

WENJIE CHEN
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<http://wjchen84.github.io/>

FIELD OF 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

- Technical lead for research and development of next generation robot concept controller
- Manage and lead the frontier robotic research collaboration with university
- Technical guidance and support for current learning robot product development

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
Details at <http://wjchen84.github.io/index.html#Honors>

2002 – 2007

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, 2016)

Editorial Board:

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

Conference Committee:

Associate Editor, 2016 ASME Dynamic Systems and Control Conference (DSCC);
Program Committee, 2016 ASME International Symposium on Flexible Automation (ISFA);
Associate Editor, 2016 American Control Conference (ACC);
Associate Editor, 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

University of California, Berkeley

Postdoc Scholar, 08/2012 – 10/2013

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

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.

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. Junkai Lu, Kevin Haninger, **Wenjie Chen**, Masayoshi Tomizuka, Suraj Gowda, and Jose M. Carmenta, "Design of a Passive Upper Limb Exoskeleton for Macaque Monkeys," *ASME Journal of Dynamic Systems, Measurement, and Control*, 2016, under review
6. Pedro Reynoso-Mora, **Wenjie Chen**, and Masayoshi Tomizuka, "A Convex Relaxation for the Time-optimal Trajectory Planning of Robotic Manipulators along Predetermined Geometric Paths," *Optimal Control Applications and Methods*, 2016; doi: 10.1002/oca.2234
5. **Wenjie Chen**, Kyoungchul Kong, and Masayoshi 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. **Wenjie Chen**, and Masayoshi 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. **Wenjie Chen**, and Masayoshi 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. **Wenjie Chen**, and Masayoshi 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. Jonathan Asensio, **Wenjie Chen**, and Masayoshi 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

26. Chung-Yen Lin, **Wenjie Chen**, and Masayoshi Tomizuka, "Learning Control for Task Specific Industrial Robots," *the 55th IEEE Conference on Decision and Control (CDC)*, Las Vegas, USA, December 12–14, 2016, submitted
25. Te Tang, Changliu Liu, **Wenjie Chen**, and Masayoshi Tomizuka, "Robotic Manipulation of Deformable Objects by Tangent Space Mapping and Non-Rigid Registration," *the 2016 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, Deajeon, Korea, October 9–14, 2016, submitted
24. Yu Zhao, **Wenjie Chen**, Te Tang, and Masayoshi Tomizuka, "Zero Time Delay Input Shaping for Smooth Settling of Industrial Robots," *the 12th Conference on Automation Science and Engineering (CASE, ISAM 2016)*, Fort Worth, TX, USA, August 21–24, 2016, submitted
23. Yu Zhao, **Wenjie Chen**, Xiaowen Yu, Chung-Yen Lin, Te Tang, and Masayoshi Tomizuka, "Accurate Trajectory Tracking of Flexible Joint Robots: A Neuroadaptive Control Approach," *the 2016 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, Banff, Alberta, Canada, July 12–15, 2016, submitted
22. Te Tang, Hsien-Chung Lin, Yu Zhao, **Wenjie Chen**, and Masayoshi Tomizuka, "Autonomous Alignment of Peg and Hole by Force/Torque Measurement for Robotic Assembly," *the 12th Conference on Automation Science and Engineering (CASE, ISAM 2016)*, Fort Worth, TX, USA, August 21–24, 2016, submitted
21. Te Tang, Hsien-Chung Lin, Yu Zhao, Yongxiang Fan, **Wenjie Chen**, and Masayoshi Tomizuka, "Teach Industrial Robots Peg-Hole-Insertion by Human Demonstration," *the 2016 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, Banff, Alberta, Canada, July 12–15, 2016, submitted
20. Yongxiang Fan, Hsien-Chung Lin, Yu Zhao, Chung-Yen Lin, Te Tang, Masayoshi Tomizuka, and **Wenjie Chen**, "Object Position and Orientation Tracking for Manipulators Considering Unnegligible Sensor Physics," *the 2016 International Symposium on Flexible Automation (ISFA)*, Cleveland, USA, August 1–3, 2016, submitted
19. Hsien-Chung Lin, Te Tang, Yongxiang Fan, Yu Zhao, Masayoshi Tomizuka, and **Wenjie Chen**, "Robot Learning from Human Demonstration with Remote Lead through Teaching," *the 2016 European Control Conference (ECC)*, Aalborg, Denmark, June 29–July 1, 2016, accepted
18. Chung-Yen Lin, Yu Zhao, Masayoshi Tomizuka, and **Wenjie Chen**, "Path-Constrained Trajectory Planning for Robot Service Life Optimization," *the 2016 American Control Conference (ACC)*, Boston, MA, USA, July 6–8, 2016, accepted
17. Hsien-Chung Lin, Te Tang, Masayoshi Tomizuka, and **Wenjie 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. Junkai Lu, Kevin Haninger, **Wenjie Chen**, and Masayoshi Tomizuka, "Design and Torque-Mode Control of a Cable-Driven Rotary Series Elastic Actuator for Subject-Robot Interac-

- tion,” 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. Junkai Lu, **Wenjie Chen**, Kevin Haninger, and Masayoshi 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. Kevin Haninger, Junkai Lu, **Wenjie Chen**, and Masayoshi 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. Yizhou Wang, **Wenjie Chen**, Masayoshi Tomizuka, and Badr 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. Chung-Yen Lin, **Wenjie Chen**, and Masayoshi 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. Pedro Reynoso-Mora, **Wenjie Chen**, and Masayoshi 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. Chi-Shen Tsai, **Wenjie Chen**, Daekyu Yun, and Masayoshi 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. Junkai Lu, **Wenjie Chen**, and Masayoshi 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. Yizhou Wang, **Wenjie Chen**, and Masayoshi 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. **Wenjie Chen**, and Masayoshi 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. Jonathan Asensio, **Wenjie Chen**, and Masayoshi 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. **Wenjie Chen**, and Masayoshi 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. **Wenjie Chen**, and Masayoshi 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. Cong Wang, **Wenjie Chen**, and Masayoshi 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. **Wenjie Chen**, and Masayoshi 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. **Wenjie Chen**, Kyoungchul Kong, and Masayoshi 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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