Minhyeok Ko

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PROFESSIONAL APPOINTMENT

The University of Texas at Tyler **Aug. 2025 – Present**
Assistant Professor of Civil Engineering (Tenure-Track) *Tyler, TX*

RESEARCH INTERESTS

- **Digital Twin Technology**: Physics-informed digital twins for civil infrastructure, with emphasis on wind turbines and renewable energy systems
- **Structural Health Monitoring**: Real-time state estimation, damage detection, and resilience-based decision making
- **Uncertainty Quantification**: Probabilistic risk assessment, fragility analysis, and reliability methods for complex structural systems
- **Data Assimilation**: Bayesian filtering, Kalman filters, and sequential Monte Carlo approaches for dynamic systems
- **Machine Learning Applications**: Deep learning, reinforcement learning, and physics-informed neural networks for predictive modeling in structural engineering

EDUCATION

The Pennsylvania State University **Aug. 2016 – Dec. 2023**
Ph.D. *in Civil Engineering (Structural Engineering)* *University Park, PA*

Northwestern University **Sep. 2015 – Aug. 2016**
M.S. *in Civil Engineering (Structural Engineering)* *Evanston, IL*

Chung-Ang University **Mar. 2012 – Feb. 2014**
M.E. *in Structural Engineering in Architecture* *Seoul, South Korea*

Chung-Ang University **Mar. 2006 – Feb. 2012**
B.S. *in Architectural Engineering (Structure)* *Seoul, South Korea*

RESEARCH EXPERIENCE

The Ohio State University **Jan. 2024 – Aug. 2025**
Postdoctoral Research Associate (Advisor: Dr. Abdollah Shafieezadeh) *Columbus, OH*

- Developing model-based Deep Learning (DL) methods for accurate state estimation and uncertainty quantification in infrastructure systems, addressing challenges in resilience and sustainability for critical civil infrastructure.
- Advancing Digital Twin (DT) frameworks for wind turbine monitoring by integrating data-driven machine learning approaches with physics-informed Bayesian filtering techniques, enabling real-time state estimation and predictive maintenance under complex operational conditions.
- Developing fragility models for reinforced concrete panels subjected to projectile impacts applying enhanced adaptive reliability analysis methods and surrogate modeling.
- Mentoring undergraduate students in a Research Experiences for Undergraduates (REU) program sponsored by The National Science Foundation (NSF)

The Pennsylvania State University **Aug. 2018 – Dec. 2023**
Graduate Student Researcher (Advisor: Dr. Kostas Papakonstantinou) *University Park, PA*

- Proposed novel probabilistic modeling methodologies addressing uncertainty quantification for stochastic processes, particularly valuable in the context of large-scale nonlinear dynamic systems.
- Created highly efficient numerical techniques for uncertainty propagation and Bayesian inference, utilizing advanced algorithms such as the Kalman Filter.
- Employed a fully parametrized nonlinear model enabling the simulation of the intricate dynamic behavior of large-dimensional structures within a computationally efficient framework.
- Conducted large-scale simulations for real-time probabilistic damage assessment of structures exposed to seismic events or other catastrophic incidents.

The Pennsylvania State University **Aug. 2016 – Aug. 2018**

Research Lab Assistant (Advisor: Dr. Ali Memari) *University Park, PA*

- Developed the structural engineering consideration in additive manufacturing using cementitious material working with ten (10) research groups from five (5) different departments.
- Conducted large-scale testing for 3D-printed concrete dome structures.
- Designed the Martian cement for NASA challenges of 3D-printed habitat on Mars.

Northwestern University **Sep. 2015 – Aug. 2016**

Graduate Student Researcher (Advisor: Dr. Gianluca Cusatis) *Evanston, IL*

- Researched effects of creep and shrinkage on column shortening in tall buildings considering various ambient conditions.
- Performed finite element analysis utilizing the Hygro-Thermo-Chemical model for concrete hydration and the Solidification-Microprestress-Microplane models for creep and shrinkage.

Chung-Ang University **Mar. 2012 – Feb. 2014**

Graduate Research Assistant (Advisor: Dr. Chadon Lee) *Seoul, South Korea*

- Developed crack-reducing technology by identifying the characteristics of long-term behavior of prestressed concrete structure.
- Conduct full-scale experiments for prestressed concrete structures.
- Performed experiments to develop innovative stirrups for shear strength improvement of FRP-reinforced concrete beam.

