AWARDS

1. Nominated for Distinguished Teacher Award, University of Waterloo, 1995
2. Finalist for Best Conference Paper at the *IEEE Conference on Robotics and Automation* in 1994 (San Diego, CA) for the paper "Issues in the Design of Passive Controllers for Flexible Link Robots" coauthored by M. Rossi and K. Zuo
3. Faculty of Engineering Outstanding Ph.D Award, University of Waterloo, 1989. Awarded to the top graduating Ph.D. student in the Faculty of Engineering
4. Engineering Academic Award, University of Saskatchewan, 1984. Awarded to top graduating student in the College of Engineering
5. Engineering Leadership Award, University of Saskatchewan, 1984. Awarded to the graduating student in the College of Engineering who best combines academics and leadership qualities
6. E.L. Harrington Prize in Physics, University of Saskatchewan, 1984, Awarded to the top student graduating with a Physics or Engineering Physics Degree
7. W.R. Buck Staples Award, University of Saskatchewan, 1982 and 1983. Awarded to the top student in 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> year combined in the College of Engineering
8. University of Saskatchewan Entrance Scholarship, University of Saskatchewan, 1980. Awarded to the top 13 students entering 1<sup>st</sup> year university, regardless of faculty.
9. Governor-General's Bronze Medal, Saskatoon, Saskatchewan, 1980. Awarded to the top high school students in Canada who best combine academic and leadership qualities.

## 1. WORK EXPERIENCE

1. Faculty Association FORUM Editor, 2006 to present
2. Founder and President, Handshake Interactive Technologies, 2001 to 2003
2. Associate Chair of Graduate Studies, Department of Electrical and Computer Engineering, 1998-2000
3. Full Professor, Department of Electrical and Computer Engineering, University of Waterloo, 1999-present
4. Associate Professor, Department of Electrical and Computer Engineering, University of Waterloo, 1994-1999
5. Assistant Professor, Department of Electrical and Computer Engineering, University of Waterloo, 1990-1994
6. Research Assistant Professor, Department of Electrical and Computer Engineering, University of Waterloo, 1989-1990

## 2. OTHER RESEARCH CONTRIBUTIONS

(Graduate students whom I have supervised are in italics)

### 2.1 Refereed Journal Publications

1. *Liya Ni*, D. Wang, “A Human-to-human Force-reflecting Teleoperation System using Fuzzy Logic Controller Tuning”, *The Journal of Intelligent and Robotic Systems*, Springer Verlag, Accepted for publication Sept, 2006, to appear
2. *Derek L. Wight*, Eric Kubica, D. Wang, “Augmenting Locomotion in an Anthropomorphic System”, *The Journal of Systemics, Cybernetics and Informatics*, Accepted for publication, 2006
3. *T. Ravichandran*, D. Wang and G. Heppler, “Simultaneous Plant Controller Design Optimization of a Two-Link Planar Manipulator”, *Mechatronics*, Vol. 16/3-4, pp. 233-242, April-May 2006
4. *K. Fregene*, D. Kennedy, R. Madhavan, L. Parker, D. Wang, “A Class of Intelligent Agents for Coordinated Control of Outdoor Terrain Mapping UGVs”, *Engineering Applications of Artificial Intelligence*, Vol 18, no. 5, pp. 513-531, August 2005
5. *K. Fregene*, D. Kennedy, D. Wang, “Toward a Systems and Control Oriented Agent Framework”, *IEEE Transactions on Systems, Man and Cybernetics, Part B*, Vol. 35, no.5, October 2005
6. *E. Kubica*, *D. Madill* and D. Wang, “Designing Stable MIMIO Fuzzy Controllers”, *IEEE Int. Journal of Systems, Man and Cybernetics, Part B: Cybernetics*, Vol. 35, no. 2, April 2005, pp. 372-380

