

CURRICULUM VITAE OF PROFESSOR CHANGHAI RU

RESEARCH CENTER OF ROBOTICS AND MICRO SYSTEM SOOCHOW UNIVERSITY, CHINA

SECTION I – PERSONAL INFORMATION

1.1 Name: Changhai Ru

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1.2 Education

Degree	Institution	Department	Thesis Field	Year
B.S.	Harbin University of Commerce, China	Mechanical Engineering	Force Sensor Design	1999
M.S.	Harbin University of Commerce, China	Mechanical Engineering	Nanopositioning technology	2002
Ph.D.	Harbin Institute of Technology	Mechanical Engineering	Model of piezoelectric actuator	2005
Postdoc	University of Toronto	Mechanical Engineering	Micro and Nanorobotics	2009-2010 2013-2014

1.3 Full Time Employment

Dates	Employer	Position
Aug. 1 2010- Present	Soochow University	Professor, College of Mechanical Engineering, Soochow University, Suzhou, China
Aug. 1, 2013 – Sep.30, 2014	University of Toronto	Visiting Professor, Dept. of Mechanical and Industrial Engineering, University of Toronto, Canada
Mar. 1, 2009 – April 30, 2010	University of Toronto	Postdoctoral Fellow, Dept. of Mechanical and Industrial Engineering, University of Toronto, Canada
Sep. 1, 2007 – Aug. 1, 2010	Harbin Engineering University	Professor, College of Automation, Harbin Engineering University, Harbin, China
July 1, 2005 – Sep. 1, 2007	Harbin Engineering University	Associate Professor, College of Automation, Harbin Engineering University, Harbin, China
Sept. 1, 2002 – July 1, 2005	Harbin Institute of Technology	Research Assistant

1.4 Awards and Honours

Date	Award Title	Awarded By	Terms of Award
May, 2014	Best Student Paper Award for IEEE International Conference on Robotics and Automation (ICRA 2014)	IEEE Robotics and Automation Society	2014
July, 2012	Jiangsu Natural Science Founds for Distinguished Young Scholar Award	Jiangsu Province Government	2012-2014
Dec., 2012	Jiangsu Province Qing Lan Project Award	Jiangsu Province Government	2012-2015
Dec., 2012	Scientific Research Foundation for the Returned Overseas Chinese Scholars	State Education Ministry	2012-2013
July, 2012	China Robotics Competition Award (2nd level)	Chinese Association for Artificial Intelligence	2012
July, 2012	First Prize of International Competition Humanoid Robot	Third International Humanoid Robot Olympic Competition	2012
Aug., 2011	Best Application Paper Award	International Conf. on Manipulation, Manufacturing and Measurement on the Nanoscale (3M-Nano), Changchun, China	2011
Feb., 2010	Foundation for University Key Teacher of Heilongjiang Province of China Award (\$10,000)	Heilongjiang Province Government	2010-2012
July, 2008	Foundation for University Key Teacher Award (\$10,000)	Harbin Engineering University	2008-2010
Sep. 2006	China Postdoctoral Science Foundation Award (\$8,000)	State Education Ministry	2006-2007
May, 2006	Heilongjiang Province Postdoctoral Science Foundation Award (\$7,000)	Heilongjiang Province	2006-2007
July, 2005	Outstanding Graduate Student Award in Heilongjiang Province	Heilongjiang Provincial Government, China	2005
Sep., 2004	General Electric Fellowship (the highest scholarship in Harbin Institute of Technology)	Harbin Institute of Technology	2004

SECTION II – PROFESSIONAL ACTIVITIES

2.1 Professional Activities

- **Editorship:**
 - Associate Editor, IEEE Transactions on Automation Science and Engineering (T-ASE), 2015-2019.
 - Associate Editor, IEEE International Conference on Robotics and Automation (ICRA), 2014-present.
 - Editorial board Member, *Sensors & Transducers Journal* (2008-present)
 - Leading Guest Editor, “Special Issue on Sensors, perception and intelligent system in robotic application”, *Journal of Sensors*, 2014.

