

ZHENG Zhi

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## Zhi Zheng

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### EDUCATION

**Vanderbilt University** Nashville, TN, USA  
Ph.D. in Electrical Engineering Aug.2011-Aug.2016 (expected)  
Dissertation: *Machine-assisted Technologies for Young Children with Autism Spectrum Disorder: Novel Platforms for Early Detection and Intervention*  
Advisors: Dr. Nilanjan Sarkar and Dr. Zachary Warren

**Vanderbilt University** Nashville, TN, USA  
M.S. in Electrical Engineering Aug. 2011- Dec. 2013  
Thesis: *Engagement Detection of Teenagers with Autism and Their Typically Developing Peers by Machine Learning*  
Advisor: Dr. Nilanjan Sarkar

**Xidian University** Xi'an, Shannxi, China  
M.S. in Pattern Recognition and Intelligent System Sep. 2008-Mar. 2011  
Thesis: *Mixed Features and Mixed Strategies Evolutionary Clustering Algorithms*  
Advisors: Dr. Licheng Jiao and Dr. Maoguo Gong

**Xidian University** Xi'an, Shannxi, China  
B.S. of Biomedical Engineering Sep. 2004-Jul. 2008

### RESEARCH INTERESTS

- Human-machine interaction and human-centered computing
- Computer vision, machine learning, pattern recognition, and data mining
- Engineering education research and special education for children with developmental disabilities

### RESEARCH EXPERIENCE

#### **Robotics and Autonomous System Laboratory, Vanderbilt University**

Graduate Research Assistant Aug. 2011-present

- Design and development of autonomous adaptive robotic/computer systems for teaching children with Autism Spectrum Disorder (ASD) social communication skills, including include joint attention, imitation, and response to name. These systems are distributed concurrent systems with multiple components for teaching

skills and detecting interaction cues. The internal intelligent cores of these systems are designed based on psychological theories to provide the maximum intervention effect.

- Design and development of head pose estimation and gaze tracking systems with a camera network. These algorithms can accurately detect a person's real-time head pose and gaze direction in a wide angle.
- Design and implementation of real-time single gesture recognition algorithms for detecting and analyzing young children's gestures in robot-human interactions.
- Design and implementation of mixed gesture recognition algorithms for spotting and recognizing multiple overlapping gestures performed in parallel.
- Physiological signal collection, processing, and analysis:
  - Operate BIOPAC physiological systems and develop systematic data collection programs.
  - Design feature extraction algorithms for processing electrocardiogram, photo plethysmogram, galvanic skin response, electromyography, heart sound, skin temperature, and respiration signals.
  - Design feature dimension reduction algorithms.
  - Design algorithms for emotion clustering and classification for children with ASD and typically developing children.
- Led and participated in about 250 sessions of human-machine interaction experiments on robot-mediated training, Virtual Reality-simulated social interaction, and Virtual Reality-simulated driving tasks. The participants included typically developing child, children with ASD, people with schizophrenia, and elderly people with dementia.

**Key Lab of Intelligent Perception and Image Understanding of Ministry of Education of China, Xidian University**

Graduate Research Assistant

Sept. 2008-Mar. 2011

- Theoretical study on clustering algorithms, classification algorithms, functional optimization, and evolutionary computation.
- Designed image segmentation algorithms for natural images, remote sensing images, and medical images.

**Electrical Engineering Experiment Center and Biomedical Engineering Undergraduate Lab, Xidian University**

Undergraduate Researcher

2005-2007

- General digital and analog circuits design and analysis, FPGA, Biomedical Engineering specialized circuit design (electrocardiogram signal acquisition).