7. Il-Hwan Kim, Stanley Fok, Kingsley Fregene, Dong-Hoon Lee, Tae-Seok Oh, D. Wang, "Neural Network-based System Identification andn Controller Synthesis for an Industrial Sewing Maching", *International Journal of Control, Automation and Systems*, Vol. 2, No. 1, March 2004
8. K. Ziaei and D. Wang, "Application of Orthonormal Basis Functions for System Identification of Flexible Link Manipulators", *Control Engineering Practice*, Vol. 14, no. 2, February 2006, pp. 99-106
9. L. Ni, D. Wang, "A Gain Switching Control Scheme for Position-error-based Bilateral Teleoperation", *International Journal of Robotics Research*, Vol. 23, no. 3, Mar.2004
10. F. Ching, D. Wang, "Exact Solution and Infinite-Dimensional Stability Analysis of a Single Flexible Link in Collision", *IEEE Transactions on Robotics and Automation*, , Jan, 2004, 1015-1020
11. M. Ghanekar, D.Wang and G.R.. Heppler, 2002, "Dynamic Equivalence Conditions for Controlled Robotic Manipulators", *AIAA Journal*, volume 41, no. 2, pages 280-287
12. R.B. Gorbet, K.A. Morris, D. Wang, "Passivity-based stability and control of hysteresis in smart actuators". Special Issue on Dynamics and Control of Smart Structures, *IEEE Transactions on Control Systems Technology* Vol. 9, no. 1, Jan, 2001, pp. 5-16
13. E. Kubica, D. Wang, 1999, "A Two-Stage Fuzzy Controller for a Flexible Link Manipulator", *International Journal of Robotics & Automation*, vol. 14, no. 1, 1999, pages 9-14
14. R.B. Gorbet, D. Wang, 1998, "A Dissipativity Approach to Stability of a Shape Memory Alloy Position Control System", *IEEE Transactions on Control Systems Technology*, vol. 6, no. 4, July 1998, pp. 554-562
15. D.R. Madill, D. Wang, 1998 "Modeling and  $L_2$ -Stability of a Shape Memory Alloy Position Control System', *IEEE Transactions on Control Systems Technology*, vol. 6, no. 4, July 1998, pp. 473-481
16. M. Rossi, D. Wang, K. Zuo, "Issues in the Design of Passive Controllers for Flexible Link Robots", *International Journal of Robotics Research*, Vol. 16, no. 4, August, 1997, pp. 577-588
17. M. Ghanekar, D. Wang, G. Heppler, 1997, "Scaling Laws for Linear Controllers of Flexible Link Manipulators Characterized by Nondimensional Groups", *IEEE Transactions on Robotics and Automation*, vol. 13, no.1, February 1997, pp 117-127
18. S. Ng, D. Wang, 1995, "Modelling and Control of a Flexible Spherical Wrist" *Robotica*, Vol. 14, no. 2, pp. 155-164
19. K. Zuo, V. Drapeau, D. Wang, 1995, "Closed Loop Shaped Input Strategies for Flexible Robots", *International Journal of Robotics Research*, Vol. 14, no. 5, pp 510-529
20. K. Tuer, M.F. Golnaraghi, D. Wang, 1994, "Development of a Generalised Active Vibration Suppression Strategy for a Cantilever Beam using Internal Resonance", *Nonlin-*

