

Bertram Emil Shi

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Research Interests

Neuromorphic Engineering, Cellular Neural Networks, Mixed Analog-Digital Implementation of Neural Networks, Embedded System Design of Neural Networks, Computational Vision.

Employment

Professor, Department of Electronic and Computer Engineering, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, 2008 – present.

Associate Professor, Department of Electronic and Computer Engineering, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, 2001 – 2008.

Visiting Associate Professor, Department of Bioengineering, University of Pennsylvania, Philadelphia, PA, Jan. 2002 – Dec. 2002 (sabbatical leave from HKUST).

Assistant Professor, Department of Electrical and Electronic Engineering, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong, 1994 – 2000.

Graduate Student Researcher, Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, CA, 1989 – 1994.

Teaching Assistant, Linear and Nonlinear Circuit Theory (EECS104), Department of Electrical Engineering and Computer Sciences, University of California, Berkeley, CA, Sep. 1992 – Dec. 1992.

Technical Associate, Science Center, Rockwell International Corporation, Thousand Oaks, CA. Jun. 1987 – Sep. 1987.

Technical Associate, Innovative Hearing, Inc., San Francisco, CA, Jun. 1986 – Sep. 1986.

Education

Ph.D., Electrical Engineering, University of California, Berkeley, CA, May 1994.

Thesis supervisor: Professor L. O. Chua

Thesis title: *Spatio-temporal Image Filtering with Cellular Neural Networks*

M.S., Electrical Engineering, Stanford University, Stanford, CA, Jun 1988.

B.S. with distinction, Electrical Engineering, Stanford University, Stanford, CA, Jun. 1987.

Awards

2001 Fellow of the Institute of Electrical and Electronic Engineers (IEEE)

Citation: *For contributions to the analysis, implementation and application of cellular neural networks*

The total number of Fellows selected per year does not exceed 0.1% of the total IEEE voting membership.

2000 Finalist - Best vision paper award at the 2000 IEEE Intl. Conf. on Robotics and Automation

1988 US National Science Foundation (NSF) Graduate Research Fellowship

1987 F. E. Terman Award, by Stanford University for scholastic achievement in engineering

- 1987 Tau Beta Pi, engineering honor society
- 1986 Phi Beta Kappa, academic honor society for liberal arts and sciences
- 1984 National Merit Scholarship

Scholarly and Professional Service

Distinguished Lecturer of the IEEE Circuits and System Society (2001/02 and 2007/08)

1. “Bio-inspired CNN Visual Systems,” Technische Universität Dresden, Dresden, Germany, Jul. 2008.
2. “Bio-inspired CNN Visual Systems,” Pázmány Péter Catholic University, Budapest, Hungary, Jul. 2008.
3. “CNN Hardware for Implementing Early Visual Processing,” Tokushima University, Japan, 27 Jul. 2007.
4. “CNN Architectures Inspired by the Visual Cortex and Their Applications,” National Cheng Kong University, Tainan, Taiwan, 14 Nov. 2002.
5. “CNN Architectures Inspired by the Visual Cortex and Their Applications,” National Taiwan University, Taipei, Taiwan, 13 Nov. 2002.
6. “CNN-based Computational Vision Sensors and their Applications,” Hungarian Academy of Sciences, Budapest, Hungary, Aug. 2001.

Journal Guest Editor

- *IEEE Trans. Circuits and Systems—I: Regular Papers*, Special issue on CNN Technology and Active Wave Computing, vol. 51, no. 5, May 2004.

Journal Associate Editor

- *IEEE Transactions on Circuits and Systems—I: Regular Papers* (for Theory and Systems) 2004-2005.
- *IEEE Transactions on Circuits and Systems—I: Fundamental Theory and Applications* (for Integrated Sensors, MEMS & System on a Chip) 2002 – 2003.
- *IEEE Transactions on Circuits and Systems—I: Fundamental Theory and Applications* (for Cellular Neural Networks) 1998-2000.

Conference General Co-Chair

- *IEEE International Workshop on Cellular Neural Networks and their Applications 2005*

Conference Technical Program Chair

- *IEEE International Workshop on Cellular Neural Networks and their Applications 2004*

Technical Committee Chair

- *IEEE Circuits and Systems Society Technical Committee on Cellular Neural Networks and Array Computing* 2002-2003 (Chair Elect), 2003-2005 (Chair), 2005-2006 (Past-Chair)

Invited Talks

Plenary Lecture

1. “Modelling the Multidimensional Selectivity of the Visual Cortex in CNN Hardware” (1 hour), International Workshop on Cellular Neural Networks, Hangzhou, China, 4 Sep. 2006.

