

Marvin H. Cheng

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Education

- Ph.D. in Mechanical Engineering, Purdue University, West Lafayette, Indiana, December 2005.
Dissertation: *Encoding of Sampled-Data Systems: Applications to Finite Wordlength Controller Implementation and Adaptive Sampling of Atomic Force Microscopy.*
Advisor: Professor George T.-C. Chiu
- M.S. in Mechanical Engineering, National Sun Yat-Sen University, Kaohsiung, Taiwan, June 1996.
Thesis: *Development of the Distributed Control System for Remotely Operated Vehicle*
Advisor: Professor Chi-Cheng Cheng
- B.S. in Mechanical Engineering, National Sun Yat-Sen University, Kaohsiung, Taiwan, June 1994.

General Summary

Dr. Cheng's research interests span the fields of mechatronics, dynamic systems and control, and sensor and measurement, including but not limited to: integrated design and control of electro-mechanical systems, controller implementation with the limitation of finite wordlength, precision motion control, and adaptive sampling and measurement of atomic force microscopy. In 2006, he has worked at the Indiana Research Institute as a Senior Control Engineer, where he conducted research on the diagnosis and monitoring system of fuel pump systems for heavy duty diesel engines. For his Ph.D. dissertation, Dr. Cheng worked on experimental and theoretical study of sampled-data systems. This involved developing new algorithms to estimate required resolution for digital controllers in mechatronic systems and an innovative sampling method to accelerate the scanning scheme of atomic force microscopes. Prior to his Ph.D. study, Dr. Cheng worked at Industrial Technology Research Institute from 1996 till 1997 as a research engineer and a project leader, where he developed a networked embedded system of HVAC control system and transferred technology from laboratory to production scale. From 1997 till 1999, he worked in Synchronous Radiation Research Center as a Research Engineer, where he was a group leader for integrating control network of cooling systems, designing monitoring devices for power equipments, and controlling the stability of clean room environments. Dr. Cheng is a member of the IEEE, ASME, and ASEE.

Work Experience

- Assistant Professor**, the Department of Mechanical and Aerospace Engineering, West Virginia University, Morgantown, West Virginia, 08/2010 – present time.
- Assistant Professor, Director of Mechatronics and Measurement Research Laboratory**, Georgia Southern University, Statesboro, Georgia, 08/2006 – 07/2010.
Teaching and research in the area of control, dynamic systems, and mechatronics.
Coordinator of the Mechatronics and Measurement Lab.
- Senior Control Engineer**, Indiana Research Institute, Columbus, Indiana, 01/2006 – 06/2006.
Design of embedded controllers, on-line monitoring system, and diagnosis of diesel engine system.
- Research Engineer**, Synchronous Radiation Research Center, Hsinchu, Taiwan, 09/1997 – 07/1999.
Control, diagnosis and maintenance of utility system for optical devices and laboratories that include: design of monitoring station for power system, integration of control network of cooling systems, and environment control for clean room laboratories.

Research Engineer, Industrial Technology Research Institute, Hsinchu, Taiwan, 08/1996 – 09/1997.

Controller design for fan coil device and dynamic-ice-harvester HVAC system that includes: protocol design of control network, circuit design of network controllers, actuator selection, and feedback sensor design. Experience in product development from investigation to prototyping and issues involving budget, manufacturability, and production.

Academic Experience

Curriculum Development, Remote Laboratory, Purdue University, West Lafayette, Indiana, 2002 – 2004.

The laboratory facility can be accessed through e-mail exchange. This avoided the issues with corporate firewall. The facility provided the student with the flexibility of being able to perform measurement and control experiments anytime and anywhere. It was first deployed during the spring 2002 semester with the ME578 Digital Control course. Student response is exceptionally positive. The facility is currently being duplicated at the University of Michigan. It was used for the first time in Purdue Continuing Engineering Education course to incorporate laboratory/experiment experience into distance learning.