TEACHING EXPERIENCE

The University of Texas at Tyler **Aug. 2025 – Present**

Assistant Professor *Tyler, TX*

- Mechanics of Materials (FA 2025)
- Civil Engineering Materials, Codes, and Specifications (FA 2025)

The Ohio State University **Aug. 2024 – Aug. 2025**

Instructor *Columbus, OH*

- Structural Engineering Principle (FA 2024 – SP 2025)

The Pennsylvania State University **Jan. 2021 – Dec. 2023**

Graduate Teaching Assistant *University Park, PA*

- Advanced Structural Design (Capstone Design) (SP 2021, SP 2022, SP 2023)
- Professionalism, Engineering Economics and Construction Project Delivery (FA 2021, FA 2022 – FA 2023)
- Taught advanced structural design concepts to undergraduate students, including load calculation (ASCE 7), reinforced concrete design (ACI 318), steel design (AISC Manual), general building standard (IBC) and SAP2000 modeling.
- Mentored 60+ undergraduate students with an emphasis of structure in Civil Engineering.

ACADEMIC PROJECTS

Real-time Aircraft Trajectory Estimation Using Bayesian Filter **2019**

- Performed model-data fusion for real-time air traffic control using noisy radar measurement data.
- Estimated the trajectory of aircraft for air-traffic control in real-time using Bayesian inference.
- Investigated the performance of different model-based online state estimation algorithms, by implementing Extended Kalman filter (EKF), Unscented Kalman filter (UKF), Sequential Monte Carlo scheme, and higher order Bayesian inferencing techniques.

Seismic Assessment of a 3-Story Building in Santa Rosa, CA **2017**

- Conducted a comprehensive seismic performance evaluation of a 3-story building, determining interstory drift ratios under various earthquake scenarios.
- Analyzed the building's steel moment frame to understand its behavior and resilience under seismic loads ensuring structural safety and integrity
- Assessed potential drift limit exceedances, providing crucial insights for potential retrofitting needs.

Seismic Assessment and Retrofitting of a Water Tower in Southern California **2017**

- Evaluated the structural integrity of a 33-foot tall water tower, ensuring compliance with ASCE 7 guidelines and assessing the tower's response to specific ground motions.
- Proposed retrofitting methodologies to enhance the tower's resilience against seismic activities, safeguarding critical connections and ensuring foundation capacity.

Earthquake Resistant Design of a 9-Story Wall Office Building **2016**

- Designed a 9-story office building successfully with a focus on earthquake resistance, incorporating advanced seismic force load determination and ensuring structural integrity.
- Conducted a comprehensive modal response spectrum analysis, ensuring the building's resilience against potential seismic activities and optimizing its structural elements for maximum safety.
- Performed detailed hand calculations for the design of structural elements, including beams, columns, and shear walls.

SKILLS

Design Code: ACI 318, AISC 360, ASCE 7, IBC
Programming & Software: Python, R, MATLAB, Maple, Abaqus, SAP2000, ETABS, AutoCAD
Statistics: Structural Reliability, Risk Assessment, Fragility Analysis, Stochastic Process
Data Assimilation: Kalman Filters, Bayesian Filter, Particle Filter, Higher Order Bayesian Filter
Machine Learning: Deep Learning, Reinforcement Learning, Bayesian Neural Network, Convolutional Neural Network, Physics-informed Neural Network

OUTREACH ACTIVITIES

K–12 STEM Outreach – Central Ohio Miniature Bridge Building Competition **2024**
Event Proctor and Team Liaison *Columbus, OH*

- Supervised student participants during bridge building to ensure safety and fair competition.
- Served as liaison between student teams and judging panel to streamline communication and logistics.

PROFESSIONAL EXPERIENCE

Sunjin Engineering & Architecture **May 2011 – Aug. 2011**
Structural Engineer Intern *Gwacheon-si, South Korea*

- Conducted finite element analysis (FEA) for a 15-story reinforced concrete office tower under the supervision of a licensed structural engineer.
- Designed and detailed 100+ structural steel and concrete members, contributing to code-compliant and structurally efficient designs.

