

# CURRICULUM VITAE

**Zheng Chen**

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## EDUCATION:

- **Ph.D in Electrical & Computer Engineering**, Michigan State University, May 2009 (expected)  
Dissertation topic: *Ionic Polymer Metal Composite Artificial Muscles and Sensors: A Control Systems Perspective*. Advisor: Dr. Xiaobo Tan
- **Ph.D candidate, in Electrical & Computer Engineering**, University of Missouri Rolla, 12/2003-12/2004
- **M.S. in Electrical Engineering**, Zhejiang University, Hangzhou, China, March 2002  
M.S. Thesis: *Integrated Control System of Power Substations*
- **B.S. in Electrical Engineering**, Zhejiang University, Hangzhou, China, June 1999  
B.S. Thesis: *Integrated Control System of Power Substation*  
Honor program: Advanced Class of Engineering and Education in Zhejiang University

## RESEARCH INTEREST:

- Modeling, control, and microfabrication of smart materials
- Application of electroactive polymers in bio-inspired robotics and bio-medical devices
- Development of smart microsystems
- Optimal control of nonlinear dynamic systems

## AWARDS AND HONORS:

- **Dissertation Completion Fellowship (2009), Summer Support Fellowship (2008), Summer Dissertation Fellowship (2006), Klomprens Fellowship (2006)**, Graduate School at Michigan State University
- **Honorable Mention, Fitch Beach Outstanding Graduate Research Award**, College of Engineering, Michigan State University, 2008
- **Student Travel Awards**, IEEE Conference on Decision and Control (CDC 2007, 2008), SPIE International Annual Symposium on Smart Material Structure 2008, IEEE Conference on Robotics & Automation (ICRA 2008)
- **Excellent Graduate of Zhejiang Province**, (awarded to the top 3% graduates in Zhejiang Province), Education Department of Zhejiang Province, 1999
- **Undergraduate scholarships**, Zhejiang University: Third class prize (1995), First class prize (1996), Second class prize (1997, 1998), Kuang-Hua (Guanghua) Scholarship (1998), Sai-ba Scholarship (1998)
- **Second class prize in Hunan Province**, National Olympiad Physics Competition for High School Students, China, 1994

## RESEARCH EXPERIENCE:

- **Graduate Research Assistant & Lab Manager**, Smart Microsystems Laboratory, Electrical & Computer Engineering Department, Michigan State University, Jan. 2005 - Present
  1. *Microfabrication, modeling, and control of bio-inspired IPMC materials and devices*: This research is to produce highly sensitive hair cells and artificial pectoral fins to be used in biomimetic robotic fish applications.
  2. *Control-oriented modeling of Ionic Polymer Metal Composite sensors and actuators*: This research is to develop a physics-based and control-oriented model for IPMC sensors and actuators, which can capture the ion diffusion, water migration, electrostatic interaction, and distributed surface resistance in IPMC.
  3. *Modeling and control of biomimetic robotic fish propelled by IPMC actuator*: The model incorporates

both the actuation dynamics of hybrid IPMC tail and the hydrodynamics of fish, which can predict the steady-state cruising speed of the robotic fish under a given periodic actuation voltage.

4. *Development of IPMC/PVDF sensory actuator and its application to fruitfly embryo injection*: This research is to develop a compact sensing scheme for IPMC actuators. IPMC/PVDF hybrid structure uses an IPMC as actuator and polyvinylidene fluoride (PVDF) film as sensor.
  5. *Modeling and control of hysteresis in smart materials and structures*: Quasi-static actuation of IPMC is investigated with the goal of precise positioning. A Preisach operator is proposed to model the hysteresis, and its density function identified experimentally.
- **Graduate Research Assistant**, Electrical & Computer Engineering Department, University of Missouri Rolla, Dec. 2003-Dec. 2004
    - + *Generalized Hamilton-Jacobi-Bellman formulation based neural network control of affine nonlinear discrete-time systems*: This research is to obtain suboptimal solutions to the control of nonlinear discrete-time (DT) systems using nonlinear neural networks.
  - **Graduate Research Assistant**, Electrical Engineering Department, Zhejiang University, P.R.China, July 1999 -May 2002
    1. *Study of the real-time fault detection and relay protection for power transmission line, transformer, and high power electrical motor*
    2. *Development of an integrated control system for 35KV power substation*: This project is to develop a prototype of integrated control system to protect 35 KV power subsystems from the damages introduced by short circuit, over voltage, heavy load, and frequency variation.
  - **Undergraduate Research Assistant**, Electrical Engineering Department, Zhejiang University, P.R.China, Sep.1997- June 1999
    - + *Development of the embedded controller design for relay protection of 35KV power transmission line in Xin Chang County*, selected in Student Research Training Program (STRP), Zhejiang Province