Teaching Assistant, Purdue University, West Lafayette, Indiana, 08/00 – 12/05.

Develop lab material in the following courses: Digital Control and Mechatronics.

Instruct lab sessions of the following courses: Mechatronics, Digital Control, and Automatic Control.

Assist teaching and tutor in the following courses: Digital Control, System Modeling, and Mechanics I&II.

Research Assistant, Purdue University, West Lafayette, Indiana, 08/1999 – 08/2005.

Develop the algorithm of adaptive sampling for fast atomic force microscopy sampling.

Conduct research on capacitive sensor used for diagnosis of hydraulic pump.

Conduct research on controller implementation with limitation of finite wordlength.

Research Assistant, Purdue University, West Lafayette, Indiana, summer, 2004.

Develop the evaluating and training system of Oral English Proficiency Program for instructors in the Department of English.

Instructor of Industrial Training Course, Industrial Development Bureau, Taiwan, 03/1997.

Lecture the training courses held by Industrial Development Bureau.

Publications

Journal Articles

1. **M. H. Cheng**, G. T.-C. Chiu, and M. Franchek, "Real-Time Measurement of Eccentric Motion with Low-Cost Capacitive Sensor," *Sensors*, in revision.
2. **M. H. Cheng**, C.-Y. Chen and E. G. Bakhoun, "Synchronization Controller Synthesis of Multi-Axis Motion System," *International Journal of Innovative Computing, Information and Control*, vol.7, no.8, August, 2011.
3. E.G. Bakhoun and **M. H. Cheng**, "Novel Electret Microphone," *IEEE Sensors Journal*, vol. 11, no.4, pp.988-994, 2011.
4. V. A. Soloiu, **M. H. Cheng**, and C. Y. Chen, "Analytic Solution of Shock Waves Equation with Higher Order Approximation," *Innovative Computing, Information and Control – Express Letters*, vol.4, no.5(B), pp. 1723-1728, October, 2010.
5. C. Y. Chen and **M. H. Cheng**, "Backstepping Controller Design for a Manipulator with Compliance," *Innovative Computing, Information and Control – Express Letters*, vol.4, no.5(A), pp. 1991-1996, October, 2010.
6. C. Y. Chen and **M. H. Cheng**, "Open Architecture Design of Embedded Controller for Industrial Communication Gateway," *ICIC – Express Letters: Part B*, vol.1, no.1, pp. 51-56, September, 2010.