- **Reviewer for international journals (~20 journals):**
 - *IEEE/ASME J. of Microelectromechanical Systems*
 - *IEEE Trans. on Biomedical Engineering*
 - *IEEE Trans. on Robotics*
 - *IEEE Trans. on Control Systems Technology*
 - *IEEE Transactions on Automatic and Control*
 - *IEEE Transactions on Neural Networks*
 - *IEEE Transactions on Industrial Electronics*
 - *IEEE Transactions on Mechatronics*
 - *IEEE Transactions on Automation Science and Engineering*
 - *IEEE Transactions on Nanotechnology,*
 - *Nanotechnology*
 - *Applied Physics Letters*
 - *Journal of Micromechanics and Microengineering*
 - *Measurement Science and Technology*
 - *Simulation Modeling Practice and Theory*
 - *Sensors and Actuators A: Physical*
 - *Smart Material and Structure*
 - *Review of Scientific and Instrument,*
 - *Electronics Letter*

- **Committee member for international conferences:**
 - Local Committee Chair for the International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale (3M-NANO 2013), Suzhou, China Aug. 27-31, 2013.
 - Program Committee member for the International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale (3M-NANO), from 2011 to 2015.
 - Program Committee member for the IEEE International Conference on Mechatronics and Automation (IEEE ICMA), from 2006 to 2014.
 - Program Committee member for the International Conference on Complex Medical Engineering (IEEE CME), from 2009 to 2013.
 - Program Committee member for the IEEE International Conference on Automation and Logistics (IEEE ICAL), from 2010.

2.2 Research Activities

- Microrobotic and nanorobotic manipulation:
 - Visual servo control with microscopy visual feedback
 - High precision mechanism design and position control
 - Development of nanorobotic systems and nanomanipulation tools
 - Characterization of mechanical and electrical properties of single nanomaterials

- Nanopositioning technology:
 - Stick-slip nanopositioning technology
 - Modeling and control of piezoelectric actuator
 - High dynamic piezoelectric driving technology

- Automated instrumentation for biomedical Applications:
 - Automatic piezoelectric cell injection
 - Automatic piezoelectric ultrasonic dissection for tissue isolation
 - Microrobotic manipulation of single cells

Key words: microrobotic and nanorobotic manipulation; piezoelectric actuator; computer vision microscopy; automation at micro-nanometer scales; piezoelectric injection; nanopositioning.

2.3 Awarded Research Grants/Contracts (single PI unless specified otherwise)

Duration	Grantor	Type	Co-grantees	Topic	Amount
2005-2008	Harbin Engineering University	Foundation Research Fund of Harbin Engineering University		Control methods of piezoelectric nanopositioning stage	\$20,000
2006-2007	Heilongjiang Province	Heilongjiang Province Postdoctoral Science Foundation		New driving and control method for piezoelectric ceramic	\$7,000
2006-2007	State Education Ministry	China Postdoctoral Science Foundation		New driving and control method for piezoelectric ceramic	\$8,000
2007-2007	NSFC	National Natural Science of China		2007 IEEE International Conference on Mechatronics and Automation Funding	\$10,000
2007-2009	NSFC	National Natural Science of China		Control method based model compensation and charge driving technology of piezoelectric ceramics	\$40,000
2008-2009	Harbin Institute of Technology	State Key Laboratory of Robotics and System		High-speed nanopositioning and driving technology	\$6,000
2008-2010	Harbin Engineering University	Foundation for University Key Teacher by Harbin Engineering University		Piezoelectric nanopositioning and driving technology	\$10,000
2010-2012	Heilongjiang Province	Foundation for University Key Teacher by Heilongjiang Province		High-speed and high-precision nanopositioning technology	\$8,000
2011-2014	NSFC	National Natural Science of China		High-speed dynamics precision positioning of piezoelectric ceramic drive mechanism and control methods	\$100,000
2012-2015	Jiangsu Province	Qing Lan Project of Jiangsu Province		Stick-slip piezoelectric actuating technology	\$20,000
2012-2015	Jiangsu Province	Jiangsu Natural Science Funds for Distinguished Young Scholar		Nanomachine developed based on stick slip piezoelectric driving	\$160,000
2013-2014	State Education Ministry	Scientific Research Foundation for the Returned Overseas Chinese Scholars		Across-scale nanopositioning technology based on stick-slip theory	\$4,000
2013-2015	Ministry of Science and Technology	863 major projects	PI: W.Q Zhao Co-PIs: C.H. Ru, etc.	Centre for Processing and Characterization of Advanced Structural and Functional Nanomaterials for Manufacturing Innovation	Ru's portion: \$150,000
2014-2017	European Commission	Seventh Framework Programme of the	PI: Carsten Maple Co-PIs: C.H. Ru,	BioRA: Biomedical Robotics and Applications	Ru's portion: \$70,000

