Bowei Li, Ph.D.

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RESEARCH INTERESTS

- Metamodeling
- Performance-based engineering
- Multi-hazard risk assessment, early warning, and mitigation
- Structural control and optimization-based design
- Scientific machine learning
- Reliability analysis
- Intelligent life-cycle maintenance
- AI-aided Design

EDUCATION

University of Michigan, Ann Arbor (UMich) Ann Arbor, USA
Ph.D. in Civil Engineering, Scientific Computing Sep 2018 – Apr 2022
- Thesis: Rapid Stochastic Response Estimation for Dynamic Nonlinear Structures: Innovative Frameworks and Applications.

University of Michigan, Ann Arbor Ann Arbor, USA
Master in Electrical & Computer Engineering Sep 2021 – Apr 2022
- Coursework: Probability and random process; Machine learning; Linear system theory; Reinforcement learning theory; Computer vision; Modern Bayesian Data Science.

Tongji University Shanghai, China
Master in Civil Engineering Sep 2015 – Jun 2018
- Thesis: Optimization-based design and experimental validation for stochastic multiple TMD systems.

Huazhong University of Science and Technology (HUST) Wuhan, China
B.E. in Civil Engineering Sep 2011 – Jun 2015
- Thesis: Design and Performance-based Seismic Assessment for A Multi-story RC Building.

PROFESSIONAL APPOINTMENTS

Texas Tech University
- Assistant Professor, Dept. of Civil, Environmental, and Construction Engineering, Aug 2024 – Present

University of Michigan, Ann Arbor
- Postdoc Research Fellow, Dept. of Civil and Environmental Engineering, May 2022 – Jul 2024
- Graduate Student Instructor, Dept. of Civil and Environmental Engineering, Sep 2021 – Dec 2021
- Research Assistant, Dept. of Civil and Environmental Engineering, May 2019 – Apr 2022

Tongji University
- Research Assistant, Shanghai Institute of Disaster Prevention & Relief Sep 2015 – Jun 2018

SELECTED HONORS & AWARDS

- Best Paper of the Year 2023, Engineering Structures 2024
- Editors' Featured Paper, Engineering Structures, vol 296 2023

- Top-cited Paper Recognition, The Structural Design of Tall and Special Buildings   2021, 2022
- Best Student Paper Award from ASCE/EMI   2021
- College of Engineering Dean's Fellowship   2018
- Outstanding Graduate of Shanghai, China   2018
- China Civil Engineering Society Citation for Outstanding College Graduate   2015
- National Scholarships, China   2013, 2014, 2016

TEACHING

Texas Tech University
- Statics (CE 2301), Instructor

University of Michigan, Ann Arbor
- Statics and Dynamics (CEE 211), Graduate Student Instructor, Evaluation: 4.5/5.0

SELECTED PROJECTS

Rapid response time history simulators for large-scale nonlinear dynamic systems   Sep 2018 - Present
- Developed an AFNA algorithm for nonlinear response time history analysis, with over an order of magnitude efficiency improvement compared to direct integration schemes.
- Proposed MIMO-NARX- and deep learning-based metamodeling schemes for general nonlinear dynamic systems subjected to stochastic excitation, with 50,000-fold efficiency improvement over direct integration schemes.
- Developing a physics-informed metamodeling framework with enhanced data efficiency for dynamic response simulation.
- Developing a metamodeling technique for response time history estimation through Fourier neural operator (FNO) in collaboration with Johns Hopkins University.

Efficient performance assessment frameworks for structures   Mar 2020 - Present
- Proposed an AFNA-based performance evaluation framework enabling industrial computationally affordable performance-based wind design.
- Developed a highly efficient small failure probability estimation framework through a deep transfer learning scheme.
- Developing user-friendly and highly efficient commercial software to facilitate the industrial adoption of Performance-Based Wind Design.

Real-time hurricane-induced damage risk forecasting for buildings   Sep 2020 - Sep 2022
- Introduced a metamodeling framework that allows rapid and computationally cheap progressive damage assessment.
- Developed a real-time multiple-day damage risk forecasting framework for large-scale building envelope systems.

SELECTED PUBLICATIONS

Refereed Journal Publications:
- Li B., Spence S.M.J.* A Software Platform for Implementation of State-Of-The-Art Performance-Based Wind Engineering. In preparation.
- Li B., Spence S.M.J.* Deep Learning Enhanced Stratified Sampling for Rapid Estimation of Small Failure Probabilities. In preparation.
- Li B., Spence S.M.J.* Deep learning enabled rapid nonlinear time history wind performance assessment. Structures, 66, 106810.
- Li B., Chuang W.-C., Spence S.M.J.* (2023). Reliability of Inelastic Wind Excited Structures by Dynamic Shakedown and Adaptive Fast Nonlinear Analysis (AFNA). Engineering Structures,