HONORS & AWARDS

2nd Place, NASA's 3D-Printed Habitat Challenge, Phase 2: Level 3 **Aug. 2017**
The National Aeronautics and Space Administration (NASA)

1st Place, 47th Chung-Ang Architecture Graduate Competition – Structure **Dec. 2011**
Chung-Ang University, School of Architecture & Building Science

Special Prize, 4th Structural Design Competition **Dec. 2011**
The Korean Structural Engineers Association

Highest Academic Honor **2010, 2012–2013**
Chung-Ang University

High Academic Honor **2006–2007**
Chung-Ang University

PUBLICAITONS

Peer-reviewed Journal Articles

Published

1. **Ko, M.**, & Shafieezadeh, A. (2025). Robust wind turbine monitoring for digital twin integration: A physics-informed covariance-preserving deep learning approach. *Renewable Energy*. https://doi.org/10.1016/j.renene.2025.123176
2. **Ko, M.**, & Papakonstantinou, K. (2025). The quadratic point estimate method for probabilistic moments computation. *Probabilistic Engineering Mechanics*. https://doi.org/10.1016/j.probengmech.2024.103705
3. **Ko, M.**, & Shafieezadeh, A. (2024). Cholesky–KalmanNet: Deep learning–based Kalman filters estimating state and error covariance. *IEEE Signal Processing Letters*. https://ieeexplore.ieee.org/document/10804573
4. Lee, S., Kim, Y., **Ko, M.**, & Lee, C. (2019). Assessment of thermal prestress loss with re-tensioning tests. *ACI Structural Journal*, 116(6). Link
5. Lee, C., **Ko, M.**, & Lee, Y. (2014). Bend strength of complete closed-type carbon fiber–reinforced polymer stirrups with rectangular section. *Journal of Composites for Construction*, 18(1), 04013022. https://doi.org/10.1061/(ASCE)CC.1943-5614.0000428

Submitted

6. **Ko, M.**, & Papakonstantinou, K. (submitted, 2025). *Quadratic point estimate method for uncertainty quantification under copula-based input dependencies. Journal of Computational Physics.*

In Preparation

7. **Ko, M.**, & Papakonstantinou, K. (in prep). A review and new perspectives on probabilistic point-estimate methods.
8. **Ko, M.**, & Papakonstantinou, K. (in prep). Probability density evaluation through the quadratic point estimate method for static, dynamic and multi-output cases.

Conference Proceedings

1. **Ko, M.**, & Shafieezadeh, A. (2025). Deep learning–based digital twin models for real-time monitoring of renewable energy systems. *Career Speaker Series and Research Poster Session*, Bryd Polar and Climate Research Center, The Ohio State University, Columbus, OH, USA.
2. **Ko, M.**, & Shafieezadeh, A. (2025). Deep learning–based digital twin models for real-time monitoring of onshore wind turbines. *NHERI Computational Symposium*, University of California, Los Angeles, CA, USA.

3. **Ko, M.**, & Papakonstantinou, K. (2023). Copula-based quadratic point estimate method for probabilistic moments evaluation. *14th International Conference on Applications of Statistics and Probability in Civil Engineering (ICASP14)*, Trinity College Dublin, Ireland.
4. **Ko, M.**, & Papakonstantinou, K. (2023). Copula-based quadratic point estimate method under incomplete probability information. *Engineering Mechanics Institute Conference 2023 (EMI 2023)*, Georgia Institute of Technology, Atlanta, GA, USA.
5. **Ko, M.**, & Papakonstantinou, K. (2022). An efficient and accurate point estimate method for probabilistic moments evaluation. *Engineering Mechanics Institute Conference 2022 (EMI 2022)*, Johns Hopkins University, Baltimore, MD, USA.
6. **Ko, M.**, Memari, A. M., Duarte, J. P., Nazarian, S., Ashrafi, N., Craveiro, F., & Bilen, S. (2018). Preliminary structural testing of a 3D-printed small concrete beam and finite element modeling of a dome structure. *The 42nd IAHS World Congress – The Housing for the Dignity of Mankind*, Naples, Italy.
7. **Ko, M.**, & Lee, C. (2014). Bend strength of complete closed-type carbon fiber reinforced polymer stirrups with rectangular section. *2013 Spring Conference – Korea Institute for Structural Maintenance Inspection (KSMI)*, Busan, South Korea.
8. **Ko, M.**, & Lee, C. (2013). Estimation of prestress loss due to steam curing. *2013 Spring Conference – Korea Institute for Structural Maintenance Inspection (KSMI)*, Busan, South Korea.
9. **Ko, M.**, & Lee, C. (2012). Theoretical prediction of prestress loss during steam curing process. *2012 Fall Conference – Korea Concrete Institute (KCI)*, Gangwon, South Korea.