		European Union	etc.		
2014-2016	NSFC	Instrument Development Major Program of National Natural Science of China	PI: Yuelin Wang Co-PI: C.H. Ru	Controllable mechanical loading platform for in-situ characterization of nanostructures under TEM	Ru's portion: \$250,000
2014-2016	Ministry of Science and Technology	International S&T Cooperation Program of China		Joint research of key technologies of nanomanipulation system inside scanning electron microscopes	\$600,000

SECTION III – PUBLICATIONS

3.1 Refereed Journal Publications (*Corresponding author)

International Journal Articles (Published/Accepted):

- [1] **Changhai Ru***, Peng Pan, Ruihua Chen. The Development of Piezo-Driven Tools for Cellular Piercing, *Applied Sciences*, 2016, 6(11).314
- [2] M. Liu, S.R. Xie, J. Ge, Z.S. Xu, Z.Z. Wu, **Changhai Ru**, J. Luo, and Y. Sun, "Microfluidic assessment of frying oil degradation," *Scientific Reports*, Vol. 6, article number: 27970, 2016.
- [3] C.Y. Shi, D.K. Luu, Q.M. Yang, J. Liu, J. Chen, **Changhai Ru**, S.R. Xie, Jun Luo, J. Ge, and Y. Sun, "Recent advances in nanorobotic manipulation inside scanning electron microscopes," *Microsystems & Nanoengineering* (Nature Publishing Group), Vol. 2, article number: 16024, 2016.
- [4] Z.R. Zhang, J. Liu, J. Meriano, **Changhai Ru**, S.R. Xie, J. Luo, and Y. Sun, "Human sperm rheotaxis: a passive physical process," *Scientific Reports*, Vol. 6, article number: 23553, 2016.
- [5] C. Zhou, Z. Gong, B.K. Chen, Z.Q. Cao, J.Z. Yu, **Changhai Ru**, M. Tan, S.R. Xie, and Y. Sun, "A closed-loop controlled nanomanipulation system for probing nanostructures inside scanning electron microscopes," *IEEE/ASME Transactions on Mechatronics*, 21 (3), 10.1109/TMECH.2016.2533636, 2016.
- [6] Y. Wang, J.H. Zhu, M. Pang, J. Luo, S.R. Xie, J. Ge, C. Zhou, M. Tan, Y. Sun*, and **Changhai Ru***, "A stick-slip positioning stage robust to load variations," *IEEE/ASME Transactions on Mechatronics*, 21 (4): 2165-2173; 10.1109/TMECH.2016.2517102, 2016.
- [7] J. Ge, S.R. Xie, Y.N. Wang, J. Liu, H. Zhang, B.W. Zhou, F.L. Weng, **Changhai Ru**, C. Zhou, M. Tan, and Y. Sun, "A system for automated detection of ampoule injection impurities," *IEEE Transactions on Automation Science and Engineering*, DOI: 10.1109/TASE.2015.2490061, 2015.
