Yanlin Guo

Personal Data:

Gender:	Female
Address:	Department of Civil and Environmental Engineering Colorado State University 1372 Campus Delivery Fort Collins, Colorado 80523-1372
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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:

08/10-08/15 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:

08/18-now Assistant Professor
Colorado State University, Fort Collins, CO, USA
- Develop advanced tools for modeling/simulation of extreme winds
- Develop data analysis tools for structural health monitoring and unmanned aerial vehicles (UAVs)-based remote sensing
- Analyze community resilience under natural hazards

08/16-08/18 Research Scientist
Colorado State University, Fort Collins, CO, USA
- Research on resilience of buildings subjected to natural hazards
- Develop stochastic wind simulation techniques
- Develop physical models for tall building envelope damage under hurricanes
- Develop an efficient and cost-effective bridge inspection system using unmanned aerial vehicles (UAVs)

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

Honors, Awards and Fellowships:

- Peer-reviewed paper titled "Generalized wind loading chain: time-frequency modeling framework for nonstationary wind effect on structures", 2019 Best Journal Paper in the Structural Hazards category, Journal of Structural Engineering, 2020
- Peer-reviewed paper titled "Non-stationary frequency domain system identification using time–frequency representations" published in Mechanical Systems and Signal Processing was honorably mentioned as one of the three annual best journal papers by the Best Journal Paper Award Committee of American Association for Wind Engineering (AAWE), 2017
- 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

Journal Publications:

1. Adhikari, P., Abdelhafez, M, Dong, Y., Guo, Y., Mahmoud, H.N., and Ellingwood, B.R. "Achieving residential coastal communities resilient to tropical cyclones and climate change", *Frontiers in Built Environment*, (accepted in December 2020).
2. Wang, C., Zhang, H., Ellingwood, B.R., Guo, Y., Mahmoud, H., and Li. Q. (2020), "Assessing post-hazard damage costs to a community's residential buildings exposed to tropical cyclones", *Structure and Infrastructure Engineering*, 1845215, 1-11.
3. Perry, B., Guo, Y., Atadero, R., and van de Lindt, J.W. (2020), "A streamlined bridge inspection system using unmanned aerial vehicles (UAVs) and machine learning techniques", *Measurement*, 164, 108048.
4. Guo, Y., Wang, L., and Kareem, A. (2020). "Interpolation of discrete time histories", *Journal of Engineering Mechanics*, 146, 06020002.
5. Sabharwal, C. L., and Guo, Y. (2019). "Tracking the 6-DOF flight trajectory of windborne debris using stereophotogrammetry", *Infrastructures*, 4, 66.
6. Guo, Y., and van de Lindt, J.W. (2019), "Simulation of hurricane wind fields for community resilience applications: a data-driven approach using integrated asymmetric Holland models for inner and outer core regions", *Journal of Structural Engineering*, 145, 04019089.
7. Kareem, A., Hu, L., Guo, Y., and Kwon, D.K. (2019), "Generalized wind loading chain: time-frequency modeling framework for nonstationary wind effects on structures", *Journal of Structural Engineering*, 145, 04019092.
8. Guo, Y.L., Ni, Y.Q., and Chen, S.K. (2017), "Optimal sensor placement for damage detection of bridges subject to ship collision", *Structural Control and Health Monitoring*, 24, 1-16.
9. 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.
10. 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.
11. Guo, Y., and Kareem, A. (2016), "Near-real-time hybrid system identification framework for civil structures with application to Burj Khalifa", *Journal of Structural Engineering*, 142, 04015132.
12. 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.
13. Spence, S.M.J., Bernardini, E., Guo, Y., Kareem, A., and Gioffrè, M. (2014), "Natural frequency coalescing and amplitude dependent damping in the wind-excited response of tall buildings", *Probabilistic Engineering Mechanics*, 35, 108-117.

14. 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.
15. 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.
16. 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 review**:*

17. Perry, B.J., and Guo, Y. "Three-Dimensional Displacement Measurement Using an Unmanned Aerial Vehicle (UAV) and Computer Vision Techniques", *Measurement*, (submitted in July 2020).