296, 116869.
- <u>Li B.</u>, Spence S.M.J.* (2023). Real-time Forecast of Hurricane-induced Damage Risk to Envelope Systems of Engineered Buildings through Metamodeling. Journal of Wind Engineering and Industrial Aerodynamics, 232, 105273.
- <u>Li B.</u>, Spence S.M.J.* (2022). Metamodeling through Deep Learning of High-Dimensional Dynamic Nonlinear Systems Driven by General Stochastic Excitation. ASCE Journal of Structural Engineering, 148(11), 04022186.
- <u>Li B.</u>, Chuang W.-C., Spence S.M.J.* (2021). Response Estimation of Multi-Degree-of-Freedom Nonlinear Stochastic Structural Systems through Metamodeling. ASCE Journal of Engineering Mechanics, 147(11), 04021082.
- <u>Li B.</u>, Dai K.*, Meng J., Liu K., Wang J., Tesfamariam S. (2021). Simplified Design Procedure for Nonconventional Multiple Tuned Mass Damper and Experimental Validation. The Structural Design of Tall and Special Buildings, 30(2), e1818.
- Wang J., Dai K.*, <u>Li B.</u>, Li B., Liu Y., Mei Z., Li J. (2020). Seismic Retrofit Design and Risk Assessment of An Irregular Thermal Power Plant Building. The Structural Design of Tall and Special Buildings, 29(6), e1719.
- Zhao Z., Dai K.*, Lalonde E.R., Meng J., <u>Li B.</u>, Ding Z., Bitsuamlak G. (2019). Studies on Application of Scissor-jack Braced Viscous Damper System in Wind Turbines under Seismic and Wind Loads. Engineering Structures, 196, 109294.
- <u>Li B.</u>, Dai K.*, Li H., Li B., Tesfamariam S. (2019). Optimum Design of A Non-conventional Multiple Tuned Mass Damper for A Complex Power Plant Structure. Structure and Infrastructure Engineering, 15(7), 954-964.
- Dai K.*, <u>Li B.</u>, Wang J., Li A., Li H., Li J., Tesfamariam S. (2018). Optimal Probability-based Partial Mass Isolation of Elevated Coal Scuttle in Thermal Power Plant Building. The Structural Design of Tall and Special Buildings, 27(11), e1477.
- Dai K.*, <u>Li B.</u>, Li H., Wang J., Li A., Liu K., Tesfamariam S. (2018). Reliability Based Mass Uncertain Nonconventional Multiple Tuned Mass Damper Optimization for Thermal Power Plant. Advanced Engineering Sciences, 50(3): 82-90.
- Dai K.*, Wang J., <u>Li B.</u>, Hong H.P. (2017). Use of Residual Drift for Post-earthquake Damage Assessment of RC Buildings. Engineering Structures, 147, 242-255.

PRESENTATIONS:

Invited Talks:
- Efficient Performance Assessment for Large Scale Engineering Systems under Wind Hazards: Frameworks and Applications, CAE seminar series, University of Miami, Virtual, 2024.
- Rapid Uncertainty Propagation through Large Scale Engineering Systems under Natural Hazards, College of Architecture and Environment, SiChuan University, Virtual, 2024.
- Machine Learning in Structural Engineering, School of Civil & Hydraulic Engineering, Huazhong University of Science and Technology, Virtual, 2021.

Conference Proceedings and Presentations:
- <u>Li B.</u>, Bernardini E., Spence S.M.J. (2024). WiRA: A software for efficient reliability assessment and performance-based wind design. 7th American Association for Wind Engineering Workshop, Ann Arbor, USA.
- Giovanis D., Goswami S., <u>Li B.</u>, Spence S.M.J., Shields M. (2024). Neural Operators for Stochastic Modeling of System Response to Natural Hazards. Engineering Mechanics Institute and Probabilistic Mechanics & Reliability Conference (EMI 2024/PMC 2024), Chicago, USA.
- <u>Li B.</u>, Spence S.M.J. (2024). Machine Learning with Knowledge Transfer for Rapid Estimation of Small Failure Probability of Large-scale Nonlinear Dynamic Systems. Engineering Mechanics Institute and Probabilistic Mechanics & Reliability Conference (EMI 2024/PMC