- [8] Ming Pang, Zhankai Meng, Wenbo Zhang and **Changhai Ru***. MGRO Recognition Algorithm-Based Artificial Potential Field (APF) for Mobile Robot Navigation, *Journal of Sensors*, Article ID 283693, 8 pages, 2015
- [9] **Changhai Ru***, Xuping Zhang, Yajing Shen, and YongZhang. Sensing and Intelligent Perception in Robotic Applications. *Journal of Sensors*, Article ID 696895, 2015
- [10] **Changhai Ru***, F.L. Wang, M. Pang, L.N. Sun, R.H. Chen, and Y. Sun, "A suspending, shrinkage-free electrospun PLGA nanofibrous scaffold for skin tissue engineering," *ACS Applied Materials & Interfaces*, 7(20), 2015: 10872-7
- [11] J. Liu, C.Y. Shi, J. Wen, D. Pyne, H.J. Liu, **Changhai Ru**, J. Luo, X.R. Xie, and Y. Sun, "Automated vitrification of embryos using a robotic system," *IEEE Robotics & Automation Magazine*, Volume 22, Issue 2, 2015: 33-40.
- [12] Yong Wang, Fujun Sun, Junhui Zhu, Ming Pang, **Changhai Ru***, Long-stroke Nanopositioning Stage Driven by Piezoelectric Motor, *Journal of Sensors*, vol. 2014, Article ID 926314, 8 pages, 2014. doi:10.1155/2014/926314.
- [13] J. Liu, V. Siragam, Z. Gong, J. Chen, M.D. Fridman, C. Leung, Z. Lu, **Changhai Ru**, S.R. Xie, J. Luo, R. Hamilton, and Y. Sun, "Robotic adherent cell injection (RACI) for characterizing cell-cell communication," *IEEE Transactions on Biomedical Engineering*, 2015, 62(1):119-125
- [14] **Changhai Ru***, Jun Luo, Shaorong Xie, and Yu Sun. A Review of Non-Contact Micro and Nano Printing Technologies, *Journal of Micromechanics and Microengineering*, Vol. 24, pp. 053001, 2014.
- [15] **Changhai Ru***, J. Liu, M. Pang, and Y. Sun, "Controlled ultrasonic micro-dissection of thin tissue sections," *Biomedical Microdevices*, Volume 16, Issue 4 (2014), Page 567-573.
- [16] **Changhai Ru***, J. Luo, S.R. Xie, and Y. Sun, "A review of non-contact micro and nano printing technologies," *Journal of Micromechanics Microengineering*, Vol. 24, pp. 053001, 2014.
- [17] Feilong Wang, Wenbo Zhang, Zhushuai Shao, Ming Pang and **Changhai Ru***. "An electrospinning system with a tunable collector for fabricating 3D nanofibrous structures." *Micro & Nano Letters*, Vol. 9, pp. 24-27, 2014.
- [18] **Changhai Ru***, Jie Chen, Zhushuai Shao and Ming Pang, "A novel mathematical model for controllable near-field electrospinning," *AIP Advances*, Vol.4, pp. 017108, 2014.