7. **M. H.-M. Cheng** and E. G. Bakhoun, "A Simplified Approach of Wordlength Estimation for Digital Controllers in State-Space Representation," *Innovative Computing, Information and Control – Express Letters*, vol.4, no.4, pp. 1295-1300, August, 2010.
8. E. G. Bakhoun and **M. H.-M. Cheng**, "Capacitive Pressure Sensor with Very Large Dynamic Range," *IEEE Transactions on Microelectromechanical Systems*, vol. 19, no.3, pp.443-450, 2010.
9. E. G. Bakhoun and **M. H.-M. Cheng**, "Experiment for Teaching a Fundamental Principle in Electrostatics," *Journal of Electrostatics*, vol. 68, no. 3, pp. 249-253, June, 2010.
10. E. G. Bakhoun and **M. H.-M. Cheng**, "Capacitive Pressure Sensor with Very Large Dynamic Range," *IEEE Transactions on Components and Packaging Technologies*, vol. 33, no.1, pp.79-83, 2010.
11. J. Lee and **M. H.-M. Cheng**, "Psychophysical Measurement of Perceptual Sensitivity to Pitch Variations," *Innovative Computing, Information and Control – Express Letters*, vol.4, no.1, February, 2010.
12. **M. H.-M. Cheng**, and G. T.-C. Chiu, "A Mechatronic Approach to a Virtual Laboratory Service on Internet," *International Journal of Virtual Technology and Multimedia*, vol. 1, no. 2, pp.140-154, 2010.
13. **M. H.-M. Cheng**, Cheng-Yi Chen, E. G. Bakhoun, and A. Mitra, "Controller Synthesis with the Consideration of Multi-Resolution," *Innovative Computing, Information and Control – Express Letters*, vol.3, no.4(A), pp.1025 – 1030, October 2009.
14. C.-Y. Chen and **M. H.-M. Cheng**, "Adaptive Robust Sensorless Position Control of Integrated Moving Coil Motor and Flexure Mechanism," *Innovative Computing, Information and Control – Express Letters*, vol.3, no.3(A), pp.445 – 450, October 2009.
15. E. G. Bakhoun and **M. H. M. Cheng**, "Electrophoretic Coating of Carbon Nanotubes for High Energy-Density Capacitor Applications," *Journal of Applied Physics*, vol. 105, no. 10, May, 2009.
16. **M. H.-M. Cheng**, G. T.-C. Chiu, and R. Reifenberger, "Fractal Compression and Adaptive Sampling: Reducing the Image Acquisition Time in Scanning Probe Microscopy," *Scanning*, pp. 463 – 473, November/December, 2008.
17. **H.-M. Cheng**, "Digital Controller Synthesis with Restricted Resolution," *Journal of Computers*, vol. 3, no. 4, April, 2008.
18. **H.-M. Cheng**, "A New Approach to Estimate the Required Wordlength of Digital Controller," *ASME Early Career Technical Journal*, vol. 6, no. 1, pp. 31-38, October, 2007.
19. **H.-M. Cheng** and G. T.-C. Chiu, "Adaptive Sampling for Atomic Force Microscopy with System Level Motion Constraints," *Proceedings of SPIE Electronic Imaging*, vol. 6065, 60650D, February, 2006.
20. **H.-M. Cheng** and G. T.-C. Chiu, "Theory and Implementation of Finite Precision Controller – Limitation on Sample Rate and Wordlength," *Mechanical Engineering Monthly (Chinese)*, no. 354, January 2005.
21. **H.-M. Cheng**, M.T.-S. Ewe, R. Bashir, and G. T.-C. Chiu, "Modeling and Control of Piezoelectric Cantilever Beam Micro-Mirror and Micro-Laser Array to Reduce Image Banding in Electrophotographic Processes," *J. of Micromechanics and Microengineering*, vol. 11, pp. 487-498, 2001.

Refereed Conference/Workshop Papers

1. **M. H.-M.** and E. Bakhoun, "Adaptive Robust Control of Tracking and Synchronization for Multi-Axis Motion System," in *2011 American Control Conference*, pp. 1-6, San Francisco, CA, June 29 – July 1, 2011.
2. **M. H.-M. Cheng**, C.Y. Chen, and E. Bakhoun, "A Simplified Approach of Wordlength Estimation and Its Application," in *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, Montreal, Quebec, Canada, July, 2010.
3. **M. H.-M. Cheng**, S. Salekeen, E. Bakhoun, and C.-Y. Chen, "Adaptive Control of Synchronization for Multi-Axis Motion System," in *the IEEE SoutheastCon 2010 (SEC10)*, Charlotte-Concord, North Carolina, USA, March 18-21, 2010.