Conference/Workshop Invited Lectures, Workgroup Leadership, Tutorials and Panel Membership

1. *Invited lecture*: “Neuromorphic hardware models of visual cortical neuron populations,” (0.7 hour) GCOE Global Seminar on Advances in Neuroengineering, Osaka, Japan, 23 Jan 2008.

2. *Invited lecture*: “Building active vision systems with POPCORN: hardware simulating POPulations of CORTical Neuron models,” (0.5 hour) Workshop on the active vision of humanoid robots, organized by Yiannis Aloimonos and Giulio Sandini as part of the IEEE-RAS 7th International Conference on Humanoid Robots, Pittsburgh, PA, USA, 29 Nov. 2007
3. *Invited lecture*: “Designing Populations of Image Motion Selective Cellular Neural Networks” (0.5 hour), International Workshop on Nonlinear Dynamics of Electronic Systems, Tokushima, Japan, 26 Jul. 2007.
4. *Invited lecture and workgroup leader*: “Building and Interpreting Populations of Model Visual Cortical Neurons” (1.5 hour) and “Vision Systems Workgroup” (with T. Delbruck), Workshop on Neuromorphic Engineering, Telluride, CO, 2 Jul. 2007.
5. *Tutorial* (with C. Rekeczky and M. Gilli): “CNN wave computing: Theory, architectures, implementations and applications” (3 hour), IEEE International Workshop on Cellular Neural Networks and their Applications, Istanbul, Turkey, 28 Aug. 2006.
6. *Invited lecture and workgroup leader*: “Modelling the Multidimensional Selectivity of the Visual Cortex in Neuromorphic Hardware” (1.5 hour) and “Vision Systems Workgroup” (with T. Delbruck) Workshop on Neuromorphic Engineering, Telluride, CO, 30 Jun. 2006.
7. *Invited lecture and workgroup leader*: “Modeling Cortical Multidimensional Selectivity in Silicon” (1.5 hour) and “Vision Systems Workgroup” (with C. Higgins) Workshop on Neuromorphic Engineering, Telluride, CO, 30 Jun. 2004
8. *Invited lecture*: “A CNN Model of multi-dimensional stimulus selectivity in the primary visual cortex,” (0.5 hour) Joint Conf. on Neural Networks, Budapest, Hungary, 28 Jul. 2004.
9. *Invited lectures and workgroup leader*: “Orientation hypercolumns in visual cortex: Multi-chip implementation,” “Wiring feature maps by following gradients: A mathematical model” (1.5 hour total) and “Vision Chips Workgroup” (with C. Higgins), Workshop on Neuromorphic Engineering, Telluride, CO, 5 Jul. 2003
10. *Invited lecture and workgroup leader*: “Multi-layer diffusively coupled neuromorphic circuit networks for visual information processing” (1.5 hour) and “Vision Chips Workgroup,” Workshop on Neuromorphic Engineering, Telluride, CO, Jul. 2002.
11. *Invited lecture and workgroup leader*: “Coupled nonlinear spring/mass systems in warped space-time: A lingua franca for circuit designers and biologists?” (1.5 hour) and “Vision Chips Workgroup,” Workshop on Neuromorphic Engineering, Telluride, CO, Jul. 2001.
12. *Invited lecture and workgroup leader*: “Architectures for Spatio-temporal Image Processing” (1.5 hour) and “Vision Chips Workgroup” (with C. Higgins), Workshop on Neuromorphic Engineering, Telluride, CO, Jun. 2000.
13. *Panelist*: “The CNN Chip: Present and Future,” 5th IEEE Int. Workshop on Cellular Neural Networks and their Applications, London, Apr. 1998.

Conference Special Session Organization

1. “Sensor integration in autonomous systems” (with Cs.Rekeczky) at the International Symposium on Circuits and Systems, New Orleans, LA, USA, May 2007.
2. “Cellular sensory wave computers” (with T. Roska and Cs.Rekeczky) at the International Joint Conference on Neural Networks, Vancouver, BC, Jul. 2006.
3. “Sensor Arrays for Visual Tracking and Navigation” (with Cs.Rekeczky) at the International Symposium on Circuits and Systems, Bangkok, Thailand, 2003.

Research Funding

1. Title: Humanoid Robotic Platform (HKUST Humanoid)
PI: Bertram Shi, CI: A. Bermak, D. Young, J. Xu, L. Qiu, L. Quan, P. Fung, R. So, Z. Li
Sponsor: HKUST Research Equipment Competition, Year: 2007
Amount: HK\$680,00
2. Title: Binary Coding in Neuromorphic Sensory Systems