- [19] J. Liu, Z. Gong, K. Tang, Z. Lu, **Changhai Ru***, J. Luo*, S. Xie*, and Y. Sun*, “Locating end-effector tips in robotic micromanipulation,” *IEEE Transaction on Robotics*, Vol.30, pp.125-130, 2014.
- [20] **Changhai Ru***, Feilong Wang, Cuicui Ge, and Jun Luo. “A multifunctional electrospinning system for manufacturing diversified nanofibrous structures. Review of Scientific Instruments, Vol. 84, pp. 086107, 2013.
- [21] X.T. Ye, Y. Zhang, **Changhai Ru**, J. Luo, S.R. Xie, and Y. Sun*, “Automated pick-place of silicon nanowires,” *IEEE Transaction on Automation Science and Engineering*, Vol.10 , pp.554-561, 2013.
- [22] **Changhai Ru***, Y.L. Zhang⁺, Y. Zhang⁺, B.K. Chen, and Y. Sun*, “A load-lock-compatible nanomanipulation system for scanning electron microscope,” *IEEE/ASME Transactions on Mechatronics*, Vol. 18, pp. 230-237, 2013. (⁺Share the first author and equal contribution)
- [23] Feng Dong, Lining Sun, **Changhai Ru***, “Method of real-time tracking for respiratory motion based on SIFT feature Matching,” *Information Technology Journal*, Vol. 12, pp. 3897-3902, 2013.
- [24] Feng Dong, Lining Sun, **Changhai Ru***. “Camera Calibration Method of Medical Robot Positioning System Based on Binocular Vision,” *Information Technology Journal*, Vol. 12, pp. 3524-3529, 2013.
- [25] **Changhai Ru*** and Steve To. “Contact Detection for Nanomanipulation in Scanning Electron Microscope,” *Ultramicroscopy*, Vol. 118, pp. 61-66, 2012.
- [26] **Changhai Ru*** and Tao Chen. “A hysteresis model based on ellipse polar coordinate and microscopic polarization theory,” *Journal of Electroceramic*, Vol. 28, pp. 240-245, 2012.
- [27] **Changhai Ru***, Yong Zhang and Haibo Huang. “An Improved Visual Tracking Method in scanning electron microscope,” *Microscopy and Microanalysis*, Vol. 18, pp. 612-620, 2012.
- [28] **Changhai Ru***, Bing Shao, Haibo Huang and Lining Sun, “A Simple Method Based on Vision for Obtaining Depth Information in Nanomanipulation,” *Applied Physics Express*, Vol.4, pp. 126601, 2011.
- [29] **Changhai Ru***, Zhang Yong and Sun Lining. “Mechanical and Electrical Characterization of Nanowires in Scanning Electron Microscope,” *Review of Scientific Instruments*, Vol. 82, pp. 106105, 2011.
- [30] **Changhai Ru***, Y. Zhang, Y. Sun, Y. Zhong, X.L. Sun, D. Hoyle, and I. Cotton, “Automated four-point probe measurement of nanowires inside a scanning electron microscope,” *IEEE Transaction on Nanotechnology*, Vol. 10, pp. 674-681, 2011.
- [31] Y. Zhang, X.Y. Liu, **Changhai Ru**, Y.L. Zhang, L.X. Dong, and Y. Sun*, “Piezoresistivity characterization of synthetic silicon nanowires using a MEMS device,” *IEEE/ASME Journal of Microelectromechanical Systems*, Vol.20, pp. 959-967, 2011.
- [32] **Changhai Ru***, Weida Li, Mingqiang Pan. “A Linear Mapping Hysteresis Model Based on Theory of Microscopic Polarization,” *Advanced Materials Research*, Vol. 287, pp.2892-2897, 2011.
- [33] Chen Ligu, **Ru Changhai*** and Sun Lining, “Design, Modeling, and Control of Piezoelectric Ultrasonic microdissection technique for Molecular Analysis of Tissue,” *Smart Materials and Structures*, Vol. 19, pp. 025003, 2010.
- [34] **Changhai Ru***, Chen Ligu, Shao Bing, Rong Weibin and Sun Lining, “A hysteresis compensation method of piezoelectric actuator: Model, identification and control,” *Control Engineering Practice*, Vol. 17, pp. 1107-1114, 2009.
- [35] Shao Bing*, Chen Ligu, Rong Weibin, **Changhai Ru** and Xu Min, “Modeling and design of a novel precision tilt positioning mechanism for inter-satellite optical communication,” *Smart Materials and Structures*, Vol. 18, pp. 035009, 2009.
- [36] **Changhai Ru*** and Sun Lining, “A new amplifier for improving piezoelectric actuator linearity based on current switching in precision positioning,” *Measurement Science and Technology*, Vol. 19, pp. 015203, 2008.
- [37] **Changhai Ru***, B Shao, L Chen, W Rong and L Sun. “Design, identification, and control of piezoactuated positioning mechanism based on adaptive inverse method,” *Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering*. Vol. 222, pp. 501-509, 2008.
- [38] Bing Shao*, Weibin Rong, Bin, Guo, **Changhai Ru**, and Lining Sun, “Modeling and control of a novel piezoelectric actuated precision fast positioning system,” *Smart Materials and Structures*, Vol. 17, pp. 025032, 2008.
- [39] **Changhai Ru** and Lining Sun, “A Control model for hysteresis based on microscopic polarization mechanisms in piezoelectric actuator,” *Journal of Harbin Institute of Technology*, Vol.15, pp. 302-306, 2008.
- [40] **Changhai Ru*** and Lining Sun, “An adaptive inverse control method for piezoelectric actuator,” *Smart Materials and Structures*, Vol. 15, N14-N18, 2006.