## INDUSTRIAL EXPERIENCE:

- **Senior IC Designer**, Silan Microelectronics Ltd., Hangzhou, P.R.China, May 2003- Dec. 2003
  - + *USB Security Key*: This project is to develop a USB key to lock PC which can protect the data in Laptop.
- **Project Manager and Embedded System Designer**, Hangzhou Blue Mobile, Jan. 2003 – May 2003
  - + *Business Fixed Wireless Access System*: This project is focused on wireless public phone system.
- **System Application Engineer**, Sino Wealth Electronic Ltd, Shanghai, P.R.China, May 2002- Dec. 2002
  - + *ISP (In System Programming)-ICE (In Circuit Emulator)*: The project is to develop ICE as a debugging tool for testing and programming microcontrollers.

## PUBLICATIONS:

- **Journal Papers**
  1. **Z. Chen**, S. Shatara, and X. Tan, "Modeling of Biomimetic Robotic Fish Propelled by An Ionic Polymer-Metal Composite Actuator", submitted to *IEEE Trans on Robotics*, 2008
  2. **Z. Chen**, and X. Tan, "A Control-oriented, Physics-based Model for Ionic Polymer-Metal Composite Actuators", *IEEE/ASME Trans on Mechatronics*, Vol. 13, No. 5, pp 519-529, 2008
  3. **Z. Chen**, K. Y. Kwon, and X. Tan, "Integrated IPMC/PVDF Sensory Actuator and Its Application to Feedback Control", *Sensors and Actuators A: Physical*, Vol. 144, No. 2, pp 231-241, 2008
  4. **Z. Chen**, X. Tan, A. Will, and C. Ziel, "A Dynamic Model for Ionic Polymer-Metal Composite Sensors", *Journal of Smart Material and Structures*, Vol. 16, No. 4, pp. 1477-1488, 2007.
  5. **Z. Chen**, Y. Shen, N. Xi, X. Tan, "Integrated sensing for ionic polymer-metal composite actuators using PVDF thin films", (**Invited paper** for special issue on Electroactive Polymer Materials), *Smart Materials and Structures*, Vol. 16, No. 2, pp. S262-S271, 2007
  6. **Z. Chen**, S. Jagannathan, "Generalized Hamilton-Jacobi-Bellman Formulation based Neural Network Control of Affine Nonlinear Discrete-Time Systems", *IEEE Trans on Neural Networks*, Vol. 19 No. 1, pp 90-106, 2008

- **Conference Papers:**

1. **Z. Chen**, D. Hedgepeth, and X. Tan “Nonlinear Capacitance of Ionic Polymer-Metal Composite”, submitted to 11<sup>th</sup> SPIE conference on Electroactive Polymer Actuation and Devices (EAPAD), San Diego, CA, 2009
2. **Z. Chen**, S. Shatara, and X. Tan “Modeling of Robotic Fish Propelled by an Ionic Polymer-Metal Composite Caudal Fin”, submitted to 11<sup>th</sup> SPIE conference on Electroactive Polymer Actuation and Devices (EAPAD), San Diego, CA, 2009
3. **Z. Chen**, D. R. Hedgepeth, X. Tan, “A Nonlinear Control-Oriented Model for Ionic Polymer-Metal Composite Actuators”, accepted for presentation at the 47<sup>th</sup> IEEE Conference on Decision and Control, 2008
4. E. Mbemmo, **Z. Chen**, S. Shatara, and X. Tan, "Modeling of Biomimetic Robotic Fish Propelled by An Ionic Polymer-Metal Composite Actuator", *Proc. of the IEEE International Conference on Robotics and Automation*, Pasadena, California, pp. 689-694, 2008
5. **Z. Chen**, K. Yong and X. Tan, “Design of Integrated IPMC/PVDF Sensory Actuator and Its Application to Feedback Control”, (**Invited**), M. Tomizuka, editor, *Sensors and Smart Structures Technologies for Civil, Mechanical, and Aerospace Systems, Proc. of the SPIE*, Vol. 6932, pp. 68321O, 2008
6. **Z. Chen**, X. Tan, “A Scalable Dynamic Model for Ionic Polymer-Metal Composite Actuators”, Y. Bar-Cohen, editor, *Electroactive Polymer Actuators and Devices (EAPAD) X, Proc. of the SPIE*, Vol. 6927, pp. 69270I, 2008
7. **Z. Chen**, and X. Tan, “A Control-oriented, Physics-based Model for Ionic Polymer-Metal Composite Actuators”, *Proc. of the 46th IEEE Conference on Decision and Control*, New Orland, pp. 590-595, 2007
8. **Z. Chen**, A. Will, C. Ziel, and X. Tan, “A Dynamic Model for Ionic Polymer-Metal Composite Sensors” (**Invited**), *Proc. of the World Forum on Smart Materials and Smart Structures Technology*, Chongqin & Nanjing, China, 2007
9. **Z. Chen**, Y. Shen, J. Malinak, N. Xi, X. Tan, “Hybrid IPMC/PVDF Structure for Simultaneous Actuation and Sensing,” in Y. Bar-Cohen, editor, *Smart Structures and Materials 2006: Electroactive Polymer Actuators and Devices (EAPAD), Proceedings of SPIE*, San Diego, CA, Vol. 6168, 2006
10. **Z. Chen**, X. Tan, M. Shahinpoor, “Quasi-static Positioning of Ionic Polymer-Metal Composite (IPMC) Actuators”, *Proc. of the IEEE/ASME International Conference on Advanced Intelligent Mechatronics*, Monterey, CA, pp. 60-65, 2005
11. **Z. Chen**, S. Jagannathan, “A Recursive Method of Obtaining the Optimal Control for Nonlinear Discrete-Time Systems”, *Proc. of the 44th IEEE Conference on Decision and Control and European Control Conference*, Seville, Spain, pp. 4123 – 4128, Dec. 2005
12. P. He, **Z. Chen**, S. Jagannathan, “Reinforcement-Learning Neural Network-based Control of Nonlinear Discrete-Time Systems in Non-Strict Form”, *Proc. of the 44th IEEE Conference on Decision and Control and European Control Conference*, Seville, Spain, pp. 2580 – 2585, 2005
13. J. Chen, **Z. Chen**, “Two-step Method for Gross Error Detection in Process Data”, *Proc. of the American Control Conference*, Arlington, VA, pp. 2121-2126, 2001.

