WENJIE CHEN

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http://msc.berkeley.edu/wjchen/

RESEARCH INTERESTS

Theory and application of dynamic systems and control; robotic/mechatronic systems. Applications to industrial robots, wearable assistive robotics, robots for advanced manufacturing.

EDUCATIONS

Ph.D. **University of California, Berkeley** Mechanical Engineering 08/2012
Dissertation: *Intelligent Control of Robots with Mismatched Dynamics and Mismatched Sensing*
Advisor: Professor Masayoshi Tomizuka

M.S. **University of California, Berkeley** Mechanical Engineering 05/2009
Thesis: *Hybrid Adaptive Friction Compensation of Indirect Drive Trains Using Joint Sensor Fusion*
Advisor: Professor Masayoshi Tomizuka

B.Eng. **Zhejiang University**, China Mechatronic Engineering 06/2007
Rank: 1/55(major) Advanced Honor Class of Engineering Education (*63 elites from over 6000*)
Thesis: *Coordinated Motion Control of Biaxial Linear-Motor-Driven Stage*
Advisor: Professor Bin Yao, Professor Qingfeng Wang

POSITIONS

Senior Research Engineer, FANUC Corporation 11/2013 – Present
Learning Robot Development Department, Robot Laboratory

Postdoctoral Scholar, University of California, Berkeley 08/2012 – 10/2013
Mechanical Systems Control Lab, Department of Mechanical Engineering

RESEARCH EXPERIENCES

NSF-EFRI-M3C: A Hybrid Control Systems Approach to Brain-Machine Interfaces for Exoskeleton Control Postdoc Scholar, 08/2012 – 10/2013
University of California, Berkeley Graduate Student Researcher, 01/2012 – 08/2012
PI: Professor Jose M. Carmena, Professor Masayoshi Tomizuka, Professor Claire J. Tomlin
Role: *Technical lead of a sub-group of 1 postdoc, 2 Ph.D. students, and 2 undergrads.* Responsibilities:

- Multi-degree of freedom (e.g., 6-DOF) upper-limb (passive and actuated) exoskeleton design for macaque monkeys in the brain-machine interface (BMI) study.
- Dynamic and kinematic modeling study for multi-DOF exoskeleton system.
- Control scheme (e.g., position control, torque control, impedance control) design for the upper-limb exoskeleton actuation.
- Collaboration on BMI experiments to address the central research question: Does the brain use motor programs to help it control a highly redundant multi-degree of freedom biomechanical plant such as the arm?

Intelligent Control of Robot Manipulators for Performance Enhancement
Sponsor: FANUC Corporation, Japan Postdoc Scholar, 08/2012 – 10/2013
University of California, Berkeley Graduate Student Researcher, 08/2007 – 08/2012
Role: *Technical lead of a group of 1 postdoc and 4 Ph.D. students.* Personal major achievements:

- Dynamic modeling and system identification for multi-joint robots.
- Develop Robot Simulator and Experimentor with customizable software control architecture.
- Sensor fusion for load side (end-effector) state estimation in robots with joint elasticity.
- Friction force identification and compensation in robots with joint elasticity.
- Disturbance rejection controller design, e.g., disturbance observer (DOB) and adaptive robust controller (ARC), in robots with joint elasticity.
- Dual-stage iterative learning control (ILC) in robots with joint elasticity.
- Automatic gain tuning using iterative feedback tuning in indirect drive trains.
- Real-time system implementation with MATLAB & xPC Target for FANUC M-16*i*B-20 robot, and NI LabVIEW Real-time & FPGA modules for single-joint robot testbed.

Development of Design/Analysis and Evaluation Technologies for Vibration Reduction of LCD Substrate Transfer Robot Sponsor: Hyundai Heavy Industry, South Korea
University of California, Berkeley Graduate Student Researcher, 01/2011 – 03/2012
Role: *Technical lead of a group of 2 Ph.D. students and 1 visiting industrial fellow.* Personal work:

- Dynamic modeling and simulation of the LCD substrate transfer robot considering end-effector vibration behavior induced by flexible links.
- Sensor-based learning control and disturbance observer (DOB) design for vibration reduction.