- [41] **Changhai Ru*** and Lining Sun, "Study of polarization control model for piezoelectric actuator," *Ultrasonics*, Vol. 44, pp. e731-e735, 2006.
- [42] **Changhai Ru*** and Lining Sun, "A new open-loop driving method of piezoelectric actuator for periodic reference inputs," *Ultrasonics*, Vol. 44, pp. e633-e637, 2006.
- [43] **Changhai Ru*** and Lining Sun, "Hysteresis and creep compensation for piezoelectric actuator in open-loop operation," *Sensors and Actuators A: Physical*, Vol. 122, pp. 124-130, 2005.
- [44] **Changhai Ru*** and Lining Sun, "Improving positioning accuracy of piezoelectric actuators by feedforward hysteresis compensation based on a new mathematical model," *Review of Scientific Instruments*, Vol. 76, pp. 1-8, 2005.
- [45] Lining Sun, **Changhai Ru*** and Weibin Rong, "Tracking control of piezoelectric actuator based on a new mathematical model," *Journal of Micromechanics and Microengineering*, Vol. 14, pp. 1439-1444, 2004.

National Journal Articles:

- [46] Canfeng Miao, Rong-an Zhai, Chengzhi Chu and **Changhai Ru***. "Fabrication of flexible printed circuit by ultrasonic spray coating," *Electroplating & Finishing*, Vol. 35, pp. 917-921, 2016.
- [47] Chengsong Shu, Ruihua Chen and **Changhai Ru***. "Design of an efficient cell electrofusion chip based on micromanipulation," *Chemistry & Bioengineering*, Vol. 33, pp. 63-66, 2016.
- [48] Peng Pan, Fujun Sun, Feiyu Yang, Chengwei Wang and **Changhai Ru***. "Design and analysis of the nanopositioner based on the stick-slip principle," *Micronanoelectronic Technology*, Vol. 52, pp. 722-728, 2015.
- [49] Longchen Gao, Junhui Zhu, and **Changhai Ru***. "Batch cell adsorbed immobilization device," *Modern Manufacturing Engineering*, Vol. 8, pp. 23-26, 2015.
- [50] Junhui Zhu, Yong Wang, Meng Zhu, Ruihua Chen and **Changhai Ru***. "Depth-controlled and Automated Piezoelectric Micro-Dissection System," *Chinese Journal of Biomedical Engineering*, Vol. 33, pp. 722-728, 2014.
- [51] Wang Chengwei, Shao Zhushuai, Wang Feilong, and **Changhai Ru***. "Research progress of the application of the electrostatic spinning fiber," *Micronanoelectronic Technology*, Vol. 51, pp. 770-775, 2014.
- [52] Sun Fujun, Zhu Junhui, Yang Feiyu, Chen Ruihua, Sun Lining and **Changhai Ru***. "Method of Microscopic Positioning with Physical Markers," *Robot*, Vol. 36, pp. 683-696, 2014.
- [53] Zhu Yulong, Chen Ruihua, Zhu Junhui, Zhu Meng RU and **Changhai Ru***. "Rotational positioning method based on micro-vision," *Journal of Machine Design*, Vol. 31, pp. 79-82, 2014.
- [54] Shao Zhushuai, Wang Feilong, Wang Chengwei and **Changhai Ru***. "Research progress in influence factors of the nanofiber prepared by the coaxial electrospinning," *Micronanoelectronic Technology*, Vol. 51, pp. 529-535, 2014.
- [55] Wang Feilong, Shao Zhushuai, He Jun, Qian Chi and **Changhai Ru***. "Research advances in electrospinning collectors for preparation of nanofibers," *Journal of Textile Research*, Vol. 35, pp. 149-156, 2014.
- [56] Dong Feng, Sun Lining and **Changhai Ru***. "Measurement method of medical robot positioning system based on binocular vision," *Journal of Optoelectronics.Laser*, Vol. 25, pp. 1027-1034, 2014.
- [57] Zhou Tao, Wang Cheng, Jiang Gang and **Changhai Ru***. "Research on a new type of piezoelectric ceramic driving power supply," *Microcomputer & Its Applications*, Vol. 32, pp. 16-19, 2013.
- [58] Zhu meng, **Changhai Ru*** and Qian chi. "Research on Automatical Cells Search and Positioning Method in Microinjection," *Journal of soochow university(Engineering science edition)*, Vol. 32, pp. 1-6, 2012.
- [59] **Changhai Ru**, Wang Cheng. "High-dynamic bridge amplifiers with generator of piezoelectric actuator," *Piezoelectrics & Acoustooptics*, Vol. 34, pp. 549-552, 2012
- [60] **Changhai Ru**, Wang Zhenhua, Chen Liguang and Sun Lining. "A hysteresis control model of piezoelectric actuator based on microscopic polarization mechanisms," *Control Engineering of China*, Vol. 17, pp. 422-425, 2010.
- [61] Wang Xihua, Guo Shuxiang, **Changhai Ru**, and Ye Xiufen. "A simple modeling method for the piezoelectric hysteresis behavior," *Journal of Harbin Engineering University*, Vol. 31, pp. 86-91, 2010.
- [62] Wang Xihua, Guo Shuxiang, Ye Xiufen and **Changhai Ru***. "Modeling and feed-forward control based on piezoelectric ceramic hysteretic," *Journal of electrical machines and control*, Vol. 13, pp. 766-771, 2009.