- PI: Bertram Shi
Sponsor: RGC CERG, Year: 2007-2009
Amount: HK\$391,591
3. Title: Hierarchical Hebbian Learning in Neuromorphic Networks
PI: Bertram Shi
Sponsor: RGC CERG, Year: 2006-2009
Amount: HK\$1,095,750
 4. Title: Modulatory Feedback in Multi-chip Neuromorphic Networks
PI: Bertram Shi
Sponsor: RGC CERG, Year: 2005-2007
Amount: HK\$553,984
 5. Title: Neuromorphic integration of disparity and motion cues
PI: Bertram Shi, CI: Philip Leong,
Sponsor: RGC CERG, Year: 2004-2006
Amount: HK\$714,322
 6. Title: A Neuromorphic Study of the Disparity-Vergence Interaction
PM: Bertram Shi, PI: Ning Qian, Bertram Shi, Meihua Tai
Sponsor: Institute of Neuromorphic Engineering, Year: 2004-2005
Amount: US\$6,500
 7. Title: Active control of gaze in a neuromorphic binocular vision system
PI: Bertram Shi
Sponsor: RGC DAG, Year: 2004-2006
Amount: HK\$82,000
 8. Title: A silicon model of multidimensional selectivity in the visual cortex
PI: Bertram Shi
Sponsor: RGC CERG, Year: 2003-2006
Amount: HK\$595,043
 9. Title: VLSI architectures for competition and adaptation in neuromorphic processors
PI: Bertram Shi
Sponsor: RGC CERG, Year: 2001-2004
Amount: HK\$816,547
 10. Title: Epigenetic Computers: An in vitro, in abstractio, and in silico study
PI: Kwabena Boahen, Co-PI: Rita Balice-Gordon, Geoff Goodhill, Bertram Shi
Sponsor: US National Science Foundation, Year: 2001-2004
Amount: US\$980,000
 11. Title: Language and speech technology research
PI/PM: Roland Chin; PI: Oscar Au, Pascale Fung, Kok Wee Gan, Brian Mak, Bertram Shi,
Manhung Siu, Dekai Wu
Sponsor: Hong Kong Telecom Institute for Information Technology, Year: 1999-2001
Amount: HK\$2,354,000
 12. Title: Automation technology cooperative research centre
PM: Zexiang Li, PI: Lilong Cai, Zexiang Li, Li Qiu, Bertram Shi and Lixin Wang
Sponsor: RGC CRC; Year: 1999-2002
Amount: HK\$3,000,000
 13. Title: Sub-threshold current mode design for low power cellular neural networks
PI: Bertram Shi
Sponsor: RGC CERG, Year: 1998-2000
Amount: HK\$380,000
 14. Title: Language and Speech Technology Research: Towards the Development of a Spoken Translation System between English, Mandarin and Cantonese
PM/PI: Roland Chin; PI: Oscar Au, Pascale Fung, Kok Wee Gan, Bertram Shi, Pan Hsin Ting, Dekai Wu

- Sponsor: RGC CA, Year: 1997-2000
Amount: HK\$3,900,000
15. Title: Active pixel input to CMOS smart vision sensors
PI: Bertram Shi
Sponsor: RGC DAG, Year: 1998-1999
Amount: HK\$50,000
 16. Title: Cellular Neural Networks for Image Motion Analysis
PI: Bertram Shi
Sponsor: RGC CERG, Year: 1996-1999
Amount: HK\$508,000
 17. Title: Multilingual Robust Speech Recognition
PM/PI: Bertram Shi; PI: Oscar Au, Zhaoping Li, Dekai Wu
Sponsor: SSRC, Year: 1996-97
Amount: HK\$191,000
 18. Title: Analog VLSI Cellular Neural Networks
PI: Bertram Shi; CI: Michael Stiber
Sponsor: RGC CERG; Amount: HK\$612,000; Year: 1995-1998
 19. Title: Dynamical Neural Networks: From Wetware to Hardware
PI: Michael Stiber; CI: Bertram Shi
Sponsor: RGC CERG, Year 1995-1998
Amount: HK\$259,000
 20. Title: Cellular Neural Networks for Gabor Filtering
PI: Bertram Shi
Sponsor: RGC DAG; Amount: HK\$50,000; Year 1994-1995.

External University Seminars

1. "Neuromorphic Hardware for Real-time Simulation of Cortical Maps," Mahoney Center for Brain & Behavior Research, Columbia University, New York, NY, 21 Dec. 2005.
2. "Modeling Cortical Multidimensional Selectivity in Silicon," Mahoney Center for Brain & Behavior Research, Columbia University, New York, NY, 22 Jun. 2004
3. "Neuromorphic modeling of visual processing in cortex," (Full day course), Brain Research Center, National Chiao Tung University, Hsinchu, Taiwan, 25 Aug. 2003.
4. "A Silicon Model of Orientation Selectivity in Visual Cortex," Electrical and Systems Engineering Seminar Series, Dept. of Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA, 16 Dec. 2002.
5. "Implementing Orientation Selective Simple Cell Functionality in Silicon," Bioengineering Seminar Series, Dept. of Bioengineering, University of Pennsylvania, Philadelphia, PA, 7 Nov. 2002.
6. "An Analog VLSI Multichip Architecture for Competitive Orientation Selective Image Filtering," Department of Electrical and Computer Engineering, Johns Hopkins University, Baltimore, MD, 4 Apr. 2002.
7. "Neuromorphic Vision Sensors and their Applications," ECE Seminar Series, Carnegie Mellon University, Pittsburgh, PA, 14 Feb. 2002.
8. "CNN Sensors for Active Vision," Analogical and Neural Computing Laboratory, Computer and Automation Institute, Hungarian Academy of Sciences, Budapest, Hungary, Sep. 1998.
9. "Digital signal processing for speech coding and recognition", Workshop on Implementation of Multimedia and Communication DSP Applications, Hong Kong, 13 Jun. 1996.