**TEACHING EXPERIENCE**

**Department of Mechanical Engineering, Vanderbilt University**

Guest lectures on Advanced Dynamics for Mechanical Systems

Spring, 2016

**Department of Electrical Engineering and Computer Science, Vanderbilt University**

Guest lecture on Computer Vision

Fall, 2015

**Center for Teaching, Vanderbilt University**

- Participated in the Vanderbilt Certificate in College Teaching (CICT) Practicum
- Participated in the Vanderbilt Certificate in College Teaching (CICT) Seminar

Fall. 2015

Spring. 2015

**School of Electronic Engineering, Xidian University**

Lectures on Optimization Theories and Methods

Spring, 2008

## PUBLICATIONS

### Journal

1. **Zhi Zheng**, Huan Zhao, Amy Swanson, Amy Weitlauf, Zachary Warren, Nilanjan Sarkar "Longitudinal Autonomous Robot-mediated Joint Attention Intervention for Toddlers with ASD." Robotics, IEEE Transactions on. (pending submission)
2. **Zhi Zheng**, Qiang Fu, Huan Zhao, Amy Swanson, Amy Weitlauf, Zachary Warren, Nilanjan Sarkar "Computer-mediated Social Orienting Training System for Young Children with ASD." Neural Systems and Rehabilitation Engineering, IEEE Transactions on. (under review)
3. **Zhi Zheng**, Zachary Warren, Amy Weitlauf, Qiang Fu, Huan Zhao, Amy Swanson, Nilanjan Sarkar. "Evaluation of an Intelligent Learning Environment for Young Children with Autism Spectrum Disorder." Journal of Autism and Developmental Disorders. (under review)
4. **Zhi Zheng**, Eric M. Young, Amy Swanson, Zachary Warren, and Nilanjan Sarkar. "Robot-mediated Imitation Skill Training for Children with Autism." Neural Systems and Rehabilitation Engineering, IEEE Transactions on. (preprint, DOI:10.1109/TNSRE.2015.2475724)
5. Warren, Zachary, **Zhi Zheng**, Shuvajit Das, Eric M. Young, Amy Swanson, Amy Weitlauf, and Nilanjan Sarkar. "Brief Report: Development of a Robotic Intervention Platform for Young Children with ASD." Journal of autism and developmental disorders (2014): 1-7.
6. Bekele, Esubalew, Julie Crittendon, **Zhi Zheng**, Amy Swanson, Amy Weitlauf, Zachary Warren, and Nilanjan Sarkar. "Assessing the Utility of a Virtual Environment for Enhancing Facial Affect Recognition in Adolescents with Autism." Journal of autism and developmental disorders 44, no. 7 (2014): 1641-1650.
7. Warren, Zachary E., **Zhi Zheng**, Amy R. Swanson, Esubalew Bekele, Lian Zhang, Julie A. Crittendon, Amy F. Weitlauf, and Nilanjan Sarkar. "Can Robotic Interaction Improve Joint Attention Skills?" Journal of autism and developmental

- disorders (2013): 1-9.
8. Bekele, Esubalew, **Zhi Zheng**, Amy Swanson, Julie Crittendon, Zachary Warren, and Nilanjan Sarkar. "Understanding how adolescents with autism respond to facial expressions in virtual reality environments." *Visualization and Computer Graphics, IEEE Transactions on* 19, no. 4 (2013): 711-720.
  9. Jiao, Licheng, Maoguo Gong, Shuang Wang, Biao Hou, **Zhi Zheng**, and Qiaodi Wu. "Natural and remote sensing image segmentation using memetic computing." *Computational Intelligence Magazine, IEEE* 5, no. 2 (2010): 78-91.

### Book Chapter

1. **Zhi Zheng**, Esubalew Bekele, Amy Swanson, Amy Weitlauf, Zachary Warren, and Nilanjan Sarkar, "The Impact of Robots on Children with Autism Spectrum Disorder (ASD)." *Autism Imaging and Devices*, Taylor & Francis, 2015. (in press)