***Under preparation**:*

18. Adhikari, P., Abdelhafez, M., Dong, Y., Guo, Y., Mahmoud, H.N., and Ellingwood, B.R. (2020) "Achieving residential coastal communities resilient to tropical cyclones and climate change", Frontiers in Built Environment, (To be submitted in April 2020).
19. Dong, Y., and Guo, Y., "Identification of non-stationary systems under non-white excitations", *Journal of Engineering Mechanics*, (To be submitted in May 2020).
20. Dong, Y., Guo, Y., and van de Lindt, J.W., "Fragility model of tall buildings due to wind-born debris under hurricanes", *Engineering Structures*, (To be submitted in May 2020).
21. Farokhnia, K., Guo, Y., Masoomi, H., and van de Lindt, J.W., "Community infrastructures and building clusters recovery model for hurricane hazard", *Engineering Structures*, (To be submitted in May 2020).

Conference Papers and Presentations:

1. Perry, B., Guo, Y., Atadero, R., and van de Lindt, J.W. (2020). "Tracking changing bridge condition over time using recurrent unmanned aerial vehicle (UAV)-based inspection", *The 10th International Conference on Bridge Maintenance, Safety and Management*, June 28-July 2, 2020, Sapporo, Japan.
2. Perry, B., and Guo, Y. (2020). "A framework for the simultaneous monitoring of moving traffic and corresponding traffic induced bridge displacement using unmanned aerial vehicles (UAVs)", *The 10th International Conference on Bridge Maintenance, Safety and Management*, June 28-July 2, 2020, Sapporo, Japan.
3. Perry, B., Guo, Y., Atadero, R., and van de Lindt, J.W. (2020). "Unmanned aerial vehicle (UAV)-enabled bridge inspection framework", *The 10th International Conference on Bridge Maintenance, Safety and Management*, June 28-July 2, 2020, Sapporo, Japan.
4. Adhikari, P., Abdelhafez, M., Dong, Y., Guo, Y., Mahmoud, H.N., and Ellingwood, B.R. (2020). "Achieving residential coastal communities resilient to tropical storm", *Engineering Mechanics Institute Conference 2020 and Probabilistic Mechanics & Reliability Conference 2020*, May 26-29, 2020, New York, USA.
5. Dong, Y., Guo, Y., and van de Lindt, J.W. (2020). "Fragility model of tall buildings due to windborne debris under hurricanes", *Engineering Mechanics Institute Conference 2020 and*

Probabilistic Mechanics & Reliability Conference 2020, May 26-29, 2020, New York, USA.

6. Guo, Y., and van de Lindt, J.W. (2019). "Data-driven simulation of hurricane wind field", *The 15th International Conference on Wind Engineering*, September 1-6, 2019, Beijing, China.
7. Perry, B., and Guo, Y. (2019). "Unmanned aerial vehicle (UAV) enabled building information modeling for bridge inspection", *The 9th international conference on structural health monitoring of intelligent infrastructure*, August 4-7, 2019, St. Louis, Missouri, USA.
8. Dong, Y., and Guo, Y. (2019). "System identification for time-varying systems under non-white excitations", *The 13th International Conference on Applications of Statistics and Probability in Civil Engineering*, ICASP13, May 26-30, 2019, Seoul, South Korea.
9. Dong, Y., and Guo, Y. (2019). "A time-frequency domain approach for identification of non-stationary systems under non-white wind excitations", *Engineering Mechanics Institute Conference 2019*, June 18-21, 2019, Pasadena, CA, USA.
10. Perry, B., and Guo, Y. (2019). "A streamlined bridge inspection system utilizing unmanned aerial vehicles (UAVs)", *The Transportation Research Board* (*TRB*) 98th *Annual Meeting*, January 13-17, 2019, Washington, D.C., USA (presentation).
11. Guo, Y., and van de Lindt, J.W. (2017). "Data-driven simulation of hurricane wind field based on an asymmetric Holland model", *The National Institute of Standards and Technology Center of Excellence Semi-Annual Meeting*, November 2-3, 2017, Gaithersburg, MD, USA (presentation).
12. Guo, Y., and van de Lindt, J.W. (2017). "Fragility model for hurricane-induced damage to tall building clusters with application to urban resilience analysis", *The 13th Americas Conference on Wind Engineering*, May 21 - 24, 2017, Gainesville, Florida, USA (presentation).
13. Kareem, A., Guo, Y., and Hu, L. (2017). "Generalized wind loading chain: a time-frequency perspective", *The 13th Americas Conference on Wind Engineering*, May 21 - 24, 2017, Gainesville, Florida, USA (presentation).
14. 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.
15. 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.
16. 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.
17. 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.
18. 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.
19. 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).