Technical and Review Committee Membership

Conference Technical Program Committee Membership

- *IEEE International Workshop on Cellular Neural Networks and their Applications (CNNA) 2008*
- *International Joint Conference on Neural Networks (IJCNN), 2008*
- *European Conference on Circuit Theory and Design (ECCTD): Track chair for image processing and multimedia, 2007.*
- *IEEE International Workshop on Cellular Neural Networks and their Applications (CNNA) 2006*
- *IEEE International Symp. on Circuits and System (ISCAS): Track chair for cellular neural networks and array computing, 2005*
- *SPIE Intl. Symp. on Microtechnologies for the New Millenium: Bioengineered and Bioinspired Systems, 2005.*
- *Design, Automation and Test in Europe (DATE): Analogue & Mixed A/D Systems track, 2005*
- *IEEE International Symp. on Circuits and System (ISCAS): Track chair for cellular neural networks and array computing, 2004*
- *SPIE Intl. Symp. on Microtechnologies for the New Millenium: Bioengineered and Bioinspired Systems, 2004.*
- *SPIE Intl. Symp. on Microtechnologies for the New Millenium: Bioengineered and Bioinspired Systems, 2003.*
- *TENCON'96: Digital Signal Processing Applications, 1996.*

Conference Review Committee Member

- *IEEE International Symposium on Circuits and Systems, 2000, 2001, 2003, 2006*

Technical Committee Membership

- *IEEE Circuits and Systems Society Technical Committee on Cellular Neural Networks and Array Computing, (1999-present).*
- *IEEE Circuits and Systems Society Technical Committee on Sensory Systems (2002-present).*
- *IEEE Circuits and Systems Society Technical Committee on Neural Systems and Applications (2004-present).*
- *Student Activities Chair: IEEE Hong Kong Section, 1996-2000.*

Journal Reviewer

- *Electronics Letters*
- *IEEE Trans. Circuits and System-I*
- *IEEE Trans. Circuits and System-II*
- *IEEE Trans. Robotics and Automation*
- *IEEE Trans. Neural Networks*
- *IEEE Trans. Speech and Audio Processing*
- *IEEE Trans. Pattern Analysis and Machine Intelligence*
- *Int. Journal of Circuit Theory and Its Application*
- *Journal of VLSI Signal Processing*
- *Machine Vision and Applications*
- *Neural Computation*
- *Neurocomputing*
- *Physics Letters A*

Postgraduate Research Supervision

Post-doctoral and visiting scholar

1. Y. W. Wang, Jul. 2008 – Jun. 2009.
2. K. C. Tsang, Sep. 2007 – Jul. 2008.
3. Z. Y. Lu, Oct. 1998– Sept. 1999.
4. L. N. Gao, Sep. 1997- Sep. 1998.

Ph.D.

1. Q. Y. Peng, in progress since Aug. 2008.
2. Y. C. Meng, in progress since Jul. 2005.
3. Y. M. Lam, “Neuromorphic Implementation of motion neuron populations by combining position and phase tuned mechanisms,” Aug. 2008.
4. K. C. Tsang, “Confidence measures for disparity estimates from energy neuron populations”, Aug. 2007.
5. Y. W. Choi, “Neuromorphic implementation of retinotopic arrays of orientation selective hypercolumns,” Aug. 2003.

M.Phil.