High-Speed / High-Precision Motion Control of Biaxial Linear Motor
Zhejiang University, China Undergraduate Research Assistant, 09/2006 – 06/2007

- Friction force identification and compensation in the biaxial linear motor stage.
- Adaptive robust control (ARC) for biaxial linear motor high-speed / high-precision motion.
- Coordinated motion controller design and comparative study for the biaxial linear motor stage.

3D Virtual Reality Software Design for Underwater Manipulator
Zhejiang University, China Undergraduate Research Assistant, 08/2004 – 09/2006

- Software design for 3D virtual reality interactive control of the underwater manipulator.
- Independent software system development using Visual C++ & OpenGL.

Bio-inspired In-Pipe Moving WormBot
Zhejiang University, China 12/2004 – 05/2005
Role: *Team leader of 3 undergrads*, the Tenth Mechanical Design Contest, *3rd prize*

- Design & fabrication of a bio-inspired robot that can move through small bent pipes of certain diameters less than 50cm, based on the principle of worm movement.

HONORS & AWARDS (SELECTED)

- **Best Student Paper Finalist**, *the 6th IFAC Symposium on Mechatronic Systems* 2013
- **Best Paper in Session Award**, *ASME Dynamic Systems and Control Conference* 2012
- **Third place, Big Ideas @ Berkeley**, *"The PikaPen"* 04/2012
  "Information Technology for Society" Category, 5 winners out of over 125 submissions
- **Block Grant Award**, University of California, Berkeley 01/2011
- **Chiang Chen Overseas Graduate Fellowship**, China 2007 – 2008
  10 awardees each year for overseas graduates from China
- Numerous undergraduate awards, Zhejiang University, China 2002 – 2007
  Details at http://msc.berkeley.edu/wjchen/index.html#Honors

PROFESSIONAL AFFILIATIONS & SERVICES

Institute of Electrical and Electronics Engineers (IEEE), Member
American Society of Mechanical Engineers (ASME), Member

Proposal Review Panel:
External Reviewer of the Research Grants Council, Hong Kong

Editorial Board:
Editorial Board Member of the International Journal of Advanced Robotic Systems (IJARS)

Conference Committee:
Topic & Session Organizer, 2014 ASME Dynamic Systems and Control Conference (DSCC);
Program Committee, 2013 IEEE International Conference on Information and Automation (ICIA);
Program Committee, 2013 IEEE International Conference on Robotics and Biomimetics (ROBIO)

Journal Referee:
IEEE Transactions on Robotics (T-RO), IEEE Transactions on Industrial Electronics (TIE), IEEE/ASME Transactions on Mechatronics (TMECH), IEEE Transactions on Control Systems Technology (TCST), IEEE Transactions on Automation Science and Engineering (T-ASE), ASME Journal of Dynamic Systems, Measurement, and Control (JDSMC), Robotics and Computer Integrated Manufacturing (Elsevier-RCIM), International Journal of Advanced Robotic Systems (IJARS), Advanced Robotics (RSJ Journal), Asian Journal of Control (AJC), Control and Cybernetics, Sensors (MDPI Journal), Journal of Zhejiang University Science C (Computers & Electronics) (ZUSC)

Conference Referee:
American Control Conference (ACC), IEEE Conference on Decision and Control (CDC), IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM), ASME Dynamic Systems and Control Conference (DSCC), ASME International Symposium on Flexible Automation (ISFA), IFAC Symposium on Robot Control (SYROCO), IEEE International Conference on Information and Automation (ICIA), IEEE International Conference on Robotics and Biomimetics (ROBIO)

TEACHING & MENTORING

Mentor, University of California, Berkeley 2009 – Present
Supervise research of undergrad and graduate students as well as visiting students (from Spain, Netherland, China, etc.)