20. 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.
21. 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).
22. 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).
23. 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.
24. 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).
25. 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.
26. 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).
27. 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).
28. 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.

Invited Lectures:

1. Guo, Y. (2020), "Unlock the power of the unmanned aerial system (UAS)-based infrastructure inspection by artificial intelligence (AI)", *FHWA EDC-5 UAS Webinar #5: Advancing UAS for Structural Inspections*, November 5, 2020.

https://www.fhwa.dot.gov/uas/webinars.cfm

Technical Reports:

2. Roueche, D., Cleary, J., Barnes, R., Davis, B., Marshall, J., Rittelmeyer, B., Smallegan, S., Guo, Y., Hodges, C., Kijewski-Correa, T., Salman, A., Turner, K., Merschman, E., mulchandani, H., Prevatt, D., Robertson, I., Mosalam, K. (2019), "3 March 2019 Tornadoes In The Southeastern US: Field Assessment Team Early Access Reconnaissance Report (EARR)", DesignSafe-CI, pp. 1-52.

Grants:

Externally-funded projects as PI or CoPI:

- (2020-2022) "Investigating the Applicability of Multi-Fidelity Modeling to Condition Evaluation of Transportation Infrastructure", Atadero, R. A. (PI), Guo, Y. (CoPI), North Dakota State University, $60,000.00.
- (2018-2022) "Development of an Autonomous Transportation Infrastructure Inspection System Based on Unmanned Aerial Vehicles (UAV)", Guo, Y. (PI), van de Lindt, J. W. (CoPI), Atadero, R. A. (CoPI), North Dakota State University, $58,000.00.
- (2017-2022) "Development of Unmanned Aerial Vehicle (UAV) Bridge Inspection Procedures", Guo, Y. (PI), van de Lindt, J. W. (CoPI), Atadero, R. A. (CoPI), North Dakota State University, $57,000.00.

Externally-funded projects as investigator or role other than PI or CoPI:

- (2020-2025) "Center of Excellence for Risk-Based Community Resilience Planning", van de Lindt, J. W. (Co-Director), Ellingwood, B. R. (Co-Director), Guo, Y. (Investigator), et. al, National Institute of Standards and Technology, $20,000,000.00.

Externally-funded pending pojects as PI or CoPI:

- (2019) "Transformative Tropical Storm Risk Mitigation of High-rise Building Clusters in Coastal Cities through Understanding Urban Aerodynamics Mechanism", Ni, Y.Q. (PC), Chan, S.L. (CoPI), Li, Q.S. (CoPI), Chen, X. (CoPI), Kareem, A. (CoPI), Nomura, T. (CoPI), Duan, H.F. (CoPI), Guo, Y. (CoPI), Lu, M. (CoPI), Liu, C.H. (CoPI), Jia, G. (CoPI), The Research Grants Council (RGC) of Hong Kong, HK$58,703,000.00 (preliminary proposal, shortlisted by RGC).
- (2019) "Problem Statement: Next Generation Data Analysis Techniques to Support Project Planning in Transportation Asset Management", Guo, Y. (PI), Atadero, R. A. (CoPI), Colorado Department of Transportation, $100,000.00.

Collaborative Research Projects:

1. Physics-based modeling of windborne debris damage to urban building envelopes through integrated experimental and computational approaches (2017, in collaboration with Dr. S. Venayagamoorthy and Dr. J. W. van de Lindt at The Colorado State University, and Dr. K. Gurley at The University of Florida)
   - Developed an NSF proposal (pending)
2. Development of unmanned aerial vehicle (UAV) bridge inspection procedures (2017-2019, in collaboration with Dr. R. Atadero and Dr. J. W. van de Lindt at The Colorado State University)

- Developed a successfully funded MPC proposal
- Developing UAV-based data collection and computer-vision based data processing techniques

3. 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*
4. 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*
5. 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*
6. 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*

Ongoing Projects of Current Research:

Development of an efficient and cost-effective bridge inspection system using unmanned aerial vehicles (UAVs) (2017-2019)