1. M. Gao, in progress (in progress since Sep. 2007)
2. H. Y. Lau, “Neural-inspired color constancy model based on double opponent neurons,” Aug. 2008.
3. Y. Yang, “Attention detection based on cortical area V2 neurons,” Aug. 2008.
4. Y. Zhao, “Incorporating contrast Invariance into a developmental model of orientation selectivity,” Aug. 2007.
5. C. H. Fung, “A biomimetic active stereo head with torsional control,” Aug. 2006
6. Y. M. Lam, “Cortical map formation by guiding connections,” Jan. 2005.
7. T. Luo, “Pattern formation in cellular neural networks,” Aug. 2003.
8. K. C. Tsang, “Preference for phase based disparity in a neuromorphic implementation of the binocular energy model,” Aug. 2003.
9. C. K. Chau, “Model-based vocal tract length normalization for speech recognition,” Aug. 2001.
10. C. S. Lai, “A one pass keyword spotting algorithm using a log-likelihood ratio confidence measure,” Jan 2001.
11. Y. Sun, “Pulse based communication in feedback networks of aVLSI neuromorphic chips,” Jun. 2000.
12. K. K. Lau, “An analog VLSI Vision Sensor for Image Velocity Measurement,” Jun. 2000.
13. W. B. Lam, “Discriminative training for speaker verification,” Sep. 2000.
14. S. K. Wong, “Channel and noise adaptation via HMM mixture mean transform and stochastic matching,” Aug. 1998.
15. K. F. Hui, “Robustness of cellular neural network implementations,” Dec. 1996.

Courses Taught

- EESM501: *CMOS VLSI Design*, F’04, F’05, F’06, F’07
- ELEC101: *Basic Electronics*, S’95, S’96, S’97, F’97, S’00
- ELEC210: *Probability and Random Processes in Engineering*, S’01, S’03, S’04, S’06, S’07
- ELEC301: *CMOS VLSI Design*, S’05
- ELEC310: *Probability, Random Variables and Stochastic Processes*, F’94, F’95, F’96
- ELEC530: *Stochastic Processes*, F’94, F’95, F’96, F’98, F’99, F’00, F’01, F’03, F’04, F’05, F’06, F’07
- ELEC534: *Advanced Digital Speech Processing*, S’98
- ELEC691z: *Analog VLSI Vision Sensors*, F’98

Undergraduate Project Supervision

1. K. L. Ma, "Visual aid," (FYT) 2007/2008
2. C. H. Tam and H. F. Tam, "Smart binoculars," 2007/2008
3. T. L. Ho, K. Y. Ho and C. H. Ng, "Visually guided robotic pet," 2006/2007
4. K. Y. Chan and K. K. Chan, "Robotic hand-eye coordination," 2006/2007
5. W. S. Fung and K. K. Wan, "Robotic hand-eye coordination," 2006/2007
6. H. C. Shen, "Sound Localization System Design", (FYT) 2006/2007
7. K. B. Tam, H. X. Xu, F. Y. Yung, "Robotic Hand-Eye Coordination," 2005/2006.
8. S. T. Chan, C. H. Chang, K. K. Wu, "Smart Teleconferencing Camera," 2005/2006.
9. C. K. Cheng, K. W. Chiu and H. Y. Lun, "Stormin' Swarmin' Robots," 2004/05.
10. K. W. Lee, S. Y. Wong and H. W. Yiu, "Stormin' Swarmin' Robots," 2004/05.
11. C. M. Lai and C. W. Luk, "Stormin' Swarmin' Robots," 2004/05.
12. W. C. Ao, S. M. Suen and K. K. Sze-to, "Autonomous and interactive robotic toys," 2003/04.
13. C. H. Fung, H. Y. Lee and H. W. Cheung, "Autonomous and interactive robotic toys," 2003/04.
14. K. Y. Liu, "Bio-inspired vision sensors," 2003/04.
15. C. T. Law, "Morphing the barn owl's sound localization system in silicon," 2002/03
16. P. K. Kwan, S. K. Lee, S. Y. Tsang and Y. F. Yung, "SmartHome: Voice-Controlled Home Environment," 2001/02.
17. Y. M. Lam, S. K. Lau, T. K. Yip, "Internet-enabled Games," 2000/01.
18. K. K. Lam and W. K. Yeung, "Mobile Insect Robots," 2000/01.
19. S. C. Man and Y. H. Tan, "Image Recognition Algorithm using a CMOS Image Sensor," 2000/01.
20. P. J. Chan and W. Y. Hui, "Compact Target Tracking System," 2000/01.
21. H. M. Ng and T. S. Wong, "Traffic Speed Monitor," 1999/2000.
22. M. T. Chan and P. M. Li, "Visual Servoing," 1999/2000.
23. W. K. Cheng, W. L. Lau and M. Y. Tse, "Compact Target Tracking System: Using Special Purpose VLSI Vision Sensors for Target Tracking," 1998/9.
24. C. P. Lau, W. K. Wong and W. M. Wong, "Collision Warning System—Image Based System For Collision Detection in Automobiles," 1997/8.
25. W. O. Chan, K. C. Mak and H. F. Tang, "Speech Controlled Answering Machine—Using Speech Recognition Technology to Retrieve Your Messages," 1997/8.
26. C. L. Chu, F. Li and K. O. Ma, "Keyword spotting in speech recognition," (co-supervisor: P. Fung) 1997/8.
27. Y. K. Lung and K. M. Wong, "Speak2Dial: Automatic Phone Dialing using Speech Recognition," (co-supervisor: O. Au and C. Y. Tsui) 1996/7.
28. L. Y. Chan, N. Y. Cheung and S. F. Lam, "Speech Recognition in Industrial Environment," (co-supervisor: O. Au and P. Chan) 1995/6.
29. M. F. Tsui, C. Y. Chan and C. S. Pun "Connected Cantonese Speech Recognition," (co-supervisor: O. Au) 1995/6.
30. K. M. Chan and H. P. Wong, "Image-based Personal Identification System," 1995/6.
31. W. K. Wong and S. K. Wong, "Cantonese Speech Recognition via hidden Markov models and neural networks," (co-supervisor: O. Au) 1994/5.
32. S. T. Lau and S.W. Chan, "Image-based Personal Identification System," 1994/5.

