

WENJIE CHEN
Email: wjchen84 AT gmail.com
<http://wjchen84.github.io/>

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

HONORS & AWARDS (SELECTED)

- **Best Student Paper Finalist**, *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)* 2015
- **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://wjchen84.github.io/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 (2013, 2014)

Editorial Board:

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

Conference Committee:

Program Committee, 2016 ASME International Symposium on Flexible Automation (ISFA);
 Associate Editor, 2016 American Control Conference (ACC);
 Associate Editor & Session Organizer, 2015 ASME Dynamic Systems and Control Conference (DSCC);
 Associate Editor, 2015 American Control Conference (ACC);
 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), Robotics and Autonomous Systems (RAS), International Journal of Advanced Robotic Systems (IJARS), Advanced Robotics (RSJ-AR), 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 International Conference on Robotics and Automation (ICRA), 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 (SY-ROCO), IEEE International Conference on Information and Automation (ICIA), IEEE International Conference on Robotics and Biomimetics (ROBIO)

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-16iB-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

University of California, Berkeley

Sponsor: Hyundai Heavy Industry, South Korea

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.

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**

7. J. Lu, K. Haninger, M. Tomizuka, **W. Chen**, Suraj Gowda, and Jose M. Carmena, "A Passive Upper Limb Exoskeleton for Macaques in a Brain-Machine Interface Study," *ASME Journal of Dynamic Systems, Measurement, and Control*, 2015, to be submitted
6. P. Reynoso-Mora, **W. Chen**, and M. Tomizuka, "A Convex Relaxation for the Time-optimal Trajectory Planning of Robotic Manipulators along Predetermined Geometric Paths," *Optimal Control Applications and Methods*, 2015, submitted
5. **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*, vol. 23, no. 1, pp. 164–175, Jan. 2015; doi: 10.1109/TCST.2014.2317776
4. **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
3. **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
2. **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
1. 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

20. Yongxiang Fan, Yu Zhao, Chung-Yen Lin, Hsien-Chung Lin, Te Tang, Masayoshi Tomizuka, and **Wenjie Chen**, "Real-time Visual Tracking of Robot Manipulators with Safety Consideration," *the 2016 European Control Conference (ECC)*, Aalborg, Denmark, June 29–July 1, 2016, submitted
19. Hsien-Chung Lin, Te Tang, Yongxiang Fan, Yu Zhao, Masayoshi Tomizuka, and **Wenjie Chen**, "Remote Lead Through Teaching for Industrial Robot Learning from Human Demonstration," *the 2016 European Control Conference (ECC)*, Aalborg, Denmark, June 29–July 1, 2016, submitted
18. C. Lin, Y. Zhao, M. Tomizuka, and **W. Chen**, "Path-Constrained Trajectory Planning for Robot Service Life Optimization," *the 2016 American Control Conference (ACC)*, Boston, MA, USA, July 6–8, 2016, submitted
17. H. Lin, T. Tang, M. Tomizuka, and **W. Chen**, "Remote Lead Through Teaching by Human Demonstration Device," in *Proceedings of the 8th ASME Dynamic Systems and Control Conference (DSCC)*, Columbus, Ohio, USA, October 28–30, 2015
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," in *Proceedings of the IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, Busan, Korea, pp. 158–164, July 7–11, 2015 (**Best Student Paper Finalist**)
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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