*ear Dynamics*, Vol.5, pp 131-151

21. M.F. Golnaraghi, K. Tuer, D. Wang, 1994, "Regulation of Flexible Structures via Internal Resonance using Nonlinear Coupling Enhancement", *International Journal of Dynamics and Stability of Systems*, Vol. 4, pp. 73-96
22. D. Wang, 1994, "Comparison of Optimal and Nonoptimal Control Strategies for the Single Flexible Link", *International Journal of Robotics and Automation*, Vol. 9, no. 3, pp 130-136
23. F. Janabi-Sharifi, W.J. Wilson, D. Wang, 1994, "On the Contact Behaviour of Manipulators Colliding with Viscoelastic Environments", *International Journal of Robotics and Automation*, Vol. 9, no. 3, pp 116-129
24. T. Ravichandran, G. Pang, D. Wang, 1993, "Robust H-infinity Control of a Single Flexible Link", *Control-Theory and Applications*, Vol. 9, no.4, pp. 887-908, Dec. 1993
25. D. Wang , J.P. Huissoon, 1993, "A Teaching Robot for Demonstrating Robot Control Strategies", *Robotica*, volume 11, pp. 393-401
26. D. Wang , M. Vidyasagar, 1992, "Passive Control of a Stiff Flexible Link", *International Journal of Robotics Research*, Vol. 11, no. 6, December, pp. 572-578
27. D. Wang , M. Vidyasagar, Feb. 1992, "Modelling of Manipulators with a Single Flexible Link", *IEEE Transactions on Robotics and Automation*, vol. 8, no. 1, pp. 33-41
28. D. Wang, M. Vidyasagar, Dec. 1991, "Control of a Class of Manipulators with the Last Link Flexible- Part I: Feedback Linearization", *ASME Journal of Dynamic Systems, Measurement and Control*, vol. 113, no. 4, pp. 655-661
29. D. Wang , M. Vidyasagar, Oct. 1991, "Transfer Function for a Single Flexible Link", *International Journal of Robotics Research*, vol 10, no. 5, pp. 540-549
30. J.P. Huissoon , D. Wang, 1991, "On the Design of a 5-Bar-Linkage Manipulator", *Robotica*, Vol. 9, pp. 441-446.
31. D. Wang , M. Vidyasagar, Dec. 1991, "Control of a Class of Manipulators with the Last Link Flexible- Part II: Observer-Controller Stabilization", *ASME Journal of Dynamic Systems, Measurement and Control* vol. 113, no. 4, pp.662-668

## **2.2 Articles submitted to refereed journals**

1. D. Wight, E. Kubica, D. Wang, "Introduction of the Foot Placement Estimator: A Dynamic Measure of Balance for Bipedal Robotics", *IEEE Transactions on Robotics and Automation*, Submitted for publication, 2005
2. S. Fok, D. Wang, G. Freeman, "Video Compression Techniques for Stereoscopic Telepresence Applications" *Presence*, Submitted for publication, 2006

## **2.3 Invited Conference Papers and Talks**

1. D. Wang, "Haptics- a new frontier in communications", 2007 Canadian Undergraduate Technology Conference, Toronto, Jan. 11-13, 2007
2. D. Wang, "Technology Start-Up Companies: Do you have what it takes?", 2006 Canadian Undergraduate Technology Conference, Toronto, Jan. 12-14, 2006
3. S. Tam, E. Kubica, D. Wang, "A System Identification Technique for Haptic Devices", *2005 IEEE Conference on Control Applications*, Toronto ON, August 28-31<sup>st</sup>, 2004
4. M. Rossi, K. Tuer, D. Wang, "A New Design Paradigm for the Rapid Development of Haptic and Telehaptic Applications", *2005 IEEE Conference on Control Applications*, Toronto, ON, August 28-31<sup>st</sup>, 2004
5. D. Wang, "Haptics in Telerobotic Applications", CITO/OCRI Tech Talk: Transmitting Touch Over Networks, December 16, 2003
6. E. Yang, D. Wang, J. Fung, "The Legality of MP3 Distribution: A Panel Discussion", Kitchener-Waterloo IEEE Section Computer Chapter Invited Talk, Nov. 23rd, 2000, University of Waterloo.
7. D. Wang, L. Ni, J. Shu, G. Lai, C. Caridima, "Virtual Reality Force Reflection Applications over the Internet", Kitchener-Waterloo IEEE Section Computer Chapter Invited Talk, Nov. 27th, 2000, University of Waterloo.
8. D. Wang, L. Ni, J. Shu, 2000, "How to Show VR Force Reflection", *NLANR/Internet2/CANARIE Techs Meeting*, University of Toronto, August 21, 2000,
9. R. Gorbet, K.A., Morris, D. Wang, 1998, "Control of Hysteretic Systems: A State-Space Approach", *Workshop on Learning, Control and Hybrid Systems*, Lecture Notes in Control and Information Sciences, Springer-Verlag, Vol. 241, Y. Yamamoto, S. Hara, eds, pp.432-451
10. S. Ng and D. Wang, 1993, "Modelling and Control of a Flexible Spherical Wrist", *36th Midwest Symposium on Circuits and Systems*, August 15-18, Detroit, MI., pp.385-388
11. D. Wang, 1992, "Comparison of Control Strategies for a Single Flexible Link", *Workshop on Sensing, Identification and Control of Flexible Structures*, The Fields Institute for Research in Mathematical Sciences, June 28-30, University of Waterloo, Waterloo, Ont., pp. 113-133
12. D. Vinke and D. Wang, 1990, "Optimal Improper Controllers for a Single Flexible Link", *Proceedings of the 3rd Int. Symposium on Robotics and Manufacturing*, Burnaby, BC., pp. 557-562
13. D. Wang and M. Vidyasagar, 1989, "Feedback Linearizability of Multi-Link Manipulators with One Flexible Link", *Proceedings of the IEEE Conference on Decision and Control*, Tampa Bay, Florida.

