

WENJIE CHEN

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RESEARCH INTERESTS

Theory and application of control, sensing, and monitoring; mechatronic systems. Applications to industrial robots, human-interactive robots (e.g., exoskeleton), robotics for advanced manufacturing.

EDUCATIONS

Ph.D. **University of California, Berkeley** Mechanical Engineering Aug. 2012

Dissertation: *Intelligent Control of Robots with Mismatched Dynamics and Mismatched Sensing*

Advisor: Professor Masayoshi Tomizuka

M.S. **University of California, Berkeley** Mechanical Engineering May 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 Jun. 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

Postdoctoral Research Fellow, University of California, Berkeley Aug. 2012 – Present

Graduate Student Researcher, University of California, Berkeley Aug. 2008 – Aug. 2012

Graduate Student Instructor, University of California, Berkeley Aug. 2010 – Dec. 2010

Reader, University of California, Berkeley Aug. 2007 – May 2008

Senior Consultant Assistant, Internship Jul. 2006 – Aug. 2006

Chuanyou Guanghan Honghua Co. Ltd., China

Undergraduate Research Assistant, Zhejiang University, China Aug. 2004 – Jun. 2007

RESEARCH EXPERIENCES

NSF-EFRI-M3C: A Hybrid Control Systems Approach to Brain-Machine Interfaces for Exoskeleton Control

University of California, Berkeley Jan. 2012 – Present

PI: Professor Jose M. Carmena, Professor Masayoshi Tomizuka, Professor Claire J. Tomlin

Sponsor: NSF-Emerging Frontiers in Research and Innovation (NSF-EFRI), USA

Role: *Technical lead of a sub-group of 1 postdoc, 3 Ph.D. students, and 1 visiting Ph.D. student.*

Personal major responsibilities:

- Multi-degree of freedom (e.g., 6-DOF) Upper-limb (passive and actuated) exoskeleton design for macaques in the brain-machine interface (BMI) study.

- Control scheme (e.g., position control, torque control, impedance control) design for the upper-limb exoskeleton actuation.
- Exoskeleton kinematic and dynamic calibration, as well as motion and torque sensing/estimation for BMI macaques.
- 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

University of California, Berkeley

Aug. 2007 – Present

PI: Professor Masayoshi Tomizuka

Sponsor: FANUC Ltd., Japan

Role: *Technical lead of a group of 1 postdoc and 5 Ph.D. students. Personal major achievements:*

- Sensor fusion for load side (end-effector) state estimation in robots with joint elasticity.
- Dual-stage iterative learning control in robots with joint elasticity.
- Disturbance rejection, e.g., disturbance observer (DOB) and adaptive robust controller (ARC) design, in robots with joint elasticity.
- Friction force identification & compensation in robots with joint elasticity.
- Dynamic modeling and system identification of multi-joint robots.
- 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

Jan. 2011 – Mar. 2012

PI: Professor Masayoshi Tomizuka

Sponsor: Hyundai Heavy Industry, South Korea

Role: *Technical lead of a group of 2 Ph.D. students and 1 Visiting Industrial Fellow. Personal major achievements:*

- Dynamic modeling and simulation techniques 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

Sep. 2006 – Jun. 2007

PI: Professor Bin Yao

Sponsor: National Natural Science Foundation of China (NSFC)

Role: *Undergraduate research assistant. Personal major achievements:*

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

3D Real-time Virtual Reality Software Design of Underwater Manipulator

Zhejiang University, China

Aug. 2004 – Sep. 2006

PI: Professor Linyi Gu

Sponsor: National Natural Science Foundation of China (NSFC)

Role: *Undergraduate research assistant. Personal major achievements:*

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

HONORS & AWARDS (SELECTED)