4. **M. H.-M. Cheng**, C.-Y. Chen, and A. Mitra “Synchronization Controller Synthesis of Multi-Axis Motion System,” in *the 4th International Conference on Innovative Computing, Information and Control (ICICIC 2009)*, Kaohsiung, Taiwan, December 7-9, 2009.
5. C.-Y. Chen, **M. H.-M. Cheng**, and C.-F. Yang, “Modified Sliding Mode Speed Control of Brushless DC Motor Using Quantized Current Regulator,” in *the 4th International Conference on Innovative Computing, Information and Control (ICICIC 2009)*, Kaohsiung, Taiwan, December 7-9, 2009.
6. **M. H.-M. Cheng**, “Fractal Compression and Adaptive Sampling with HV Partitioning: Accelerating the Scanning Process in Scanning Probe Microscopy,” in *the ASME International Mechanical Engineering Congress & Exposition (IMECE09)*, Orlando, Florida, USA, November 13-10, 2009.
7. **M. H.-M. Cheng**, G. T.-C. Chiu, and M. Franchek, “Real-Time Measurement of Eccentric Motion with Capacitive Sensor for Hydraulic Pumps,” in *2009 American Control Conference (ACC)*, St. Louis, Missouri, USA, June 10-12, 2009.
8. C.-Y. Chen, F. Hsieh, S.-H. Yu, and **M. H.-M. Cheng**, “Adaptive Position Control of Integrated Linear Actuator and Flexure Mechanism,” in *IEEE Conference on Industrial Electronics and Applications (ICIEA 2009)*, Xi’an, China, May 25-27, 2009.
9. **M. H.-M. Cheng** and C.-Y. Chen, “Discrete-Time Controller Synthesis of a Piezoelectric Cantilever Beam with the Consideration of Finite Precision,” in *the IEEE SoutheastCon 2009 (SEC09)*, Atlanta, Georgia, USA, March 6-8, 2009.
10. **M. H.-M. Cheng** and C.-Y. Chen, “Controller Synthesis of Piezoelectric Cantilever Beam with the Consideration of Finite Wordlength,” in *the 3rd International Conference on Innovative Computing, Information and Control (ICICIC2008)*, June 2008.
11. C.-Y. Chen and **H.-M. Cheng**, “Robust Adaptive Control for Robot Manipulators with Friction,” in *the 3rd International Conference on Innovative Computing, Information and Control (ICICIC2008)*, June 2008.
12. **M. H.-M. Cheng**, “Modeling and Measurement of Cylindrical Capacitive Sensor and Parameter Estimation of Hydraulic Pump,” in *International Symposium on Industrial Electronics Mechatronics and Applications 2007*, Kaohsiung, Taiwan, November 16-17, 2007.
13. **H.-M. Cheng** and G. T.-C. Chiu, “Finite Precision Controller Implementation with Delta Transform,” in *2007 American Control Conference (ACC)*, New York City, New York, July 11-13, 2007.
14. **H.-M. Cheng**, A. Desai, and J.-C. Thomassian, “Wordlength Estimation of Digital Controller Synthesis for Inkjet Printer Mechanism,” in *IEEE SoutheastCon 2007*, Richmond, Virginia, March 22-25, 2007.
15. C.-Y. Chen and **H.-M. Cheng**, “Motion Synchronization of Dual-Cylinder Electrohydraulic System with Unbalanced Loadings and Uncertainties,” in *IEEE Conference on Industrial Electronics and Applications (ICIEA 2007)*, Harbin, China, May 23-25, 2007.
16. **H.-M. Cheng** and G. T.-C. Chiu, “Fractal Compression and Adaptive Sampling for Atomic Force Microscopy,” in *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, Monterey, California, USA, July, 2005.
17. **H.-M. Cheng**, “An E-Mail Based On-Line Control Experiment Service for Distance Learning,” in *Teaching and Learning with Technology Conference 2005*, West Lafayette, Indiana, February 15-16, 2005.
18. **H.-M. Cheng** and G. T.-C. Chiu, “Finite Precision Controller Implementation – Explore the Coupling between Sample Rate and Wordlength,” in *Proc. of the 3rd International Federation of Automatic Control (IFAC) Symposium on Mechatronic Systems*, Sydney, Australia, September 2004.
19. **H.-M. Cheng**, G. T.-C. Chiu, and H. Peng, “RemoteLab – an Email Based On-Line Control Experiment Service,” in *2004 American Control Conference (ACC)*, Boston, Massachusetts, January 2004.
20. **H.-M. Cheng** and G. T.-C. Chiu, “Improved AFM Imaging Speed with Adaptive Sampling and Path Planning,” in *Proc of the Workshop on Scanning Probe Microscopy*, West Lafayette, Indiana, February 2004.