Maintenance of deteriorating bridges is a pressing need throughout the U.S.. In the maintenance process, condition evaluation of this sector of the infrastructure is critical, as it informs repair decisions, load-rating and management of limited state resources. Throughout the Mountain-Plains region, the condition of nearly 25,000 bridges must be evaluated by state DOTs regularly. The cost of bridge inspection forms the basis of much of the bridge management budget for state DOTs (e.g. it varies from about $4.5 to $10 million annually for CDOT). Considering the need for frequent inspection of a large number of bridges in the state and the significant expense, this project proposed to develop an efficient and cost-effective bridge inspection system based on UAVs. The feasibility of UAV based data acquisition and damage identification/condition assessment for decision-making support will be investigated. A guideline for integrating the developed technology in current bridge inspection practice will be proposed.

Data-driven simulation of hurricane wind field (2017)

For accurate modeling of the cumulated damage of hurricane events to physical structures in

community resilience analysis, the temporally and spatially varying wind field of a hurricane event needs to be estimated. However, wind field measurements from past events may not include the wind field data for every hour/minute, which are needed for carrying out time-dependent analysis. Also, for certain analyses (e.g., synthetic scenario analysis in resilience planning) the hurricane wind field needs to be simulated to model the damage to an arbitrary community of interest. In response to this need, this project proposes a novel data-driven simulation technique to simulate the temporally and spatially varying hurricane wind fields for hindcast and synthetic scenario analysis purpose. Due to its data-driven nature, the proposed technique can simulate realistic hurricane wind fields based on the observations of historical hurricane events. This technique is based on an asymmetric Holland model and has addressed two shortcomings of the existing Holland-type modes, i.e. the poor representation of wind field for inner core region and inability to model surface wind speed change due to roughness change from water to land. The developed models will be integrated into IN-CORE (a research web portal being developed by NIST center of excellence in resilience planning) as the hurricane wind simulation module.

Fragility model for hurricane-induced damage to tall building clusters with application to urban resilience analysis (2016-2017)

The primary damage to tall buildings after hurricanes is mainly comprised of the non-structural damage to the cladding systems and façade, as well as the water intrusion through the building envelope resulting from that damage. The existing damage assessment models for mid/high-rise buildings often neglect the geometry of building clusters or simply assume a homogeneous configuration for simplification purposes. These simplified approaches likely introduce significant uncertainties for urban tall buildings whose geometries and distributions often vary. In this context, this project is to develop a new fragility model for hurricane-induced damage to tall buildings, which explicitly considers both the individual building geometries and complex surrounding environment of urban areas, so that the uncertainties associated with geometries of individual buildings and building clusters can be propagated through the community or urban model to better provide risk-informed decision support.

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 proposed to explore new technologies for towers up to 150 meter tall. The feasibility and benefits of ultra-tall wind turbine towers was investigated.

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 proposed 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.

Teaching Experiences:

Courses taught at Colorado State University:

Semester/Year	Course No./Title	Cr. Hrs.	Enrollment	Overall Rating
Spring 2017	CIVE 367 – Structural Analysis	3	30	4.35/5.00
Spring 2018	CIVE 367 – Structural Analysis	3	34	4.69/5.00
Fall 2019	CIVE 504 – Wind Engineering	3	13	N/A
Spring 2019	CIVE 367 – Structural Analysis	3	25	

Other teaching experiences:

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

Graduate Student Advising:

Current graduate advisees:

Name	Degree	Thesis Title	Expected Graduation Year
Brandon Perry	MS (Thesis)	A novel infrastructure inspection	2019

		technique based on unmanned aerial vehicles (UAVs)	
Yue Dong	PhD	N/A	2022
Brandon Perry	PhD	N/A	2023

Professional Affiliations and Activities:

***Memberships in professional societies**:*

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

***Journal paper reviewer**:*

- Journal of Structural Engineering (ASCE)
- Journal of Sound and Vibration
- Mechanical Systems and Signal Processing
- Advances in Structural Engineering
- Journal of Nondestructive Evaluation
- Structural Safety
- International Journal of Structural Stability and Dynamics
- Wind and Structures
- Measurement

***Grant reviewer**:*

- National Science Foundation

Editorial Board:

- Review Editor for Frontiers in Built Environment
- Guest Editor for Journal of Civil Structural Health Monitoring