Teaching Assistant, University of California, Berkeley
Deliver review lectures, discussions, and labs, hold office hours, grade lab reports and exams

- **Feedback Control Systems** (EE128/ME134, Upper Division) Fall 2010

Grader, University of California, Berkeley
Grade problem sets and exams

- **Dynamic Systems and Feedback** (ME132, Upper Division) Fall 2007, Spring 2008
- **Introduction to Computer Programming for Scientists & Engineers** (E7) Fall 2007

PUBLICATIONS

Journal Publications

21. **W. Chen**, and M. Tomizuka, "Dual-Stage Iterative Learning Control for MIMO Mismatched System with Application to Robots with Joint Elasticity," *Control Systems Technology, IEEE Transactions on*, vol. 22, no. 4, pp. 1350–1361, July 2014; doi: 10.1109/TCST.2013.2279652
20. **W. Chen**, K. Kong, and M. Tomizuka, "Dual-Stage Adaptive Friction Compensation for Precise Load Side Position Tracking of Indirect Drive Mechanisms," *Control Systems Technology, IEEE Transactions on*, 2014; doi: 10.1109/TCST.2014.2317776
19. **W. Chen**, and M. Tomizuka, "Direct Joint Space State Estimation in Robots with Multiple Elastic Joints," *Mechatronics, IEEE/ASME Transactions on*, vol. 19, no. 2, pp. 697–706, April 2014; doi: 10.1109/TMECH.2013.2255308
18. **W. Chen**, and M. Tomizuka, "Comparative Study on State Estimation in Elastic Joints," *Asian Journal of Control*, vol. 16, no. 3, pp. 818–829, May 2014; doi: 10.1002/asjc.755
17. J. Asensio, **W. Chen**, and M. Tomizuka, "Feedforward Input Generation Based on Neural Network Prediction in Multi-Joint Robots," *Journal of Dynamic Systems, Measurement, and Control*, 136(3), 031002, May 2014; doi:10.1115/1.4025986

Refereed Conference Proceedings

16. J. Lu, K. Haninger, **W. Chen**, and M. Tomizuka, "Design and Torque-Mode Control of a Cable-Driven Rotary Series Elastic Actuator for Subject-Robot Interaction," *2015 IEEE International Conference on Robotics and Automation (ICRA)*, Seattle, Washington, May 26–30, 2015, submitted
15. J. Lu, **W. Chen**, K. Haninger, and M. Tomizuka, "A Passive Upper Limb Exoskeleton for Macaques in a BMI Study – Kinematic Design, Analysis, and Calibration," *in Proceedings of the 7th ASME Dynamic Systems and Control Conference (DSCC)*, San Antonio, Texas, USA, October 22–24, 2014
14. K. Haninger, J. Lu, **W. Chen**, and M. Tomizuka, "Kinematic Design and Analysis for a Macaque Upper-Limb Exoskeleton with Shoulder Joint Alignment," *in Proceedings of the 2014*

IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), Chicago, Illinois, USA, September 14–18, 2014