- [63] Huang Chun, **Changhai Ru**, Ye Xiufen and DU Zhibo. "A broadband piezoelectric amplifier based on compensation technology," *Piezoelectrics & Acoustooptics*, Vol. 31, pp. 373-376, 2009.
- [64] Chen Ligu, Rong Weibin, **Changhai Ru**, Zhang Guoping and Sun Lining. "Research of power supply and its experimental study of piezoelectric ceramic based on current control," *Chinese Journal of Mechanical Engineering*, Vol. 42, pp. 179-183, 2006.
- [65] **Changhai Ru**, Wang Kejun and Ye Xiufen. "Tracking control of piezoelectric ceramic based on a new hysteresis model," *Journal of instrument and meter*, Vol. 27, pp. 536-538, 2006.
- [66] **Changhai Ru**, Rong Weibin, Sun Lining and Qu Dongsheng. "Review of Research on driving methods of piezoelectric actuator based on charge control," *Piezoelectrics & Acoustooptics*, Vol. 26, pp. 83-86, 2004.

3.2 Refereed Conference Papers: (full papers accepted/published in proceedings; abstracts not listed)

(*Corresponding author)

- [1] Jie Chen, Zhushuai Shao, **Changhai Ru** and Zhan Yang*. “Mathematical Analysis for Controllable Near-Field Electrospinning,” International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale (3M-NANO 2013), Suzhou, China, August 27-31, 2013.
- [2] Yong Wang, Zhan Yang, Junhui Zhu, Yulong Zhu, **Changhai Ru** and Pengbo Wang, “Rotational positioning method based on the microscopic vision,” International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale (3M-NANO 2013), Suzhou, China, August 27-31, 2013.
- [3] Meng Zhu and **Changhai Ru**, “Automated and Depth-Controlled System for Tissue Dissection,” 2012 IEEE Biomedical Engineering and Sciences (EMBS), LANGKAWI, MALAYSIA, Dec. 17-19, 2012.
- [4] Chi Qian, Ruihua Chen, Feilong Wang and **Changhai Ru**, “Printing sub-micrometer lines based on electrohydrodynamics,” 2012 International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale (3M-NANO), Xi’an, China, Aug. 29-Sep. 1, 2012.
- [5] Yong Zhang, Xinyu Liu, **Changhai Ru**, Yanliang Zhang, Lixin Dong, Woo, P., Nakamura, M., Hoyle, D., Cotton, I. and Yu Sun, “Piezoresistivity characterization of silicon nanowires using a MEMS device s (MEMS),” 2011 IEEE 24th International Conference on Micro Electro Mechanical System, Cancun, MEXICO, January 23 – 27, 2011.
- [6] Y.L. Zhang, Y. Zhang, **Changhai Ru**, B.K. Chen, J. Li, and Yu Sun, “A compact closed-loop nanomanipulation system in scanning electron microscope,” IEEE International Conf. on Robotics and Automation (ICRA2011), Shanghai, China, May 9-13, 2011.
- [7] **Changhai Ru**, Zhang Yong, Sun Lining, “Mechanical and Electrical Characterization of Nanowires in Scanning Electron Microscope,” International Conference on Manipulation, Manufacturing and Measurement on the Nanoscale (3M-NANO), Changchun, China, Aug. 29-Sep. 2, 2011.
- [8] **Changhai Ru** and Zhenhua Wang “High-dynamic Bridge Amplifiers with Generator for Piezoelectric Actuator, 2011 Third Pacific-Asia Conference on Circuits,” Communications and System (PACCS), Wuhan, China. July17-18, 2011.
- [9] **Changhai Ru** and Zhu Meng “Design and Realization of Drive Power Supply for Micro-positioning Platform,” 2011 International Conference on Electrical and Control Engineering (2011 ICECE), Yichang, China, Sept. 16-18, 2011.
