Yanlin Guo

Personal Data:

Gender:	Female
Date of Birth:	Feb. 3, 1985
Nationality:	Chinese
Place of Birth:	Lanzhou, Gansu Province, P.R. China
Address:	Department of Civil & Environmental Engineering & Earth Sciences 156 Fitzpatrick Hall University of Notre Dame Notre Dame, Indiana 46556
Phone：	(574)-485-8186
E-mail:	yguo1@nd.edu

Research Interests:

Structural health monitoring (SHM) based resilient infrastructure system, system identification, structural dynamics, signal processing, decision making, big data analytics and data-driven wind simulation

Education Background:

08/10-07/15 Ph.D. in Structural Engineering
University of Notre Dame, Notre Dame, Indiana, USA
Advisor: Dr. Ahsan Kareem

11/07-07/10 M.Phil. in Civil Engineering
Hong Kong Polytechnic University, Hong Kong
Advisor: Dr. Yi-Qing Ni

08/03-06/07 B.Eng. in Transportation Engineering
Southeast University, Nanjing, China

Research Experience:

08/16-now Research Scientist
Colorado State University
- Research on resilience of buildings subjected to natural hazards
- Develop stochastic wind simulation techniques

08/15-08/16 Postdoctoral Research Associate
University of Notre Dame, Notre Dame, Indiana, USA
- Studied the feasibility and benefits of ultra-tall concrete wind turbine towers
- Developed a proposal for an external funding agency

08/10-07/15 Research Assistant
University of Notre Dame, Notre Dame, Indiana, USA
- Developed a non-stationary system identification (SI) technique using

time-frequency blind source separation to handle colored excitation
- Developed a non-stationary SI technique using wavelet transform, transformed singular value decomposition, and Laplace wavelet to handle transient data
- Developed a non-stationary SI framework using time-varying spectra of wavelet transform or short time Fourier transform to track time-varying system properties
- Developed a real-time hybrid framework for performance assessment of tall buildings under both normal and transient loading conditions
- Applied the developed real-time hybrid framework to the world's tallest building-Burj Khalifa through a web-enabled approach

11/07-07/10 Research Assistant
Hong Kong Polytechnic University, Hong Kong
- Developed sensor placement optimization methods for bridge damage detection
- Developed Hilbert-Huang transform based procedures for ship-bridge collision accident alarming and condition/damage assessment of the collided bridges

01/08-02/08 Research Assistant
PolyU Technology and Consultancy Co. Ltd., Hong Kong
- Cooperated in an independent structural appraisal of a cable-stayed bridge in Vietnam

09/05-09/06 Undergraduate Researcher
Southeast University, Nanjing, China
- Team leader, wrote a successful proposal to get funding from Student Research Training Project
- Studied how to effectively use time-space resources at crossings of urban roads

Academic Activities:

➢ **Collaborations in research projects**:

1. Study of natural frequency coalescing and amplitude dependent damping (2012-2013, in collaboration with Dr. S.M.J. Spence and Dr. E. Bernardini at The University of Notre Dame)
   - Conducted wavelet analysis to analyze natural frequency coalescing phenomena
   - Co-authored a paper published in *Probabilistic Engineering Mechanics*
2. Chicago full-scale monitoring project (CFSMP) (2012-2013, in collaboration with Dr. T. Kijewski-Correa at The University of Notre Dame)
   - Conducted a comparison study of the measured structural response and wind tunnel prediction
   - Identified structural properties from transient data measured under wind storms
   - Co-authored (*leading student author*) a paper published in *International Journal of High-Rise Buildings*
3. Development of a real-time structural health monitoring and identification system-"Smartsync" for Burj Khalifa (2010-2013, in collaboration with Dr. T. Kijewski-Correa and Dr. D.-K. Kwon at The University of Notre Dame)
   - Developed a clustering scheme to automate the spectra based system identification process
   - Co-authored a paper published in *Journal of Structural Engineering*

4. Evaluation of structural performance of the Guangzhou New TV Tower under winds using structural health monitoring data (2010-2012, in collaboration with Dr. Y.Q. Ni from The Hong Kong Polytechnic University)
   - Analyzed wind properties, and conducted a comparison study of the measured structural response and wind tunnel prediction
   - Identified structural properties using various classical methods and conducted serviceability assessment
   - Co-authored (*1st author*) a paper published in *Journal of Wind Engineering and Industrial Aerodynamics*

➢ **Journal paper reviewer**:
   - *Journal of Structural Engineering (ASCE)*
   - *Journal of Sound and Vibration*
   - *Mechanical Systems and Signal Processing*
   - *Advances in Structural Engineering*

Honors, Awards and Fellowships:

- ND Energy Postdoctoral Fellowship, Center for Sustainable Energy at Notre Dame, 08/2015-08/2016
- Finalist of Dynamics Committee Student Paper Competition, ASCE EMI Conference, 2014
- GSU Conference Presentation Grant, University of Notre Dame, 2014 and 2013
- Finalist of Structural Health Monitoring & Control Committee Student Paper Competition, ASCE EMI Conference, 2013
- Professional Development Award, University of Notre Dame, 2011 and 2013
- Honor of “Excellent College Graduate”, Southeast University, 2007
- Prize for Outstanding Student Research Project, Southeast University, 2006
- Honor of “Advanced Student”, Southeast University, 2005
- Honor of “Three Good Student”, Southeast University, 2004

Professional Memberships:

- American Society of Civil Engineers
- American Association for Wind Engineering
- Earthquake Engineering Research Institute

Teaching Experience:

08/10-12/12 Teaching Assistant
University of Notre Dame, Notre Dame, Indiana, USA

➢ **Courses:**
- CE 40250, Analysis of Wobbly Structures
- CE 40620, Transportation Engineering
- CE 40290/60290, Design of Structures to Resist Natural Hazards
- CE 40240/60240, Structural Systems

➢ **Duties**

- Homework/exam grading, office hours, website updating
- Designed homework problems
- Mentored students on course projects

11/07-12/09 Teaching Assistant
Hong Kong Polytechnic University, Hong Kong

- Homework/exam grading
- Mentored students on research and final year projects

Journal Publications:

1. Guo, Y., and Kareem, A. (2016), "Non-stationary frequency domain system identification using time–frequency representations", *Mechanical Systems and Signal Processing*, 72-73, 712-726.
2. Guo, Y., and Kareem, A. (2016), "System identification through nonstationary data using Time–Frequency Blind Source Separation", *Journal of Sound and Vibration* , 371, 110-131.
3. Guo, Y., and Kareem, A. (2015), "Near-real-time hybrid system identification framework for civil structures with application to Burj Khalifa", *Journal of Structural Engineering*, 04015132.
4. Guo, Y., and Kareem, A. (2015), "System identification through nonstationary response: a wavelet and transformed singular value decomposition based approach", *Journal of Engineering Mechanics*, 141, 04015013.
5. Spence, S.M.J., Bernardini, E., Guo, Y., Kareem, A., and Gioffrè, M. (2013), "Natural frequency coalescing and amplitude dependent damping in the wind-excited response of tall buildings", *Probabilistic Engineering Mechanics*, 35, 108-117.
6. Kijewski-Correa, T., Kareem, A., Guo, Y., Bashor, R., and Weigand, T. (2013), "Performance of tall buildings in urban zones: lessons learned from a decade of full-scale monitoring", *International Journal of High-Rise Buildings*, 2, 179-192.
7. Kijewski-Correa, T., Kwon, D.K., Kareem, A., Bentz, A., Guo, Y., Bobby, S., and Abdelrazaq, A. (2013), "Smartsync: an integrated real-time structural health monitoring and structural identification system for tall buildings", *Journal of Structural Engineering*, 139, 1675-1687.
8. Guo, Y., Kareem, A., Ni, Y.Q., and Liao, W.Y. (2012), "Performance evaluation of Canton Tower under winds based on full-scale data", *Journal of Wind Engineering and Industrial Aerodynamics*, 104-106, 116-128.

***Under preparation**:*

9. Guo, Y., Wang, L., and Kareem, A., "Conditional simulation of non-stationary gust-front wind field", *Journal of Wind Engineering and Industrial Aerodynamics* (To be submitted in May 2016).

Conference Papers and Presentations:

1. Kareem, A., Guo, Y., Hu, L., and Kwon, D. K. (2016). "A transition from time or frequency domain to time-frequency domain for estimating non-synoptic wind load effects", *Proceedings of the 14th International Symposium on Structural Engineering*, Oct. 12-15, 2016, Beijing, China.
2. Guo, Y., Fang, Y., Ding, F., Kurama, Y., and Kareem, A. (2016). "Aerodynamic shape

tailoring of ultra-tall wind turbine towers", *Proceedings of the 8th International Colloquium on Bluff Body Aerodynamics and Applications*, June 7-11, 2016, Boston, USA.