- **Third place, Big Ideas @ Berkeley**, "*The PikaPen*" Apr. 2012
"Information Technology for Society" Category, 5 winners out of over 125 submissions
- **Block Grant Award**, University of California, Berkeley Jan. 2011
- **Chiang Chen Overseas Graduate Fellowship**, China 2007–2008
10 awardees each year for overseas graduates from China
- **Excellent College Graduate**, both Zhejiang University & Zhejiang Province, China Jun. 2007
- **Excellent Undergraduate Thesis (Design)**, Zhejiang University, China Jun. 2007
- **Weichai Power First Class Fellowship**, China Nov. 2006
- **Ferrotec Fellowship and Fellowship of Tarim Oil Co.**, China Nov. 2005
- **First Prize Scholarship of Excellent Undergraduate** 2003, 2004, 2006
Top 3%, Zhejiang University, China, 3 times
- **Zhuang Caifang Scholarship**, Fujian Province, China Jun. 2002
Top 0.1%, 200 awardees each year out of over 250,000 high school graduates

PROFESSIONAL AFFILIATIONS & SERVICES

Institute of Electrical and Electronics Engineers (IEEE), Member

American Society of Mechanical Engineers (ASME), Member

Journal Referee

- IEEE Transactions on Industrial Electronics (TIE)
- IEEE Transactions on Mechatronics (TMECH)
- Robotics and Computer Integrated Manufacturing (Elsevier-RCIM)
- Asian Journal of Control (AJC)
- Control and Cybernetics
- Sensors (MDPI Journal)

Conference Referee

- American Control Conference (ACC)
- 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)

TEACHING & MENTORING

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

Teaching Assistant, University of California, Berkeley
Deliver review lectures, discussions, and labs, 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

1. **W. Chen**, and M. Tomizuka, "Direct Joint Space State Estimation in Robots with Multiple Elastic Joints," *IEEE Transactions on Mechatronics*, accepted with minor revision
2. **W. Chen**, K. Kong, and M. Tomizuka, "Dual-Stage Adaptive Friction Compensation for Precise Load Side Position Tracking of Elastic Joint Mechanisms," *IEEE Transactions on Control Systems Technology*, under review
3. **W. Chen**, and M. Tomizuka, "Load Side Position Estimation in Elastic Joint Mechanisms: Comparative Study," *Asian Journal of Control*, invited paper, under review
4. **W. Chen**, and M. Tomizuka, "Dual-Stage Iterative Learning Control for MIMO Mismatched Linear System with Application to Robots with Joint Elasticity," *IEEE Transactions on Control Systems Technology*, under review
5. J. Asensio, **W. Chen**, and M. Tomizuka, "Feedforward Input Generation Based on Neural Network Prediction in Multi-Joint Robots," *ASME Journal of Dynamic Systems, Measurement, and Control*, under review

Refereed Conference Proceedings

1. Junkai Lu, **W. Chen**, and M. Tomizuka, "Kinematic Design and Analysis of a 6-DOF Upper Limb Exoskeleton Model for a Brain-Machine Interface Study," *the 6th IFAC Symposium on Mechatronic Systems (Mechatronics '13), 2013*, under review
2. Yizhou Wang, **W. Chen**, Philip Roan, and M. Tomizuka, "Extended Kalman Filtering for Robot Joint Angle Estimation Using MEMS Inertial Sensors," *the 6th IFAC Symposium on Mechatronic Systems (Mechatronics '13), 2013*, under review
3. Pedro Reynoso-Mora, **W. Chen**, and M. Tomizuka, "On the Time-optimal Trajectory Planning and Control of Robotic Manipulators Along Predefined Paths," *2013 American Control Conference (ACC)*, under review
4. Chi-Shen Tsai, **W. Chen**, Daekyu Yun, and M. Tomizuka, "Iterative Learning Control for Vibration Reduction in Industrial Robots with Link Flexibility," *2013 American Control Conference (ACC)*, under review

5. **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
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
7. **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
8. **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
9. 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
10. **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
11. **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)

- 03/08/2012 "EFRI-M3C: A hybrid control systems approach to brain-machine interfaces for exoskeleton control (NSF EFRI 10-596)", *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 Ltd., Japan

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