### Conference Proceedings

1. **Zhi Zheng**, Guangtao Nie, Amy Swanson, Amy Weitlauf, Zachary Warren, and Nilanjan Sarkar. " Longitudinal Impact of Autonomous Robot-mediated Joint Attention Intervention for Young Children with ASD." In the 25th IEEE International Symposium on Robot and Human Interactive Communication, 2016. (under review)
2. **Zhi Zheng**, Eric M. Young, Amy Swanson, Zachary Warren, and Nilanjan Sarkar. " Robot-mediated Mixed Gesture Imitation Skill Training for Young Children with ASD." In *Advanced Robotics (ICAR)*, IEEE International Conference on, 2015.
3. **Zhi Zheng**, Qiang Fu, Huan Zhao, Amy Swanson, Amy Weitlauf, Zachary Warren, Nilanjan Sarkar. "Design of a Computer-assisted System for Teaching Attentional Skills to Toddlers with Autism." The 17th International Conference on Human-Computer Interaction, 2015. (**Best Paper Award**)
4. **Zhi Zheng**, Shuvajit Das, Eric M. Young, Amy Swanson, Zachary Warren, and Nilanjan Sarkar. "Autonomous robot-mediated imitation learning for children with autism." In *Robotics and Automation (ICRA)*, 2014 IEEE International Conference on, pp. 2707-2712. IEEE, 2014.
5. Bekele, Esubalew, Joshua W. Wade, Dayi Bian, Lian Zhang, **Zhi Zheng**, Amy Swanson, Medha Sarkar, Zachary Warren, and Nilanjan Sarkar. "Multimodal Interfaces and Sensory Fusion in VR for Social Interactions." In *Virtual, Augmented and Mixed Reality. Designing and Developing Virtual and Augmented Environments*, pp. 14-24. Springer International Publishing, 2014.
6. Bekele, Esubalew, Dayi Bian, **Zhi Zheng**, Joel Peterman, Sohee Park, and Nilanjan Sarkar. "Responses during Facial Emotional Expression Recognition Tasks Using Virtual Reality and Static IAPS Pictures for Adults with Schizophrenia." In *Virtual, Augmented and Mixed Reality. Applications of Virtual and Augmented Reality*, pp.

- 225-235. Springer International Publishing, 2014.
7. **Zhi Zheng**, Lian Zhang, Esubalew Bekele, Amy Swanson, Julie A. Crittendon, Zachary Warren, and Nilanjan Sarkar. "Impact of robot-mediated interaction system on joint attention skills for children with autism." In Rehabilitation Robotics (ICORR), 2013 IEEE International Conference on, pp. 1-8. IEEE, 2013. (**Best student paper nominated**)
  8. Bekele, Esubalew, Mary Young, **Zhi Zheng**, Lian Zhang, Amy Swanson, Rebecca Johnston, Julie Davidson, Zachary Warren, and Nilanjan Sarkar. "A step towards adaptive multimodal virtual social interaction platform for children with autism." In Universal Access in Human-Computer Interaction. User and Context Diversity, pp. 464-473. Springer Berlin Heidelberg, 2013.
  9. Bekele, Esubalew, **Zhi Zheng**, Amy Swanson, Julie Davidson, Zachary Warren, and Nilanjan Sarkar. "Virtual reality-based facial expressions understanding for teenagers with autism." In Universal Access in Human-Computer Interaction. User and Context Diversity, pp. 454-463. Springer Berlin Heidelberg, 2013.
  10. Bekele, Esubalew, **Zhi Zheng**, Uttama Lahiri, Amy Swanson., Julie Davidson, Zachary Warren, Nilanjan Sarkar. (2012). Design of a novel virtual reality-based autism intervention system for facial emotional expressions identification. In The 9th International conference on Disability, Virtual Reality and Associated Technologies.
  11. **Zhi Zheng**, Maoguo Gong, Jingjing Ma, Licheng Jiao, and Qiaodi Wu. "Unsupervised evolutionary clustering algorithm for mixed type data." In Evolutionary Computation (CEC), 2010 IEEE Congress on, pp. 1-8. IEEE, 2010.

### **Conference Abstract**

1. **Zhi Zheng**, Qiang Fu, Huan Zhao, Amy Swanson, Amy Weitlauf, Zachary Warren, Nilanjan Sarkar. "3-D Social Attention Training for Young Children with ASD" International meeting for autism research, 2016. (under review)
2. **Zhi Zheng**, Qiang Fu, Huan Zhao, Amy Swanson, Amy Weitlauf, Zachary Warren, Nilanjan Sarkar. "A 3-D learning environment for infants and toddlers at-risk for ASD: Can technology improve early social communication vulnerabilities?" International meeting for autism research, 2015.