3. Kareem, A., Guo, Y., and Hu, L. (2016). "Time-frequency domain modeling framework for non-stationary aerodynamic load effects", *Proceedings of the 8th International Colloquium on Bluff Body Aerodynamics and Applications*, June 7-11, 2016, Boston, USA.
4. Guo, Y., Kwon, D. K., and Kareem, A. (2015). "Real-time structural health monitoring under stationary and transient winds", *Proceedings of the 14th International Conference on Wind Engineering*, June 21-26, 2015, Porto Alegre, Brazil.
5. Gibbs, M., Guo, Y., and Kareem, A. (2015). "Performance evaluation of wind-sensitive footbridges", *Proceedings of the 14th International Conference on Wind Engineering*, June 21-26, 2015, Porto Alegre, Brazil.
6. Guo, Y., and Kareem, A. (2014), "Non-stationary system identification based on instantaneous or marginal spectra of time-frequency transforms", *Conference of the ASCE Engineering Mechanics Institute*, Hamilton, ON, Canada, August 5-8, 2014 (presentation).
7. Guo, Y., and Kareem, A. (2013a), "System identification from non-stationary data: blind source separation and time-frequency approaches", *Proceedings of the 11th International Conference on Structural Safety & Reliability*, New York, NY, USA, June 16-20, 2013.
8. Guo, Y. , and Kareem, A. (2013b), "System identification of nonstationary data: a wavelet and transformed singular value decomposition based approach", *Conference of the ASCE Engineering Mechanics Institute*, Evanston, IL, USA, August 4-7, 2013 (presentation).
9. Guo, Y., and Kareem, A. (2012), "System identification using nonstationary data", *Joint Conference of the Engineering Mechanics Institute and the 11th ASCE Joint Specialty Conference on Probabilistic Mechanics and Structural Reliability*, Notre Dame, IN, USA, June 18-20, 2012 (presentation).
10. Guo, Y., Ni, Y.Q., and Kareem, A. (2011), "Performance evaluation of the Guangzhou New TV Tower under winds based on full-scale monitoring data", *Proceedings of the 13th International Conference on Wind Engineering*, July 10-15, 2011, Amsterdam, The Netherlands.
11. Zhou, H.F., Ni, Y.Q., Guo, Y., and Ko, J.M. (2010), "Performance assessment of Jiangyin Bridge using long-term structural health monitoring data", *Bridge Maintenance, Safety, Management and Life-Cycle Optimization*, D.M. Frangopol, R. Sause, and C.S. Kusko (eds.), Taylor & Francis, London, UK, 2962-2971 (CD-ROM) (*Proceedings of the 5th International Conference on Bridge Maintenance, Safety and Management*, July 11-15, 2010, Philadelphia, Pennsylvanian, USA).
12. Guo, Y., Ni, Y.Q., and Chen, S.K. (2009), "Sensor placement optimization for damage evaluation of bridges subject to ship collision", *Proceedings of the International Postgraduate Conference on Infrastructure and Environment*, June 5-6, 2009, Hong Kong.
13. Guo, Y., Ni, Y.Q., Zhou, H.F., and Chen, S.K. (2009), "Condition assessment of post-ship-collision bridges using HHT analysis", *Proceedings of the 5th International Workshop on Advanced Smart Materials and Smart Structures Technology*, M.L. Wang,

B.F. Spencer, Jr., and Y. Cao (eds.), Techno-Press, Daejeon, Korea, 57-64 (July 29-31, 2009, Boston, *Massachusetts*, USA).

14. Guo, Y., Ni, Y.Q., and Ko, J.M. (2009), "Optimal sensor placement on cables of cable-stayed bridges for structural damage detection", *Structural Health Monitoring 2009: From System Integration to Autonomous Systems*, F.-K. Chang (ed.), DEStech Publications, Lancaster, Pennsylvania, USA, 2131-2138 (*Proceedings of the 7th International Workshop on Structural Health Monitoring*, September 9-11, 2009, Stanford, California, USA).
15. Guo, Y., Ni, Y.Q., Chen, S.K., and Zhou, H.F. (2009), "Optimal sensor layout for bridges subject to ship collision", *Proceedings of the 33rd IABSE Symposium on Sustainable Infrastructure: Environment Friendly, Safe and Resource Efficient*, September 9-11, 2009, Bangkok, Thailand.

Ongoing Projects of Postdoctoral Research:

Feasibility and benefits of ultra-tall wind turbine towers (2015-2016)
Bigger turbines with blades over 60 meters and availability of more wind energy at higher elevations are leading efforts to develop taller turbine supporting towers. Current state of the art is around 80 meters and moving to higher heights will face serious structural issues surrounding excessive vibration and fatigue effects which may lead to operational constraints and ultimate failure of turbine towers. This project proposes to explore new technologies for towers up to 150 meter tall. Currently, I am researching the feasibility and benefits of ultra-tall wind turbine towers, with final goal of developing a proposal for an external funding agency.