## 2.4 Refereed Conference Papers

1. D. Wang, M. Rossi, J. Shu, K. Tuer, "Collaborative Tele-haptics: A Pilot Study Evaluation", 2005 Laval-Virtual, 7<sup>th</sup> Virtual Reality International Conference, April 20-24<sup>th</sup>, Laval, France
2. D. Wang, L. Ni, M. Rossi, K. Tuer, "Implementation Issues for Bilateral Tele-mentoring Applications", *HAVE 2004- IEEE International Workshop on Haptic Audio Visual Environments and their Applications*, Ottawa, ON, Oct. 2-3, 2004, pp. 75-80
3. T. Ravichandran, G.R. Heppler, D. Wang, "Task-Based Optimal Simultaneous Manipulator/Controller Design Using Evolutionary Algorithms", 6<sup>th</sup> *International Conference on Dynamics and Control of Systems and Structures in Space*, 2004, Riomaggiore, Cingue Terre, Liguaria, Italy. 18-22 July 2004. Stephen Hobbs (ed.), Cranfield University Press, 2004. pp 707 -- 716.
4. Robert S. Allison, James E. Zacher, David Wang, Joseph Shu, "Effects of network delay on a collaborative motor task" 2004 ACM SIGGRAPH International Conference on VRCAI, Singapore, June 16-18.
5. D. Wight, E. Kubica, D. Wang, "Augmenting Locomotion in Anthropomorphic Systems", 8<sup>th</sup> World Multiconference on Systemics, Cybernetics and Informatics (SCI 2004), Orlando, FL, July 18-21, 2004, To appear
6. T. Ravichandran, D. Wang, G. Heppler, "Stability and Robustness of a Class on Nonlinear Controllers for Robot Manipulators", *American Control Conference*, Boston, Massachusetts, June 30-July 2, 2004, pp 5262 - 5267
7. D. Wang, K. Tuer, M. Rossi, L. Ni, J. Shu, "The Effect of Time Delays on Tele-haptics", *Proceedings of the 2<sup>nd</sup> IEEE Int Workshop on Haptic, Audio and Visual Environments and their Applications- HAVE 2003*, Ottawa, ON, Sept. 20-21, 2003
8. T. Ravichandran, G.R. Heppler and D.W.L. Wang, "Stability Analysis of a Class of Nonlinear Controllers", *ASME International Mechanical Engineering Congress and Exposition*, Washington, DC., November 16-21, 2003.
9. T. Ravichandran, G.R. Heppler and D.W.L. Wang, "Simultaneous Manipulator/Controller Design Optimization Using Multi-objective Evolutionary Algorithms", *ASME International Mechanical Engineering Congress and Exposition*, Washington, DC., November 16-21, 2003.
10. Lai, G.M.Y., Ziaei K., Wang, D.W.L. and Heppler G.R., "Application of an Advanced Frequency Domain Identification Method for Modeling of Flexible-Link Manipulators", *ASME International Congress and Exposition, Dynamic Systems and Control*. Washington, DC., November 16-21, 2003
11. K. Ziaei, D. Wang, G. Heppler, "Modeling of a Constrained Flexible Manipulator", Symposium on Advances in Robot Dynamics and Control, ASME International Mechanical Engineering Congress and Exhibition, November, 2003, Washington, D.C,
12. Kingsley Fregene, Diane Kennedy and David Wang, "A Study of Supervisory Constraints in a Class of Coordinated Multiagent Systems," *Proceedings of the American Control Conference*, Denver, CO, USA,

2003.