21. **H.-M. Cheng** and G. T.-C. Chiu, "Finite Precision Controller Implementation – Limitation on Sample Rate," in *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, Kobe, Japan, June 2003.
22. **H.-M. Cheng**, C.R. Chen, Z.D. Tsai, and J.R. Chen, "Utility Optimization for the Beam Orbit Stability at SRRC," in *IEEE Proc. of the 1999 Particle Accelerator Conference*, pp. 1150-1152, New York, USA, March 1999.
23. **H.-M. Cheng**, J. Chang, and C.-C. Cheng, "Suppression of Background Noise in Speech," *Proc. of 15th National Conference of the Chinese Society of Mechanical Engineers, Part A*, pp. 637-643, Tainan, Taiwan, November 1998.
24. **H.-M. Cheng**, C.-Y. Chen, and G. T.-C. Chiu, "An Application of Distributed Air-Conditioning Control Network," in *1998 American Control Conference (ACC)*, Philadelphia, Pennsylvania, June, 1998.
25. **H.-M. Cheng** and C.-C. Cheng, "Implementation of Distributed Control System for the Remotely Operated Vehicle," in *Proc. of the 1997 Automatic Control Conference*, pp. 773-778, Taipei, Taiwan, March 1997.

Other Technical Presentations and Invited Seminars

"Development of Mechatronic Systems," presented at Cheng-Siu, Kaohsiung, Taiwan, May, 2011.

"Fractal Compression and Adaptive Sampling for Atomic Force Microscopy," presented at the Texas A&M University, College Station, TX, February, 2009.

"Fractal Compression and Adaptive Sampling for Atomic Force Microscopy," presented at the University of Alabama, Tuscaloosa, AL, April, 2008.

"Synthesis of Digital Controller with the Limited Resolution," presented at Villanova University, Villanova, PA, February, 2008.

"Implementation of Digital Controller with the Consideration of Finite Wordlength," presented at University of Arkansas, Fayetteville, AK, March, 2006.

"Adaptive Sampling Algorithm of Atomic Force Microscopy," presented at National Chung-Cheng University, Chia-Yi, Taiwan, November, 2005.

"Fractal Compression and Adaptive Sampling for Atomic Force Microscopy," presented at North Dakota State University, Fargo, ND, April 25, 2005.

Research and Curriculum Grants and Contracts

H.-M. Cheng, *Professional Development Grant*, 2009 Georgia Southern University, \$1,880.

M. H.-M. Cheng (PI), "*Vibration Measurement of Piezo-cantileverbeam*," 2009 Paulson Technology Research Awards under the College of Science and Technology, \$523.

M. H.-M. Cheng (PI) and D. Armel, "*Robotic Ink Jet Printing*," 2008 Paulson Technology Research Awards under the College of Science and Technology, \$11,950.

H.-M. Cheng, *Development of Instruction Competition*, 2007 Georgia Southern University, \$17,634.

H.-M. Cheng, *Professional Development Grant*, 2007 Georgia Southern University, \$2,025.

H.-M. Cheng and B.-M. Yen (PI), "*Diagnosis of Pump Systems for High Power Engine*," Cummins, Taiwan, 2006, \$45,000.

H.-M. Cheng (PI) and K.-S. Yang, "*Networking Controller for Fan Coil Systems*," Industrial Development Bureau, Taiwan, 1997, \$46,138.

H.-M. Cheng (PI), H.-C. Chiang, and K.-S. Yang, "*Development of Networking Controller for HVAC System*," Industrial Technology Research Institute, Taiwan, 1996, \$61,538.

