

# CURRICULUM VITAE of ZHENG ZHANG

**Address:** 4109 Harold Frank Hall, University of California at Santa Barbara, Santa Barbara, CA 93106

**E-mail:** [zhengzhang@ece.ucsb.edu](mailto:zhengzhang@ece.ucsb.edu); **Phone:** (805) 893-7294; **Web:** <http://www.ece.ucsb.edu/~zhengzhang>

## EMPLOYMENT HISTORY

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**07/2017-present: Assistant Professor of Electrical and Computer Engineering, UC Santa Barbara**

03/2016-06/2017: Postdoc Associate at the Research Lab of Electronics, Massachusetts Institute of Technology

07/2015-03/2016: Postdoc Associate at the Math and Computer Science Division, Argonne National Laboratory

## RESEARCH INTERESTS

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High-dimensional and stochastic methods for uncertainty analysis and data inference; specific topics include:

- 1) Variation-aware design methodology of nano-scale ICs, MEMS and integrated photonics;
- 2) Modeling, verification and control of uncertain systems (arising from autonomous vehicles, robotics);
- 3) Tensor computation for machine learning and medical imaging.

## EDUCATION

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**06/2015: Massachusetts Institute of Technology (MIT), Cambridge, MA**

**Ph.D.** in Electrical Engineering and Computer Science, Thesis Advisor: Prof. Luca Daniel.

Dissertation: "Uncertainty quantification for integrated circuits and MEMS."

**08/2010: The University of Hong Kong (HKU), Hong Kong**

**M.Phil.** in Electrical and Electronic Engineering, Thesis Advisor: Prof. N. Wong.

Thesis: "Passivity assessment and model order reduction for descriptor systems in VLSI simulation."

**06/2008: Huazhong University of Science and Technology (HUST), China**

**B. Eng.** in Electronic Science and Technology

## ACADEMIC AWARDS

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**2016: Best Oral Paper Award at 20<sup>th</sup> IEEE Workshop of Signal and Power Integrity**

**2016: ACM Outstanding Ph.D. Dissertation Award in Electronic Design Automation**

**2015: Doctoral Dissertation Seminar Award (i.e., Best Ph.D. Thesis Award) from the Microsystems Technology Laboratory of MIT**

2015: Chinese Government Award for Outstanding Students Abroad (5 winners from MIT in 2015)

**2014: D. O. Pederson Best Paper Award of IEEE Trans. CAD of Integrated Circuits & Systems**

2104: Best Paper Nomination at IEEE Custom Integrated Circuit Conference (CICC)

**2011: Li Ka-Shing Prize (University-Wide Best Thesis Award) from the University of Hong Kong**

2011: Best paper nomination at International Conference of Computer-Aided Design (ICCAD)

2011: Best paper nomination at Asia and South Pacific Design Automation Conference (ASP-DAC)

## SERVICES

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**Technical Program Committee Member:**

- Design Automation Conference (DAC): 2017;
- International Conference of Computer-Aided Design (ICCAD): 2016, 2017

**Journal reviewer:** SIAM J. Uncertainty Quantification, Journal of Computational Physics, IEEE Trans. Circuits and Systems, IEEE Trans. CAD, IEEE Trans. Power Systems, IEEE JMEMS, IEEE Trans. VLSI, IEEE Trans. MTT, IEEE Trans. CPMT, ACM TODAES.

**Conference reviewer:** DAC, ICCAD, DATE, ASP-DAC.

## **TEACHING**

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1. 07/2014: "Uncertainty quantification of nonlinear dynamic systems", at Politecnico di Milano, Italy.
2. Fall 2012 & 2013: "Computing periodic steady states of dynamic systems", in MIT Course 6.336.
3. Fall 2011: Teaching Assistant of MIT 6.336 "Introduction to Numerical Simulation" (PhD course).
4. Spring 2009: Teaching Assistant of HKU ELEC 3612 "VLSI Design Principles" (undergraduate).