13. *Kingsley Fregene*, Diane Kennedy and David Wang, "On the Stability of Coordinated Multiagent Systems with Degraded Communication," Proceedings of the American Control Conference, Denver, CO, USA, (Best Presentation Award) 2003.
14. W. Xie, *M. Krzeminski*, D. Wang, H. El-Tahan, M.. El-Tahan, "Intelligent Friction Compensation (IFC) in a Harmonic Drive", 12th Annual IEEE Newfoundland Electrical and Computer Engineering Conference (NECEC), Newfoundland, November 13, 2002.
15. *T.Ravichandran*, D. Wang, G.R. Heppler, "Optimal Nonlinear Controller Design for Set-point Control of Robot Manipulators", CCECE 2003, Montreal, Canada, May 4-7, 2003.
16. *K. Ziaei*, D. Wang, "Design and Experimental Evaluation of a Single Robust Position/Force Controller for a Single Flexible Link Manipulator in Collision", *IEEE International Conference on Robotics and Automation*, Taipei, Taiwan, Sept 2003,
17. *K. Fregene*, D. Kennedy, D. Wang, "Multi-vehicle pursuit-evasion: an agent-based framework", *IEEE International Conference on Robotics and Automation*, Taipei, Taiwan, Sept. 2003,
18. *L. Ni* and D. Wang "Fuzzy Logic Controller Tuning for a Human-to-Human Force-Reflecting Teleoperation System", *The 2002 International Conference on Control and Automation*, June 16-19, 2002, Xiamen, China
19. *L. Ni* and D. Wang, "A Gain Switching Control Scheme for Position-error-based Force-reflecting Teleoperation", *10<sup>th</sup> Symposium on Haptic Interfaces for Virtual Environment and Teleoperation Systems*, March 24-25, 2002, Orlando, Florida, U.S.A.
20. *L. Ni* and D. Wang, "Contact Transition Stability Analysis for a Bilateral Teleoperation System", *2002 IEEE International Conference on Robotics and Automation*, May 2002, Washington, DC, U.S.A.
21. *T. Ravichandran*, G. Heppler and D. Wang, "Optimal Multi-objective Manipulator/Controller Design for Space Applications", to appear at the *5<sup>th</sup> International Conference on Dynamics and Control of Systems and Structures in Space*, 2002.
22. *K. Fregene*, D. Kennedy and D. Wang, "HICA: A Minimal Framework for Distributed Multi-agent Control", *Intelligent Systems and Control*, Tampa, Florida, November 2001.
23. *E. Kubica*, D. Wang and D. Winter, 2001, "Feedforward and Deterministic Fuzzy Control of Balance and Posture during Human Gait", *IEEE International Conference on Robotics and Automation 2001*, May 2001, Seoul, Korea, Vol. 3, pp. 2293-2298.
24. *G. Lai*, *C. Caradima*, D. Wang, "A Mechatronics Approach to Safe, Stable Teleoperation in Medical Applications", 26th Biennial Mechanisms and Robotics Conference, ASME Design Technical Conferences, September 10-13, 2000, Baltimore Maryland
25. *C. Caradima*, D. Wang, "Time Delay Compensation and Stability Issues in Teleopera-

tion”, IMECE 2000 Conference, ASME Winter Annual Conference, Nov. 5-10, 2000, Orlando, FL

26.. D. Madill, D. Wang, 1999, “A Mechatronics Approach to the Control of a Haptic Interface”, *1999 International Mechanical Engineering Congress and Exposition*, Nov. 14-19, 1999, Nashville, TN

27. F. Ching , D. Wang, 1999, “An Infinite-dimensional Analysis of a PD-Controlled Single Flexible Link in Collision”, *IEEE International Conference on Robotics and Automation*, May 1999, Detroit, Michigan, USA, pp. 419-426,

28.M. Ghanekar, D. Wang, G. Heppler, 1999, “Scaling Laws for the Dynamics and Control of Flexible Link Manipulators”, *IEEE International Conference on Robotics and Automation*”, Detroit, Michigan - May 1999, pages 427-434

29. R.B. Gorbet, D. Wang and K.A. Morris, 1998, “Preisach Model Identification of a Two-Wire SMA Actuator”, *IEEE International Conference on Robotics and Automation* “, (Leuven, Belgium) May 16-21 1998, pp. 2161-2167