University Administrative Service

- Member, *ECE Curriculum Committee for 334 Conversion*, 2008 – present
- Member, *ECE Department Computing Resources Committee*, 2007 – present
- Member, *ECE Department PG Committee*, Sep. 2006 – present.
- **Founding Director:** *MSc Program in Electronic Engineering*, Sep. 2004 – present.

- **Director:** *Consumer Media Center*, Mar. 2001 – Jun. 2008.
- **Chair:** *EEE Computing Resources Committee*, Sep. 1996 – Dec. 2001.
- Undergraduate Advisor (EEE and CPEG), Sep. 1995 – Dec. 2001.
- Member, *CPU Farm Task Force*, 1999-2001.
- Member, *1997 Engineering Summer Camp Committee*, Nov. 1996 - July. 1997.
- Member, *EEE Computing Resources Committee*, Jan. 1996 - Aug. 1996.
- Member, *Engineering Summer Camp Committee*, Nov. 1995 - Jul. 1996.
 - *Chair*, Design Competition Subcommittee
- Member, *EEE UG Brochure and Recruitment Video Subcommittee*, Oct. 1995 - May 1996.

Public Community Service

- Member,
- Member, Appeal Board Panel (Toys and Children's Products Safety) 2004-present.

Consulting Activities

1. Weniwen Technologies, Inc. (Hong Kong): Development of robust speech recognition algorithms. Apr. 2000-Sep. 2001.
2. Perception Digital Co. (Hong Kong): Development of audio recognition technology for consumer products, Nov. 1999-Apr. 2000.
3. Nacco Development Co. (Hong Kong): Technical analysis of products, recommendation of circuit design., Mar. 1995

Journal Publications

(author names in *italics* are supervised students, author names followed by * are supervised postdocs or RAs)

- J1. *L. Y. Zhao* and B. E. Shi, "Integrating Contrast Invariance into a Model for Cortical Orientation Map Formation," *Neurocomputing*, to appear.
- J2. B. E. Shi, "The Effect of Mismatch in Current- versus Voltage-mode Resistive Grids," *International Journal of Circuit Theory and its Applications*, to appear.
- J3. E. K. C. Tsang* and B. E. Shi, "Normalization enables robust validation of disparity estimates from neural populations," *Neural Computation*, to appear.
- J4. *Y. Meng* and B. E. Shi, "Adaptive gain control for spike-based map communication in a neuromorphic vision system," *IEEE Transactions on Neural Networks*, vol. 19, no. 6, pp. 1010-1021, Jun. 2008.
- J5. *S. Y. M. Lam* and B. E. Shi, "Recursive Anisotropic 2D Gaussian Filtering Based on a Triple-Axis Decomposition" *IEEE Transactions on Image Processing*, vol. 16, no. 7, pp. 1925-1930, Jul. 2007.
- J6. P. Merolla, J. Arthur, B. Shi and K. Boahen, "Expandable Networks for Neuromorphic Chips," *IEEE Transactions on Circuits and Systems –I: Regular Papers*, vol. 54, no. 2, pp. 301-311, Feb. 2007.
- J7. B. E. Shi, *E. K. C. Tsang* and *P. S. P. Au*, "An ON-OFF temporal filter circuit for motion energy computations," *IEEE Transactions on Circuits and Systems—II: Express Briefs*, vol. 53, no. 9, pp. 951-955, Sep. 2006.
- J8. B. E. Shi, "An Eight Layer Cellular Neural Network for Spatio-Temporal Image Filtering," *International Journal of Circuit Theory and Its Applications*, vol. 34, no. 1, pp. 141-164, Jan./Feb. 2006.
- J9. *T. Y. W. Choi*, P. Merolla, J. Arthur, K. Boahen, and B. E. Shi "Neuromorphic implementation of orientation hypercolumns." *IEEE Transactions on Circuits and Systems—I: Regular Papers*, vol. 52, no. 6, pp. 1049-1060, Jun. 2005.
- J10. *E. K. C. Tsang* and B. E. Shi, "A preference for phase-based disparity in a neuromorphic implementation of the binocular energy model," *Neural Computation*, vol. 16, no. 8, pp. 1579-1600, Aug. 2004.