Conditional simulation of non-stationary wind fields (2015-2016)
The direct measurement of wind fields is often restrained by the number of available sensors, difficulty of sensor deployment at inaccessible locations, or partial failure of sensing network. The missing information at unmeasured locations can be recovered through the conditional simulation based on the measured data. This study proposes to use the Kriging method to conditionally simulate the non-stationary wind speeds of a gust-front wind field at arbitrary locations using the limited measurements.

Major Research Accomplishments during Ph.D.:

Identification of time-varying systems using spectra of time-frequency analysis (2014-2015)
Full-scale monitoring has witnessed that structural dynamic properties may change over time due to temperature, aging or extreme loadings. Spectra of wavelet or short time Fourier transform are very popular in tracking time-varying frequencies; however, they have seldom been used to identify the time-varying damping ratio, because a short window required to capture time-varying information amplifies the bandwidth significantly, which may lead to considerably overestimated damping ratios. To solve this problem, this study innovatively adapted theoretical frequency response functions (FRF) of systems for instantaneous or marginal spectra of the wavelet or short time Fourier transform by adding short window effects explicitly. In this way, the response spectra estimated within the short time windows and the adapted FRFs are influenced by the same window, thus the adapted FRFs can be fitted to instantaneous or time-localized marginal spectra of response to identify frequency and damping ratio at each time instant. This method is a breakthrough that allows spectra based system identification (SI) methods to reliably identify damping of time-varying systems under non-stationary excitations.

Real-time performance assessment of tall buildings (2013-2014)
This study proposed a near real-time framework for SI of structures using streaming data from SHM systems. To account for both stationary/weakly non-stationary response under normal conditions (e.g., extra-tropical winds and/or ambient excitations) and transient/highly non-stationary response under transient events (e.g. earthquakes, windstorms or time-varying traffic loadings), a hybrid framework was developed by integrating a new non-stationary SI scheme based on wavelets in tandem with transformed singular value decomposition, and a robust stationary SI scheme called covariance-driven stochastic subspace identification. To enable expeditious and convenient utilization of this framework in the world's tallest building, Burj Khalifa, a web-enabled approach was proposed to facilitate automated hybrid SI in near real-time as an "Internet of Things" (IoT). It is anticipated that the proposed framework in the context of the IoT has the potential of being well-suited for SHM systems to meet the demand of quick near real-time structural performance assessment involving minimal human intervention.

Non-stationary SI based on wavelets and transformed singular value decomposition (2012-2014)
Traditional SI methods may not be reliable (especially for damping estimation) from transient response measured under earthquakes, windstorms, or time-varying traffic loadings, due to a lack of long segments of stationary data. In this project, a new nonstationary SI scheme based on continuous Morlet wavelet transform, transformed singular value decomposition and Laplace wavelet filtering (WT-TSVD-Laplace) was proposed. Thanks to the automatic identification of the analysis regions by the TSVD, this scheme can be readily used to conduct the online nonstationary SI from a set of streaming signals, which can be extremely advantageous for a quick structural condition assessment under extreme events. In addition, Laplace wavelet filtering in this scheme extracts impulse type signals from the WT coefficients in the identified analysis regions, therefore enabling a reliable damping estimation from transient nonstationary data. This scheme proves to have significant leverage for highly non-stationary response induced by transient excitations.

Non-stationary SI based on time-frequency blind source separation (2012-2013)
The spectra of strong winds and earthquakes could not be sufficiently white near the structural natural frequencies, rendering most of the existing modal identification methods with the assumption of stationary white noise excitation problematic. To handle the challenge, a new SI technique based on time-frequency blind source separation was proposed. By selectively utilizing the information in local regions of time-frequency domain, where only one mode has energy contribution, the proposed technique can successfully identify mode shapes and separate modal responses from non-stationary response under colored excitations. This technique can also handle response with closely spaced modes. In addition to the exclusive advantage in dealing with non-stationary data, the proposed technique also benefits from low sensitivity to noise and the absence of end effects in modal separation, which might be an advantage over conventional wavelet and empirical mode decomposition based SI methods when data length is extremely limited.

Performance evaluation of Canton Tower under winds based on full-scale data (2011-2012)
Canton Tower is a 610 m tall tower, located at the edge of the most active typhoon prone area in the world. Therefore, the wind effects are critical to the satisfactory performance of the tower. A sophisticated long-term SHM system consisting of about 700 sensors has been implemented by The Hong Kong Polytechnic University. In this study, wind characteristics (wind speed, direction, and turbulence intensity) and structural responses (strain, acceleration, and displacement

responses) during several typhoon events were analyzed. Full-scale response and wind tunnel predictions were compared. Different techniques were employed to identify the modal properties and sources of identification errors were analyzed. In addition, the amplitude-dependence in modal properties was investigated. Finally, the tower serviceability during different typhoon events was evaluated and the performance was found to be satisfactory from human comfort consideration.