30. M. Ghanekar, D. Wang, G. Heppler, 1998, “Scaling Laws for Nonlinear Controllers of Dynamically Equivalent Rigid-Link Manipulators”, *Proceedings of the 1998 IEEE International Conference on Robotics and Automation* (Leuven, Belgium), pp. 2633-2639

31. R.B. Gorbet, K.A. Morris, D. Wang, 1997, “Stability of Control for the Preisach Hysteresis Model”, *1997 IEEE International Conference on Robotics and Automation*, Albuquerque, New Mexico, April 1997, Vol. 1, pp. 241-247

32.M. Ching, D. Wang, 1997, “A Five-bar-linkage Force Reflecting Interface for a Virtual Reality System”, *1997 IEEE International Conference on Robotics and Automation*, Albuquerque, New Mexico, April 1997, pp 3012-3017

33. S. Moorehead, D. Wang, 1997, “An Experimental Study of Contact Transition Control of a Single Flexible Link using Positive Acceleration Feedback”, *1997 IEEE International Conference on Robotics and Automation*, Albuquerque, New Mexico, April 1997, pp 2838-2843

34.M. Rossi, D. Wang, 1996, “Hybrid Passive Adaptive Control of a Single Flexible Link Manipulator with a Payload”, *1996 Proceedings of the IEEE Conference on Robotics and Automation*, Minneapolis, MN, pp 2109-2116

35. S. Moorehead, D. Wang, 1996, “Collision Detection using a Flexible Link Manipulator: A Feasibility Study”, *1996 Proceedings of the IEEE Conference on Robotics and Automation*, Minneapolis, MN, pp. 804-809

36. C. Trautman, D. Wang, 1996, “Noncollocated Passive Control of a Flexible Link Manipulator” *1996 Proc. of the IEEE Conf on Robotics and Automation*, Minneapolis, MN, pp. 1107-1114

37. E. Kubica, D. Wang and D.A. Winter, 1995, “Modelling Balance and Posture Control Mechanism of the Upper Body using Conventional and Fuzzy Techniques”, *North American Clinical Gait Laboratory Conference*, Waterloo, Canada (Refereed Abstract, 2 pages)



38. M. Ghanekar D. Wang and G.H. Heppler, 1995, "Controller Scaling Laws for Flexible Link Manipulators Characterized by Nondimensional Pi Groups", *1995 American Control Conference* Seattle, Washington, 6:4101-4105, June 1995.
39. M. Ghanekar D. Wang and G. Heppler, 1995, "Scaling Laws for Frequency Domain Controllers of Dynamically Equivalent Single Flexible Link Manipulators", *1995 Proceedings of the IEEE Conference on Robotics and Automation*, Nagoya, Japan, 1:919-924, May, 1995
40. C. Trautman, D. Wang, "Experimental H-infinity Control of a Single Flexible Link with a Shoulder Joint", *1995 Proceedings of the IEEE Conference on Robotic and Automation* Nagoya, Japan, 1:1235-1241, May 1995
41. R.B. Gorbet, D. Wang, 1995, "General Stability Criteria for a Shape Memory Alloy Position Control System", *1995 Proceedings of the IEEE Conference on Robotics and Automation*, Nagoya, Japan, No. 3, pp. 2313-2319
42. D. Madill, D. Wang, 1994, "L<sub>2</sub>-stability of a Shape Memory Alloy Position Control System", *33rd Conference on Decision and Control*, Orlando, Florida, pp. 399-404
43. D. Madill, D. Wang, 1994, "The Modelling and L<sub>2</sub> Stability of a Shape Memory Alloy Position Control System", *Proceedings of the IEEE Conference on Robotics and Automation*, San Diego, CA, pp. 293-299
44. M. Rossi, K. Zuo, D. Wang, 1994, "Issues in the Design of Passive Controllers for Flexible Link Robots", *Proceedings of the IEEE Conference on Robotics and Automation*, San Diego, CA, (Finalist for Best Conference Paper and Semi-Finalist for Best Student Conference Paper Award), pp. 321-326
45. K. Tuer, D. Wang, M.F. Golnaraghi, 1994, "Vibration Suppression of a Single Flexible Link using a Linear Modal Coupling Paradigm", *Proceedings of the IEEE Conference on Robotics and Automation*, San Diego, CA, pp. 1810-1815
46. Kevin Tuer, D. Wang, M.F Golnaraghi, 1993, "Ascertaining the Stability of the 2:1 and 1:1 Modal Coupling Canonical Controllers", *International Symposium on Nonlinear Dynamics and Stochastic Mechanics*, Fields Institute, University of Waterloo, August 29-September 1, 1993
47. E. Kubica, D. Wang, 1993, "A Fuzzy Control Strategy for a Flexible Single Link Robot", *1993 IEEE Conference on Robotics and Automation*, Atlanta, Georgia, vol. 2 pp. 236-241
48. V Drapeau, D. Wang, 1993, "Verification of a Closed-Loop Shaped-Input Controller for a Five-Bar-Linkage Manipulator", *1993 IEEE Conference on Robotics and Automation*, Atlanta, Georgia, Vol. 3., pp. 216-221
49. K. Tuer, M.F. Golnaraghi, D. Wang, 1993, "Vibration Suppression of Multi-degree-of-Freedom Systems via Linear and Nonlinear Coupling Effects", *Fifth Conference on Nonlinear Vibrations, Stability, and Dynamics of Structures and Mechanisms* , Virginia Polytechnic Institute and State University, Blacksburg, Virginia