- J11. B. E. Shi and T. Luo, "Spatial Pattern Formation via Reaction-Diffusion Dynamics in 32 x 32 x 4 CNN Chip," *IEEE Transactions on Circuits and Systems—I: Regular Papers, Special issue on CNN Technology and Active Wave Computing*, vol. 51, no. 5, pp. 939-947, May 2004.
- J12. B. E. Shi, "Oriented spatial pattern formation in a four layer CMOS cellular neural network," *International Journal of Bifurcation and Chaos*, vol. 14, no. 4, pp. 1209-1221, Apr. 2004. **(cover article)**
- J13. T. Y. W. Choi, B. E. Shi, and K. Boahen, "An ON-OFF orientation selective address event representation image transceiver chip," *IEEE Transactions on Circuits and Systems-I: Regular Papers*, vol. 51, no. 2, pp. 342-353, Feb. 2004.
- J14. B. E. Shi, "Pseudo-resistive networks and the pseudo-voltage-based cocontent," *IEEE Transactions on Circuits and Systems-I: Fundamental Theory and Applications*, vol. 50, no. 1, pp. 56-64, Jan 2003.
- J15. B. E. Shi and K. Boahen, "Competitively coupled orientation selective cellular neural networks," *IEEE Transactions on Circuits and Systems-I: Fundamental Theory and Applications*, vol.49, no.3, pp.388-94, Mar. 2002.
- J16. Z. Y. Lu* and B. E. Shi, "Sub-pixel resolution binocular visual tracking using analog VLSI vision sensors," *IEEE Trans. Circuits and Systems-II: Analog and Digital Signal Processing*, vol. 47, no. 12, pp. 1468-1475, Dec. 2000.
- J17. K. S. Yao, B. E. Shi, P. Fung and Z. Cao, "Log-add approximation on-line noise compensation method adopting robust decision rules for robust digits recognition," *Chinese Journal of Electronics*, vol. 9, no. 3, pp.278-83, July 2000.
- J18. B. E. Shi, "A low power orientation selective vision sensor," *IEEE Trans. Circuits and Systems-II: Analog and Digital Signal Processing*, vol. 47, no. 5, pp. 435-440, May 2000.
- J19. B. E. Shi, L. N. Gao*, and K. K. Lau, "A resistor/transconductor network for linear fitting," *IEEE Trans. Circuits and Systems-II: Analog and Digital Signal Processing*, vol. 47, no. 4, pp. 322-331, Apr. 2000.
- J20. B. E. Shi, "Focal plane implementation of 2D steerable and scalable Gabor-type filters," *Journal of VLSI Signal Processing, Special Issue on Spatiotemporal Signal Processing with Analog CNN Visual Microprocessors*, vol. 23, no. 2/3, pp. 319-334, Nov./Dec. 1999
- J21. K. F. Hui and B. E. Shi, "Distortion in analog networks for image filtering," *IEEE Trans. Circuits and Systems--I: Fundamental Theory and Applications*, vol. 46, no. 10, pp. 1161-1171, Oct. 1999.
- J22. B. E. Shi, "A 1D CMOS focal plane array for Gabor-type image filtering," *IEEE Trans. Circuits and Systems--I: Fundamental Theory and Applications, Special Issue on Bio-inspired Processors and Cellular Neural Networks*, vol. 46, no. 2, pp. 323-327, Feb. 1999.
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Conference Publications

(author names in *italics* are supervised students, author names followed by * are supervised postdocs or RAs)