Professional Services

- Editor of *International Journal of Intelligent Technologies and Engineering Systems* (since 2011).
- Editor of *International Journal of Convergence Information Technology* (since 2009).
- Publicity Chair of *2010 IEEE/ASME Advanced Intelligent Mechatronics* (AIM 2010).
- Associate Editor of *IEEE/ASME Advanced Intelligent Mechatronics* (2010).
- Associate Editor of *American Control Conference* (2008 – 2011).
- Member of Technical Committee of the *International Symposium on Industrial Electronics, Mechatronics and Applications* (2007).
- Reviewer of *IFAC Journal of Control Engineering Practice* (since 2005).
- Reviewer of *IEEE Transactions on Instrumentation & Measurement* (since 2006).
- Reviewer of *ASME Journal of Dynamic Systems, Measurement and Control* (since 2003).
- Reviewer of *Journal of System and Control Engineering* (since 2005).
- Reviewer of *Journal of Scanning* (since 2005).
- Reviewer of *American Control Conference (ACC 2004 - 2010)*.
- Project reviewer of *National Science Council in Taiwan*.

Student Mentoring

- Current Graduate Students: 1 PhD students in the area of Mechatronics
- Undergraduate Student Advised: 7 Undergraduates.

Honors and Awards

- Nominated for the award of excellence in research of Georgia Southern University in 2010.
- AIM (International Conference on Advanced Intelligent Mechatronics) Academic Travel Grant, 2005.
- Nominated for the best student paper of the proceedings of 2005 Advanced Intelligence Mechatronics.
- The Magoon Teaching Assistant Award, (Fall 2004 – Spring 2005). Outstanding graduate student for excellence in teaching.
- ACC (American Control Conference) Travel Grant, 2004.
- TECO (Taipei Economic and Culture Office) Academic Travel Grant, 2004.
- Purdue University Graduate Student Travel Grant, 2004.

Affiliations

- Member of IEEE.
- Member of ASME.
- Member of ASEE.

Extracurricular Activities

Committee of I Love Taiwan Club at Purdue University (March, 2003 – February, 2005)

- Exhibition in “Holiday Around the World” at Purdue University (*December 8, 2004*)
- Taiwanese Representative and Exhibition in the 8th Annual Global Fest in West Lafayette, Indiana (*August 31, 2004*)
- Exhibition in 2004 International Awareness Week at Purdue University (*April 4, 2004*)
- Host of the research forum for Taipei Economics and Culture Office and faculty at Purdue University (*February 21, 2004*)
- Taiwanese Representative and Exhibition in the 9th Annual Global Fest in West Lafayette, Indiana (*August 29 - 30, 2003*)
- Speaker of Promote Taiwan in Cumberland elementary school in West Lafayette (*May 16, 2003*)
- Taiwanese Representative and Exhibition in 2003 International Awareness Week at Purdue University (*April 6, 2003*)

President of I Love Taiwan Club at Purdue University (February, 2002 – March, 2003)

- Participation of the President Meeting of Taiwanese student organizations in Midwest (*October 26, 2002*)
- Taiwanese Representative and Exhibition in the 8th Annual Global Fest in West Lafayette, Indiana (*August 31, 2002*)
- Host of the Discussion Forum of Taiwan Night – The Future of Taiwan (*July 31, 2002*)
- Representative and Exhibition in the 1st Taiwanese Cultural Week in Chicago (*May 25 – 26*)
- Taiwanese Representative and Exhibition in 2002 International Awareness Week at Purdue University (*April 7, 2002*)
- Taiwanese Puppet Drama and Exhibition in Chinese Elementary School in West Lafayette (*April 2, 2002*)

Webmaster of I Love Taiwan Club at Purdue University (February, 2001 – February, 2002)

- First Winner of Taiwanese Collegian 2002 Website competition
- Exhibition in “Culture Diversity Fair” at Purdue University (*October 20, 2001*)
- Taiwanese Representative and Exhibition in 2001 Multi-Culture Festival at Purdue University (*April 2, 2001*)