50. K. Tuer, M.F. Golnaraghi, D. Wang, 1992, "Formulation of a Vibration Control Law Based on Internal Resonance", *Fourth Conference on Nonlinear Vibrations, Stability and Dynamics of Structures and Mechanisms*, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, June 7-11.
51. K. Zuo, D. Wang, 1992, "Closed Loop Shaped-Input Control of a Class of Manipulators with a Single Flexible Link", *1992 IEEE Conference on Robotics and Automation, Nice, France*, pp. 782-787
52. B. Patnaik, G. Heppler, D. Wang, 1993, "Stability Analysis of a Piezoelectric Vibration Controller for an Euler-Bernoulli Beam", *American Control Conference San Francisco, CA*, pp 197-201
53. D. Wang and M. Vidyasagar, 1991, "Observer-Controller Stabilization of a Class of Manipulators with a Single Flexible Link", *1991 IEEE Conference on Robotics and Automation, Sacramento, California.*, pp 516-521
54. D. Wang and J.P. Huissoon, 1990, "Reducing Torque Requirements in 5-Bar-Linkage Manipulators", *Proceedings of the 13th IASTED Int. Symp. on Robotics and Manufacturing* Santa Barbara, California.
55. D. Wang and M. Vidyasagar, 1990, "Passive Control of a Single flexible Link", *Proceedings of the 1990 IEEE Conference on Robotics and Automation* , Cincinnati, Ohio., pp 1432-1437
56. D. Wang and M. Vidyasagar, 1989, "Transfer Function for the Single Flexible Link", *Proceedings of the 1989 IEEE International Conference on Robotics and Automation*, Scottsdale, Az., pp. 1042-1047
57. D. Wang and M. Vidyasagar, 1988, "Modelling of a 5-bar-linkage Manipulator with One Flexible Link", *Proceedings of the 1988 IEEE International Conference on Robotics and Automation*, Philadelphia, PA, pp. 21-26.
58. D. Wang and M. Vidyasagar, 1987, "Algorithm for Generating Inertia Matrices of N-bar-linkage Robots", *Modelling and Control of Robotic Manipulators and Manufacturing Processes*, ASME, pp. 111-116.
59. D. Wang and M. Vidyasagar, 1987, "Control of a Flexible Beam for Optimum Step Response", *Proceedings of the 1987 IEEE International Conference on Robotics and Automation*, Raleigh, NC, pp. 1567-1572.