- C1. *X. J. Guo* and B. E. Shi, "A Two Stage Energy Model Exhibiting Selectivity to Changing Disparity," presented at *International Symposium on Neural Networks*, Beijing, China Sep. 2008.
- C2. *Y. N. Yang* and B. E. Shi, "A V2 Neuron-Based Model for Salient Point Detection," presented at *International Workshop on Cellular Neural Networks and their Applications*, Santiago de Compostela, Spain, Jul. 2008.
- C3. *J. H. Y. Lau* and B. E. Shi, "Improved Illumination Invariance Using a Color Edge Representation Based on Double Opponent Neurons" presented at *Intl. Joint Conf. on Neural Networks*, Hong Kong, Jun. 2008.
- C4. E. K. C. Tsang*, *S. Y. M. Lam*, *Y. Meng* and B. E. Shi, "Neuromorphic Implementation of Active Gaze and Vergence Control," presented at *IEEE Intl. Symp. on Circuits and Systems*, Seattle, WA, May 2008.
- C5. *Y. Meng* and B. E. Shi, "Communicating maps of model neurons using the HKUST MultiMap System," presented at *Global COE International Symposium on Electronic Devices Innovation (EDIS 2008)*, Osaka, Japan, Jan. 2008.
- C6. *S. Y. M. Lam* and B. E. Shi, "Extending position/phase-shift tuning to motion energy neurons improves velocity discrimination," presented at *Neural Information Processing Systems Conference*, Vancouver, BC, Dec. 2007.
- C7. E. K. C. Tsang* and B. E. Shi, "Estimating disparity with confidence from energy neurons," presented at *Neural Information Processing Systems Conference*, Vancouver, BC, Dec. 2007.
- C8. B. E. Shi, "Designing populations of image motion selective cellular neural networks," presented at *International Workshop on Nonlinear Dynamics of Electronic Systems*, Tokushima, Japan, Jul. 2007 (**Invited Speaker**).
- C9. *E. K. C. Tsang* and B. E. Shi, "Probabilistic modeling of phase-tuned disparity energy neuron populations," presented at *IEEE Intl. Symp. on Circuits and Systems*, New Orleans, LA, May 2007.
- C10. *S. Y. M. Lam* and B. E. Shi, "Active visual tracking of heading direction by combining motion energy neurons," presented at *IEEE Intl. Symp. on Circuits and Systems*, New Orleans, LA, May 2007.
- C11. B. E. Shi and C. Rekeczky, "Sensor integration in autonomous systems," presented at *IEEE Intl. Symp. on Circuits and Systems*, New Orleans, LA, May 2007.
- C12. *E. K. C. Tsang* and B. E. Shi, "Active binocular gaze control inspired by superior colliculus," presented at *Intl. Joint Conf. on Neural Networks*, Vancouver, BC, Jul. 2006.
- C13. *S. Y. M. Lam*, *E. K. C. Tsang*, *Y. Meng* and B. E. Shi, "Neuromorphic translational ego-motion estimation from visual input," presented at *Intl. Joint Conf. on Neural Networks*, Vancouver, BC, Jul. 2006.
- C14. *Y. Meng*, *S. Y. M. Lam*, *E. K. C. Tsang* and B. E. Shi, "An efficient spike-based communication -protocol for neurally inspired feature maps," presented at *Intl. Joint Conf. on Neural Networks*, Vancouver, BC, Jul. 2006.
- C15. O. Y. H. Cheung, P. H. W. Leong, *E. K. C. Tsang* and B. E. Shi, "Implementation of Gabor-type filters on field programmable gate arrays," presented at *Intl. Joint Conf. on Neural Networks*, Vancouver, BC, Jul. 2006.
- C16. B. E. Shi, *E. K. C. Tsang*, *S. Y. M. Lam* and *Y. Meng*, "Expandable hardware for computing cortical maps," presented at *IEEE Intl. Symp. on Circuits and Systems*, pp. 3606-3609, Kos, Greece, May 2006.
- C17. *C. H. Fung* and B. E. Shi, "A biomimetic active stereo system with torsional control and saccade-like speed," presented at *IEEE / RAS-EMBS International Conference on Biomedical Robotics and Biomechatronics*, Pisa, Italy, Feb. 2006.

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- C54. *K. F. Hui* and B. E. Shi, "Nonlinear distortion in analog networks for image processing," *Proc. IEEE Int. Symp. Circuits Syst.*, Hong Kong, vol. 1, pp. 537-540, Jun. 1997.
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Technology Demonstrations

(author names in *italics* are supervised students, author names followed by * are supervised postdocs or RAs)

1. E. K. C. Tsang*, *S. Y. M. Lam*, *Y. Meng* and B. E. Shi, "Robotic Gaze and Vergence Control via Disparity Energy Neurons," presented at *IEEE Intl. Workshop on Cellular Neural Networks and their Applications*, Santiago de Compostela, Spain, Jul. 2008.
2. E. K. C. Tsang*, *S. Y. M. Lam*, *Y. Meng* and B. E. Shi, "Neuromorphic implementation of active gaze and vergence control," presented at *IEEE Intl. Symp. on Circuits and Systems*, Seattle, WA, May 2008.
3. *E. K. C. Tsang*, *S. Y. M. Lam*, and B. E. Shi, "Visualization of depth/motion perception by model cortical neurons," presented at the *Neural Information Systems Conference*, Vancouver, BC, Dec. 2007.

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Patents

1. "Circuit Architecture for 2D Electronically Steerable and Scalable Image Filtering," US Patent No. 6,198,089, 5 March 2001. Licensed to outside party via HKUST Technology Transfer Corporation.

Other publications

1. B. E. Shi, "Development of a cortically inspired active binocular vision system," *Institute for Neuromorphic Engineering Newsletter*, vol. 2, no. 2, 2005.
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