## **RESEARCH PROJECTS**

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1. **Postdoc projects** (07/2015-present): uncertainty quantification and inverse problems in photonic design automation and renewable energy systems; tensor methods for machine learning.
2. **Ph.D. projects** (09/2010-06/2015): uncertainty quantification of nano-scale ICs, MEMS and silicon photonics; parameterized model-order reduction for large-scale systems (PDEs, DAEs and ODEs); high-dimensional data analysis and computational tomography of MRI.
3. **M.Phil projects** (09/2008-08/2010): theory and algorithms for the system identification and passivity characterization of differential algebraic equations describing electronic devices & circuits.

## **RESEARCH VISITS & INTERNS**

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1. **Visiting Scholar at UCSD (2009), Brown University (2013), Politecnico di Milano (2014, 2017).** Developed some computational techniques for VLSI power grid simulation and for high-dimensional uncertainty quantification of MEMS and oscillator arrays.
2. **Summer Intern and then R&D Consultant at Coventor Inc.,** Cambridge, MA, 06/2011-06/2015. Based on DAE and PDE descriptions, I developed some numerical algorithms and software for simulating the pull-in/lift-off and softening/hardening effects in MEMS/IC co-design.
3. **Summer Intern at Maxim Integrated Products** (06/2012-09/2012). Worked on fast PDE and integral equation solvers for modeling high-speed passive devices in 90-nm CMOS process.

## **PUBLICATIONS**

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### ➤ **Journal Articles**

1. **Z. Zhang, L. Daniel, K. Batselier, H. Liu and N. Wong,** "Tensor computation: a new framework for high-dimensional problems in EDA," IEEE Trans. CAD of Integrated Circuits and Systems, vol. 36, no. 4, pp. 521-536, April 2017. **(Invited Keynote Paper, TCAD Popular Paper).**
2. **Z. Zhang, T.-W. Weng and L. Daniel,** "Big-data tensor recovery for high-dimensional uncertainty quantification of process variations," IEEE Trans. Component, Packaging and Manufacturing Technology, vol. 7, no. 5, pp. 687-697, May 2017 **(Invited Paper, Popular Paper).**
3. **Z. Zhang, X. Yang, I. Oseledets, G. Karniadakis, L. Daniel,** "Enabling high-dimensional hierarchical uncertainty quantification by ANOVA and tensor-train decomposition, " IEEE Trans. CAD of Integrated Circuits and Systems, vol. 34, no. 1, pp. 63-76, Jan. 2015. **(TCAD Popular Paper)**
4. N. Petra, C. Petra, **Z. Zhang,** E. Constantinescu, M. Anitescu, "A Bayesian approach for parameter estimation with uncertainty for dynamic power systems," IEEE Trans. Power Systems, vol. 32, no. 4, pp. 2735-2743, July 2017.