**PRESENTATIONS:**

1. “Modeling of Biomimetic Robotic Fish Propelled by Ionic Polymer Metal Composite”, oral presentation at IEEE conference on Robotics and Automation, Pasadena, CA 2008
2. “A Scalable Dynamic Model for Ionic Polymer Metal Composite Actuator”, oral presentation at 15<sup>th</sup> SPIE International Annual Symposium on Smart Material Structure, San Diego, CA, 2008
3. “Design of Integrated IPMC/PVDF Sensory Actuator and Its Application to Feedback Control”, oral presentation at 15<sup>th</sup> SPIE International Annual Symposium on Smart Material Structure, San Diego, CA, 2008
4. “Electroactive polymers as Artificial Muscles and Sensors: A Systems Perspective”, oral presentation for Fitch Beach Outstanding Graduate Research Award at Noontime Research Seminar, Michigan State University, 2008
5. “A Control-oriented, Physics-based Model for Ionic Polymer Metal Composite Actuators”, oral presentation at 46<sup>th</sup> IEEE conference on Control and Decision, New Orleans, LA 2007
6. “A Dynamic Model for Ionic Polymer-Metal Composite Sensors”, poster at Red Raider Mini Symposium, Lubbock, TX, 2006
7. “Hybrid IPMC/PVDF Structure for Simultaneous Actuation and Sensing”, oral presentation at the SPIE 13th Annual International Symposium on Smart Structures and Materials, San Diego CA, 2006

## **FULL HOUR INVITED TALK**

- + “Electroactive Polymers as Artificial Muscles and Sensors: A Control Systems Perspective”, Department of Electrical & Computer Engineering, National University of Singapore, July, 2008, (Host: Dr. Yung C. Liang).

## **PATENTS:**

- + X. Tan, **Z. Chen**, Y. Shen, and N. Xi, “Integrated Actuator-Sensor Structure”, US patent pending, 2006

## **PROFESSIONAL MEMBERSHIP AND SERVICE**

1. Professional membership
  - Student member of IEEE, SPIE, and ASME
2. Reviewer for archival journals
  - IEEE Transactions on Neural Networks
  - Smart Materials and Structures
  - IEEE/ASME Transactions on Mechatronics
  - Scripta Materialia
3. Reviewer for conferences
  - IEEE International Symposium on Intelligent Control, (ISIC 2007)
  - IFAC World Congress, (2008)
  - Annual Conference of IEEE Industrial Electronics Society, (IECON 2006, 2007)
  - IEEE International Symposium on Industrial Electronics, (ISIE 2007)
  - International Symposium on Neural Networks, (ISNN 2007)
  - European Control Conference (ECC 2007)
  - IEEE Asia Pacific Conference on Circuits and Systems (APCCAS 2008)
  - IEEE Conference on Decision and Control (CDC 2008)
  - IEEE Conference on Robotics and Automation (ICRA 2009)
  - IEEE International Conference on Robotics and Biomimetics (ROBIO 2008)