## 2.5 Non-Refereed Conference Papers

1. B. Tweddle, M. Black, B. Deguire, S. Peleato, A. Philip, D. Wang, "Development of a network-centric Aerial Robotic System", *Journal of the AUVSI Unmanned Systems 2006 Symposium Proceedings*, 2006

2. Brent Tweddle, *M. Black*, B. Deguire, A. Philip, D. Wang, "An Implementation of a Network-Based Aerial Reconnaissance System, *Journal of the AUVSI Unmanned Systems 2005 Symposium Proceedings*, 2005
3. B. Tweddle, N. Mahendran, A. Philip, J. Gilham, S. Peleato, *M. Black*, D. Wang, "A Network-based Implementation of an Aerial Robotic System, *Journal of the AUVSI Unmanned Systems Symposium Proceedings*, 2004
4. "A Dual Robot Aerial Reconnaissance System; Designing the Delivery Vehicle", Brent Tweddle, *Gilbert Lai*, Steve Buchanan, D. Wang, *Association for Unmanned Vehicle Systems: Millennial Event Competition*, 2003
- 5 "Optimal Nonlinear Controller Design for Set-point Control of Robot Manipulators", *T. Ravichandran*, D. Wang and G. Heppler, *IEEE Canadian Conference in Electrical and Computer Engineering*, CCECE 2003, Montreal Canada.
6. "Component Architecture for a combined indoor and outdoor aerial reconnaissance system", M. Abd-El-Malek, D. Kroetsch, *G. Lai*, D. Wang, D. Zlotnikov, *Association for Unmanned Vehicle Systems: Millennial Event Competition*, 2002
7. "An autonomous multi-vehicle System for Reconnaissance", *C. Turner*, D. Kroetsch, D. Hemingway, *G. Lai*, D. Wang, *Association for Unmanned Vehicle Systems: Millennial Event Competition*, 2001
8. *G. Lai*, *K. Fregene*, D. Wang, "Investigation of a layered control strategy for an autonomous helicopter", Canadian Conference of Electrical and Computer Engineering, 2000, (Refereed abstract)
9. *R.B.Gorbet*, K. Morris, D. Wang, "A State Space Representation for the Preisach Hysteresis Model", *1998 SIAM Conference on Control & Its Applications*, Jacksonville, FL. May 7-9, 1998.
10. L. Behjat, D. Kroetsch, C. McKillop, W. Rosehart, Daobo Wang, David Wang, "Implementation of an Autonomous Multi-Vehicle System", *Association for Unmanned Vehicle Systems: Millennial Event Competition*, 1999
11. Mattias Hembruch, David Kroetsch, *Gilbert Lai*, William Rosehart, David Wang, "Description, Modeling and Control of an Autonomous Helicopter" *Association for Unmanned Vehicle Systems: Millennial Even! Competition*, 1998
12. L. Behjat, D. Kroetsch, C. McKillop, W. Rosehart, D. Wang, "Implementation of an Autonomous Multi-Vehicle System", *Association for Unmanned Vehicle Systems: Millennial Event Competition*, July, 1999

## 2.6 Refereed Video Conference Proceedings

1. J. Leng, B. Olson, E. Tahir, D. Hemingway, A. Elkhazin, D. Wang, "Icebot Robot", *IEEE Robotics and Automation Video Conference Proceedings*, 2001
2. *G. Lai*, *C. Caradima*, D. Wang, *L. Ni*, E. Kubica, D. Madill, "Haptic Applications using a Virtual Reality Mouse", *IEEE Robotics and Automation Video Conference Proceedings*, 2000

3. Mennas Ching, D. Wang, , "A Five Bar Linkage Force Reflecting Interface for a Virtual Reality System", *IEEE Robotics and Automation Video Conference Proceedings*, 1997

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2. D. Wang, K. Tuer, L. Ni, P. Porciello, "Conducting a Real-Time Remote Handshake with Haptics", *12<sup>th</sup> Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, Chicago, Illinois, March 27-28, 2004

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4. D. Wang, K. Tuer, M. Rossi, J. Shu, "Identification Friend of Foe Application Demonstrating Effects of Haptics and Time Delay", *12<sup>th</sup> Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems*, Chicago, Illinois, March 27-28, 2004

## **2.8 Patents**

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2. Provisional Patent no. 2,363,396. "Hard Real Time Control Center", converted to PCT, June 21, 2003

3. Provisional Patent no. 2,370,580, "Thin Client Based Intelligent Transportation Applications", Feb. 3, 2002

4. US Provisional Patent 10/701,688, "Intelligent Friction Compensation (IFC) Techniques", Nov. 6, 2002

5. Provisional Patent, "A Methods and System for Providing Haptic Effects", March 14, 2003