5. **Z. Zhang**, T. El-Moselhy, I. Elfadel, L. Daniel, "Stochastic testing method for transistor-level uncertainty quantification based on generalized polynomial chaos, " IEEE Trans. CAD of Integrated Circuits and Systems, vol. 32, no. 10, pp. 1533-1545, Nov. 2013. **(Best Paper Award)**
6. **Z. Zhang**, T. El-Moselhy, P. Maffezzoni, I. Elfadel, L. Daniel, "Efficient uncertainty quantification for the periodic steady state of forced and autonomous circuits," IEEE Trans. Circuits and Systems II: Express Briefs, vol. 60, no. 10, pp. 687-691, Oct. 2013.
7. **Z. Zhang**, T. El-Moselhy, I. Elfadel, L. Daniel, "Calculation of generalized polynomial-chaos basis functions and Gauss quadrature rules in hierarchical uncertainty quantification," IEEE Trans. CAD of Integrated Circuits and Systems, vol. 33, no. 5, pp. 728-740, May 2014. **(TCAD Popular Paper)**
8. **Z. Zhang**, M. Kamon, L. Daniel, "Continuation-based pull-in and lift-off simulation for microelectromechanical devices, " IEEE Journal of MEMS, vol. 23, no. 5, pp. 1084-1093, Oct. 2014.
9. T.-W. Weng\*, **Z. Zhang\***, Z. Su, Y. Marzouk, A. Melloni, L. Daniel, "Uncertainty quantification of silicon photonic devices with correlated and non-Gaussian random parameters," Optics Express, vol. 23, no. 4, pp. 4242-4254, Feb. 2015. **(\* Equally contributing authors)**
10. **Z. Zhang\***, N. Farnoosh\*, T. Klemas and L. Daniel, "Maximum-entropy density estimation for MRI stochastic surrogate models," IEEE Antenn. Wireless Propag. Lett., vol. 13, pp. 1656-1659, 2014.
11. P. Maffezzoni, B. Bahr, **Z. Zhang**, L. Daniel, "Analysis and design of Boolean associative memories made of resonant oscillator arrays," IEEE Trans. Circuits and Systems I: Regular Papers, vol. 63, no. 11, pp. 1964-1973, Nov. 2016.
12. P. Maffezzoni, B. Bahr, **Z. Zhang**, and L. Daniel, "Reducing phase noise in multi-phase oscillators," IEEE Trans. Circuits and Systems I: Regular Papers, vol. 63, no. 3, pp. 379-388, March 2016.
13. P. Maffezzoni, B. Bahr, **Z. Zhang**, and L. Daniel, "Analysis and design of weakly coupled LC oscillator arrays based on phase-domain macromodels," IEEE Trans. CAD of Integrated Circuits and Systems, vol. 34, no. 1, pp. 77-85, Jan. 2015.
14. P. Maffezzoni, B. Bahr, **Z. Zhang**, L. Daniel, "Oscillator array models for associative memory and pattern recognition," IEEE Trans. Circuits & Syst. I: Regular Papers, vol. 62, no. 6, pp. 1591-1598, June 2015
15. P. Maffezzoni, **Z. Zhang**, and L. Daniel, "A study of deterministic jitter in crystal oscillators," IEEE Trans. Circuits and Systems I: Regular Papers, vol. 61, no. 4, pp. 1044-1054, April 2014. **(TCAS-1 Popular Paper)**
16. **Z. Zhang**, N. Wong, "An efficient projector-based passivity test for descriptor systems," IEEE Trans. CAD of Integrated Circuits and Systems, vol. 29, no. 8, pp. 1023-1042, Aug. 2010.
17. **Z. Zhang**, N. Wong, "Passivity test of immittance descriptor systems based on generalized Hamiltonian methods, " IEEE Trans. Circuits and Systems II: Express Briefs, vol. 57, no. 1, pp. 61-65, Jan. 2010
18. X. Wang, **Z. Zhang**, Q. Wang and N. Wong, "Gramian-based model order reduction of parameterized time-delay systems," Intl. Journal of Circuit Theory and Applications, Dec. 2012
19. Y. Wang, **Z. Zhang**, C. Koh, G. Shi, G. Pang, N. Wong, "Passivity enforcement for descriptor systems via matrix pencil perturbation," IEEE Trans. CAD Integr. Circuits Syst., vol. 31, no. 4, pp. 532-545, April 2012.
20. **Z. Zhang** and N. Wong, "Passivity check of S-parameter descriptor systems via S-parameter generalized Hamiltonian methods," IEEE Trans. Advanced Packaging, vol. 33, no. 4, pp. 1034- 1042, Nov. 2010.
21. N. Wong and **Z. Zhang**, "Discussion of "A half-size singularity test matrix for fast and reliable passivity assessment of rational models"," IEEE Trans. Power Delivery, vol. 25, no. 2, pp. 1212-1213, Apr. 2011.