13. Y. Wang, **W. Chen**, M. Tomizuka, and B. N. Alsuwaidan, "Model Predictive Sliding Mode Control – for Constraint Satisfaction and Robustness," *in Proceedings of the 6th ASME Dynamic Systems and Control Conference (DSCC)*, Palo Alto, CA, October 21–23, 2013
12. C-Y. Lin, **W. Chen**, and M. Tomizuka, "Automatic Sensor Frame Identification in Industrial Robots with Joint Elasticity," *in Proceedings of the 6th ASME Dynamic Systems and Control Conference (DSCC)*, Palo Alto, CA, October 21–23, 2013
11. P. Reynoso-Mora, **W. Chen**, and M. Tomizuka, "On the Time-optimal Trajectory Planning and Control of Robotic Manipulators Along Predefined Paths," *in Proceedings of the 2013 American Control Conference (ACC)*, Washington, DC, June 17–19, 2013
10. C-S. Tsai, **W. Chen**, D-K. Yun, and M. Tomizuka, "Iterative Learning Control for Vibration Reduction in Industrial Robots with Link Flexibility," *in Proceedings of the 2013 American Control Conference (ACC)*, Washington, DC, June 17–19, 2013
9. J. Lu, **W. Chen**, and M. Tomizuka, "Kinematic Design and Analysis of a 6-DOF Upper Limb Exoskeleton Model for a Brain-Machine Interface Study," *in Proceedings of the 6th IFAC Symposium on Mechatronic Systems (Mechatronics '13)*, Hangzhou, China, pp. 293–300, April 10–12, 2013 **(Best Student Paper Finalist)**
8. Y. Wang, **W. Chen**, and M. Tomizuka, "Extended Kalman Filtering for Robot Joint Angle Estimation Using MEMS Inertial Sensors," *in Proceedings of the 6th IFAC Symposium on Mechatronic Systems (Mechatronics '13)*, Hangzhou, China, pp. 406–413, April 10–12, 2013
7. **W. Chen**, and M. Tomizuka, "Iterative Learning Control with Sensor Fusion for Robots with Mismatched Dynamics and Mismatched Sensing," *in Proceedings of the 2012 ASME Dynamic Systems and Control Conference (DSCC)*, Fort Lauderdale, Florida, USA, pp. 1480–1488, October 17–19, 2012 **(Best Paper in Session Award)**
6. J. Asensio, **W. Chen**, and M. Tomizuka, "Robot Learning Control Based on Neural Network Prediction," *in Proceedings of the 2012 ASME Dynamic Systems and Control Conference (DSCC)*, Fort Lauderdale, Florida, USA, pp. 1489–1497, October 17–19, 2012
5. **W. Chen**, and M. Tomizuka, "Load Side State Estimation in Robot with Joint Elasticity," *in Proceedings of the 2012 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, Kaohsiung, Taiwan, pp. 598–603, July 11–14, 2012
4. **W. Chen**, and M. Tomizuka, "A Two-Stage Model Based Iterative Learning Control Scheme for a Class of MIMO Mismatched Linear Systems," *in Proceedings of the 2012 ASME International Symposium on Flexible Automation (ISFA)*, St. Louis, Missouri, USA, paper No. ISFA2012–7199, June 18–20, 2012
3. C. Wang, **W. Chen**, and M. Tomizuka, "Robot End-effector Sensing with Position Sensitive Detector and Inertial Sensors," *in Proceedings of the 2012 IEEE International Conference on Robotics and Automation (ICRA)*, Saint Paul, Minnesota, USA, pp. 5252–5257, May 14–18, 2012
2. **W. Chen**, and M. Tomizuka, "Estimation of Load Side Position in Indirect Drive Robots by Sensor Fusion and Kalman Filtering," *in Proceedings of the 2010 American Control Conference (ACC)*, Baltimore, Maryland, USA, pp. 6852–6857, June 30–July 2, 2010

1. **W. Chen**, K. Kong, and M. Tomizuka, "Hybrid Adaptive Friction Compensation of Indirect Drive Trains," *in Proceedings of the 2009 ASME Dynamic Systems and Control Conference (DSCC)*, Hollywood, California, USA, pp. 313–320, October 12–14, 2009

TALKS & PRESENTATIONS

Besides the above conference presentations

- 04/10/2013 "EFRI-M3C: A hybrid control systems approach to brain-machine interfaces for exoskeleton control (Overview)", Qiushi Academy for Advanced Studies, Zhejiang University, China
- 03/11/2013 "Mechatronic Considerations for Mismatched Robotic Systems", Department of Mechanical Engineering, Carnegie Mellon University
- 03/04/2013 "Mechatronic Considerations for Mismatched Robotic Systems", Department of Mechanical Engineering, Worcester Polytechnic Institute
- 02/26/2013 "Mechatronic Considerations for Mismatched Robotic Systems", Department of Mechanical Engineering and Engineering Science, University of North Carolina at Charlotte
- 08/09/2012 "Intelligent Control of Robots with Mismatched Dynamics and Mismatched Sensing", *Ph.D. seminar*, University of California, Berkeley
- 03/08/2012 "EFRI-M3C: A hybrid control systems approach to brain-machine interfaces for exoskeleton control (NSF EFRI-M3C 1137267)", *Poster presentation (group work), NSF EFRI Grantees Conference*, Arlington, VA, Mar. 07–09, 2012
- 02/28/2012 "Estimation in Robots with Mismatched Sensing", *The 1st International Workshop between University of California Berkeley and Keio University*, Berkeley, CA
- 04/26/2011 "Disturbance Cancellation Schemes for Indirect Drive Robot Manipulator", FANUC Corporation, Japan

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