- [10] **Changhai Ru**, Yong Zhang, Yu Sun, Y. Zhong, X.L. Sun, D. Hoyle, and I. Cotton, “Automated four-point probe measurement of nanowires inside a scanning electron microscope,” IEEE International Conf. on Automation Science and Engineering (CASE2010), Toronto, Canada, Aug. 22-24, 2010.
- [11] Yong Zhang, **Changhai Ru**, Xinyu Liu, Yu Zhong, Xueliang Sun, Hoyle, D., Cotton, I. and Yu Sun, “A MEMS tensile testing device for mechanical characterization of individual nanowires,” Hawaii, USA, Nov. 1-4, 2010.
- [12] Xihua Wang, Shuxiang Guo and **Changhai Ru**, “Modeling and compensation of piezoelectric ceramic hysteretic behavior” Proceedings of 2009 IEEE International Conference on Mechatronics and Automation (ICMA 2009), Changchun, China, August 9-12, 2009.
- [13] B. Shao, **Changhai Ru**, L.G. Chen, W.B. Rong, L.N. Sun, “Piezoelectric actuated precise positioning system based on a new hysteresis model,” ASME International Mechanical Engineering Congress and Exposition, Boston, USA, 2008.
- [14] Shao Bing, **Changhai Ru**, Rong Weibin, Chen Ligu, Xu min, “The research on a novel PZT actuated precise tilt positioning system,” The 4th IEEE conference on industrial electronics and applications, Xi’an, China, 2009.
- [15] Xihua, Wang, **Changhai Ru** and Shuxiang Guo, “A research based on piezoelectric ceramic hysteretic modeling and inverse control,” Proceedings of 2008 IEEE International Conference on Mechatronics and Automation (ICMA 2008), Takamatsu, Kagawa, Japan, Aug. 5-8, 2008.
- [16] Xihua, Wang, **Changhai Ru**, Shuxiang Guo, “A novel model of piezoelectric ceramic hysteretic,” 2008 IEEE International Conference on Robotics and Biomimetics, Bangkok, Thailand, Feb. 22-25, 2009.
- [17] Xihua, Wang, **Changhai Ru**, Shuxiang Guo. “A research based on modeling of piezoelectric ceramic hysteretic, ” Proceedings of 2nd Joint Student Workshop on Mechatronics, JSWM, Japan, 2008.
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3.3 Books and Chapters in Books

Book and Chapters (*Sun's student name in boldface*)

- [B1] ***Edited Book:*** **Changhai Ru**, Xinyu Liu and Y. Sun, “Nanopositioning Technologies - Fundamentals and Applications”, Springer, will appear in 2015.
- [B2] **Y.L. Zhang, Y. Zhang, C.H. Ru, J. Li**, and Y. Sun, “Nanorobotic manipulation of 1D nanomaterials in scanning electron microscopes,” **NanoRobotics: Current Approaches and Techniques**, Springer, Editors: Antoine Ferreira and Constantinos Mavroidis, *invited chapter*, 2012.
- [B3] Haibo Huang, Su Hao, **Changhai Ru**. “Design and Evaluation of a Piezo-driven Ultrasonic Cell Injector”, Prototyping of Robotic Systems: Applications of Design and Implementation, *IGI Global*, 2012, editors: Tarek Sobh and Xingguo Xiong, February, 2012: 327 -355.

3.4 Patents

Granted Patents:

- [P1] Yu Sun, **Changhai Ru**, and Y. Zhang, “Manipulator carrier for electron microscopes,” invention disclosure filed through U. of Toronto, Feb. 15, 2010. US patent issued on May 8, 2014 (No. CA2010/000521).
- [P2] *18 issued Chinese patents.*

Patents under Examination:

- [P3] *28 filed Chinese patents.*