2024), Chicago, USA.
- Li B., Spence S.M.J. (Presenter) (2023). Performance-based Wind Assessment of Nonlinear Systems through LSTM-based Metamodeling and Transfer Learning. 16th International Conference on Wind Engineering (ICWE 16), Florence, Italy.
- Li B., Spence S.M.J. (Presenter) (2023). Deep Transfer Learning for Efficient Performance-based Assessment of Stochastic Nonlinear Dynamic Systems through Metamodeling. 14th International Conference on Applications of Statistics and Probability in Civil Engineering (ICASP14), Dublin, Ireland.
- Li B. (Presenter), Spence S.M.J. (2023). Deep Learning of Nonlinear Dynamic Structural Systems Subject to Natural Hazards. Structural Congress 2023, New Orleans, USA.
- Li B. (Presenter), Spence S.M.J. (2023). WiRA 4.0 Tools for Performing PBWD through Method 3. ASCE PBWE Task Committee Meeting, Structural Congress 2023, New Orleans, USA.
- Li B. (Presenter), Spence S.M.J. (2022). Physics-informed Deep Learning Metamodeling for MDOF Nonlinear Systems under Nonstationary Stochastic Wind Excitation. Engineering Mechanics Institute Conference (EMI 2022), Baltimore, USA.
- Li B., Spence S.M.J. (Presenter) (2022). Deep Learning-based Metamodeling of Nonlinear Dynamic Systems Subject to Stochastic Wind Excitation. 14th American Conference on Wind Engineering, Lubbock, USA.
- Li B., Spence S.M.J. (Presenter) (2022). A Real Time Damage Forecast Framework for Building Envelope Systems Subjected to Hurricanes. 14th American Conference on Wind Engineering, Lubbock, USA.
- Li B. (Presenter), Ouyang Z., Chuang W.-C., Spence S.M.J. (2021). Real Time Assessment of Building Envelope Systems subject to Hurricanes through Kriging Metamodels. 31th European Safety and Reliability Conference (ESREL 2021), Angers, France.
- Li B. (Presenter), Chuang W.-C., Spence S.M.J. (2021). An Adaptive Fast Nonlinear Analysis (AFNA) Algorithm for Rapid Time History Analysis. 8th International Conference on Computational Methods in Structural Dynamics and Earthquake Engineering (COMPDYN 2021), Athen, Greece.
- Li B. (Presenter), Spence S.M.J. (2021). A Deep Learning Metamodeling Framework for High-dimensional Nonlinear and Dynamic Structural Systems Subject to Stochastic Excitation. Engineering Mechanics Institute and Probabilistic Mechanics & Reliability Conference (EMI 2021/PMC 2021), Virtual Event.
- Li B. (Presenter), Spence S.M.J. (2020). A Metamodeling Framework for Rapid Uncertainty Propagation through High-dimensional Nonlinear Structural Systems Subject to Stochastic Excitation. Engineering Mechanics Institute and Probabilistic Mechanics & Reliability Conference (EMI 2020/PMC 2020), Virtual Event.
- Li B. (Presenter), Spence S.M.J. (2019). Non-polynomial PC-NARX Metamodel for Wind Stochastic Response of Tall Building with Nonlinearity. 15th International Conference on Wind Engineering (ICWE15), Beijing, China.
- Li B., Spence S.M.J. (Presenter) (2019). Uncertainty Propagation through High-fidelity Non-linear Dynamic Systems Driven by Stochastic Excitation. Engineering Mechanics Institute and Probabilistic Mechanics & Reliability Conference (EMI 2019/PMC 2019), Pasadena, USA.
- Li B., Spence S.M.J. (Presenter) (2019). A Metamodeling Framework for Efficient Uncertainty Propagation through Nonlinear Structural Systems. 3rd International Conference on Uncertainty Quantification in Computational Sciences and Engineering, Crete, Greece.

REVIEWER/JUDGE FOR

Selected Journals:
- Computer-Aided Civil and Infrastructure Engineering
- Journal of Wind Engineering & Industrial Aerodynamics

- Engineering Structures
- Soil Dynamics and Earthquake Engineering
- Journal of Supercomputing
- Buildings

Conferences:
- Three Minute Thesis (3MT®) competition, Ann Arbor, USA.   Sep 2023

ADVISING

Ph.D. students (co-advised):
- Atila Haimiti, Civil Engineering, UMich, Thesis: Machine learning powered efficient performance-based wind frameworks.   Sep 2023 - Apr 2028 (Expected)

Master students (co-advised):
- Jacob Overberg, Civil Engineering, UMich, Independent Study: Dynamic Shakedown and Wind Reliability Analysis of Archetype Building using WiRA software.   Sep 2021 - Apr 2022

Undergraduate students:
- Pavani Anand (UMich's Society of Women Engineers), Civil Engineering, UMich, Undergraduate Research Opportunity Program (UROP): Discovering State-of-the-art Engineering Software for Performance-based Wind Engineering.   Sep 2022 - Apr 2023
- Minjeong Kim (UMich's Society of Women Engineers), Mechanical Engineering, UMich, Undergraduate Research Opportunity Program (UROP): Discovering Performance-Based Wind Engineering.   Sep 2021 - Apr 2022
- Riya Kashyap, (UMich's Society of Women Engineers), Civil Engineering, UMich, Undergraduate Research Opportunity Program (UROP): Discovering Performance-Based Wind Engineering.   Sep 2021 - Apr 2022

K-12 SERVICE
- Led the Discover Engineering 2023 Workshop of Civil and Environmental Engineering at the University of Michigan.   Aug 2023