### ➤ Conference Papers

22. **Z. Zhang**, T.-W. Weng, L. Daniel, "A big-data approach to handle process variations: uncertainty quantification by tensor recovery," IEEE Conf. Signal & Power Integrity, pp. 1-4, May 2016 **(Best Conference Paper Award)**

23. **Z. Zhang**, I. Elfadel, L. Daniel, "Uncertainty quantification for integrated circuits: Stochastic spectral methods," in Proc. Int. Conf. Computer-Aided Design (ICCAD), pp. 803-810, Nov. 2013. (**Invited Paper**).
24. **Z. Zhang**, X. Yang, G. Marucci, P. Maffezzoni, I. Elfadel, G. Karniadakis, L. Daniel, "Stochastic testing simulator for integrated circuits and MEMS: Hierarchical and sparse techniques," in Proc. IEEE Custom Integrated Circuit Conference (CICC), pp. 1-8, Sept. 2014. (**Invited Paper, Best Paper Nomination**).
25. **Z. Zhang**, I. Elfadel, L. Daniel, "Model order reduction of fully parameterized systems by recursive least square optimization," in Proc. IEEE/ACM Int. Conf. Computer-Aided Design (ICCAD), pp. 523-530, Nov. 2011. (**Best Paper Nomination**).
26. **Z. Zhang**, Q. Wang, N. Wong, L. Daniel, "A moment-matching scheme for the passivity-preserving model order reduction of indefinite descriptor systems with possible polynomial parts," in Proc. IEEE/ACM Asia and South-Pacific Design Autom. Conf. (ASP-DAC), pp. 49-54, Jan. 2011. (**Best Paper Nomination**).
27. **Z. Zhang**, C.-U. Lei and N. Wong, "GHM: A generalized Hamiltonian method for passivity test of impedance/admittance descriptor systems," in Proc. IEEE/ACM Int. Conf. Computer Aided Design (ICCAD), pp. 767-773, San Jose, CA, Nov 2009.
28. **Z. Zhang** and N. Wong, "An extension of the generalized Hamiltonian method to S-parameter descriptor systems," IEEE/ACM Asia & South Pacific Design Autom. Conf. (ASP- DAC), pp. 43-47, Taipei, Jan 2010.
29. **Z. Zhang**, X. Hu, C.-K. Cheng, N. Wong, "A block-diagonal structured model reduction scheme for power grid networks," in Proc. IEEE Design, Autom. Test in Europe (DATE), pp. 44-49, France, Mar. 2011.
30. Y. Wang, **Z. Zhang**, C.-K. Koh, G. K. H. Pang and N. Wong, "PEDS: Passivity enforcement for descriptor systems via Hamiltonian-symplectic matrix pencil perturbation," in Proc. IEEE/ACM Int. Conf. Computer-Aided Design (ICCAD), pp. 800-807, San Jose, CA, Nov. 2010.
31. X. Wang, Q. Wang, **Z. Zhang**, Q. Chen and N. Wong, "Balanced truncation for time-delay systems via approximate gramians," in Proc. Asia & South Pacific Design Autom. Conf., pp. 56-60, Japan, Jan. 2011.
32. C. Y. Lin, **Z. Zhang**, N. Wong and H. K.-H. So, "Design Space Exploration for Sparse Matrix- Matrix Multiplication on FPGAs," in Proc. IEEE/ACM Int. Conf. Field Programmable Technology (FPT), pp. 369-372, Beijing, China, Dec. 2010.
33. M. Kamon, S. Maity, D. Dereus, **Z. Zhang**, S. Cunningham, S. Kim, J. McKillop, A. Morris, G. Lorenz and L. Daniel, "New simulation and experimental methodology for analyzing pull-in and release in MEMS switches," IEEE Int. Conf. Solid-State Sensors, Actuators and Microsystems, pp. 2373-2376, Barcelona, Spain, June 2013.
34. **Z. Zhang**, M. Kamon and L. Daniel, "Continuation-based pull-in and lift-off simulation for microelectromechanical system design," SRC TECHCON, 4 pages, Austin, TX, Sept. 2012.

## **INVITED TALKS AND LECTURES**

1. Z. Zhang, "Uncertainty-aware and data-driven engineering design verification: Nanoscale systems and multi-domain applications," Public Seminar, Politecnico di Milano, Milan, Italy, May 2017.
2. Z. Zhang, "Data-driven methods for variation-aware design automation of nano-scale chip design," KAUST, Saudi Arabia, April 2017.
3. Z. Zhang, "Uncertainty-aware and data-driven engineering design verification: Nanoscale systems and multi-domain applications," EE Seminar, City University of Hong Kong, Hong Kong, 30<sup>th</sup> March 2017.
4. Z. Zhang, "Uncertainty-aware and data-driven engineering design verification: Nanoscale systems and multi-domain applications," ECE Seminar, University of Rochester, New York, 22<sup>nd</sup> March 2017.
5. Z. Zhang, "Variation-aware and data-driven algorithms and tools for enabling reliable nanoscale design," EEE Seminar, Nanyang Technological University, Singapore, 15<sup>th</sup> March 2017.