### **Workshop paper**

1. **Zhi Zheng**, Huan Zhao, Amy Swanson, Amy Weitlauf, Zachary Warren, Nilanjan Sarkar. "A Fully Autonomous Robotic System for Training Attentional Skills to Toddlers with ASD" International Workshop on Intervention of Children with Autism Spectrum Disorders using a Humanoid Robot, 2015.

## **PROFESSIONAL AFFILIATIONS AND SERVICE**

### **Membership**

- Institute of Electrical and Electronics Engineers (IEEE)
- American Society for Engineering Education (ASEE)
- International Society for Autism Research (INSAR)

### **Reviewer**

IEEE transaction on robotics, Research in Developmental Disabilities, BMC psychiatry

### **Volunteer**

Assistant in the IET Xi'an Network Inaugural Meeting, Xi'an, China Nov. 2008

### **Talks and Demonstrations**

- Robot-human interaction show for Nashville Art2STEM program Oct. 2nd 2015
- Robot-human interaction show for the Vanderbilt Kennedy Center 50th anniversary ceremony Jun. 17th 2015
- Robot-human interaction show at the 20th annual Coalition for National Science Funding in Washington, D.C. May 7th 2014
- Robot-children interaction show at Nashville Belcourt Theatre as part of Saturday Kid Shows and Science on Screen: Connecting Cinematic Art with Hard Science programs. Mar. 22nd 2014

## **PROFESSIONAL SKILLS**

- Programming: C (since 2006), C++ (since 2008), C# (since 2011), MATLAB (since 2006), Python (since 2011)
- Software: Simulink (since 2011), Unity (since 2011), Visual Studio (since 2006)
- Commercial Hardware: NAO robot (since 2012), BIOPAC systems (since 2011), Tobii eye trackers (since 2012), Eye Tribe eye tracker (since 2013), Arduino controllers (since 2015), LEGO Mindstorms (since 2012), Interstate inertia cube (since 2014), Microsoft Kinect (since 2013)

## **LEADERSHIP**

- Class leader of 52 students in graduate class 2-085 at Xidian University Aug. 2008-Mar. 2011
- Head of the student union's publicity department in the School of Electronic Engineering (about 800 students) Sep. 2005-Jul. 2006

## **HONORS AND AWARDS**

- Blended & Online Learning Design Fellow (NSF supported) of Vanderbilt University Aug. 2015-May 2016

- Certificate in College Teaching from Vanderbilt University Center for Teaching Dec. 2015
- Best paper award in the 9<sup>th</sup> International Conference on Universal Access in Human-Computer Interaction (in the context of HCI International 2015) Aug. 2015
- Vanderbilt University tuition scholarship and research assistantship 2011-Present
- Outstanding Master's graduate of Xidian University Mar. 2011
- Outstanding graduation dissertation for Master's degree (1st prize ) at Xidian University Mar. 2011
- The 1st prize graduate scholarship at Xidian University Sep. 2010-Mar. 2011
- The 2nd prize "Present Around the World" IET Global English Speaking Competition in Xi'an Network Jun. 2010
- The principle graduate scholarship at Xidian University Sep. 2009-Jul. 2010
- Outstanding student of Xidian University Sep. 2009-Jul. 2010
- The 1st prize graduate scholarship at Xidian University Sep. 2008-Jul. 2009
- Outstanding student leader of Xidian University Sep. 2008-Jul. 2009
- The 3rd prize of "Gugao&Bochuang" cup competition of outstanding bachelor dissertation in Shannxi Province Sep. 2008
- The 3rd prize in National English Competition for College Students Apr. 2007
- The 2nd prize undergraduate scholarship at Xidian University Sep. 2006-Jul. 2007
- The 1st prize undergraduate scholarship at Xidian University Sep. 2005-Jul. 2006
- Outstanding student of Xidian University Sep. 2005-Jul. 2006
- Outstanding student leader of Xidian University Sep. 2005-Jul. 2006
- The 3rd prize undergraduate scholarship at Xidian University Sep. 2004-Jul. 2005