6. Z. Zhang, "Uncertainty-aware and data-driven engineering design verification: Nanoscale systems and beyond," ECE Seminar, University of California, San Diego (UCSD), La Jolla, CA, 8<sup>th</sup> March 2017.
7. Z. Zhang, "Uncertainty-aware and data-driven engineering design verification: Nanoscale systems and beyond," ECE Seminar, University of California, Santa Barbara (UCSB), CA, 2<sup>nd</sup> March 2017.
8. Z. Zhang, "High-dimensional and stochastic methods for uncertainty-aware engineering design verification: nanoscale systems and beyond", ESE Seminar, University of Pennsylvania, 7<sup>th</sup> February 2017.
9. Z. Zhang, "Variation-aware and data-driven algorithms and tools for enabling reliable nanoscale design," EE Seminar, Swiss Federal Institute of Technology at Lausanne (EPFL), Switzerland, 3<sup>rd</sup> February 2017.
10. Z. Zhang, "High-dimensional and stochastic methods for data-intensive engineering design verification: algorithms and multi-domain applications," ECE Seminar, HKUST, Hong Kong, Jan. 2017.
11. Z. Zhang, "Numerical techniques for stochastic modeling of nanoelectronics and robotics," invited talk at Toyota Research Institute of Palo Alto, CA, July 2016.
12. Z. Zhang, "Variation-aware modeling and simulation for nano-scale devices and systems," invited talk at the IT-EE department, ETH Zurich, April 2016.
13. Z. Zhang, "Uncertainty quantification for data-intensive design: nanoelectronics and beyond," invited talk at the ECE department, Johns Hopkins University, March 2016.
14. Z. Zhang and L. Daniel, "Uncertainty quantification for electronic systems: state of the art and recent progress," tutorial talk at IEEE/ACM ASP-DAC 2016, Macau, Jan. 2016.
15. Z. Zhang, "High-dimensional uncertainty quantification for electronic and power systems: a tensor perspective," invited talk at the ICCAD Workshop on Variability Modeling and Characterization, Nov. 2015.
16. Z. Zhang, "Uncertainty quantification for nano-scale integrated circuits and MEMS design," invited talk at the Department of Mathematics, Worcester Polytechnic Institute, MA, April 2015.
17. Z. Zhang, "High-dimensional and hierarchical uncertainty quantification for nano-electronic systems," invited talk at SIAM Computational Science and Engineering Conf., Salt Lake City, Utah, March 2015.
18. Z. Zhang, "Fast SPICE-like non-Monte-Carlo simulation for ICs, MEMS and photonics," invited talk at Oracle Research Labs of San Francisco, CA, January 2015.
19. Z. Zhang and L. Daniel, "State-of-the-art uncertainty quantification techniques for VLSI parasitic extraction and simulation of MEMS and ICs," invited talk at IEEE Custom Integrated Circuit Conference, Sept. 2014.
20. Z. Zhang, "Numerical simulation of process variations for MEMS design," invited talk at the Paris R&D Center of Coventor, France, July 2014.
21. Z. Zhang, "Introduction to uncertainty quantification," invited Ph. D lecture at Politecnico di Milano, and invited talk to the Chinese Student and Scholar Association, Milan, Italy, June 2014.
22. Z. Zhang and L. Daniel, "Stochastic spectral methods for SPICE-level simulation," invited talk at the special session of IEEE/ACM ICCAD, November 2013.
23. Z. Zhang, "Uncertainty quantification for integrated circuits: stochastic spectral methods," invited talk at the Applied Math Division, Brown University, Providence, RI, July 2013.