KAREEM A. ELTOUNY, PhD

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SUMMARY

Kareem Eltouny specializes in machine learning and structural engineering with a passion for AI applications for structural and mechanical engineering. His work focuses on vibration- and vision-based structural health monitoring powered by machine learning, and he also has expertise in robotics and automation. He is experienced in both computer and embedded systems programming.

KEY SKILLS

Programming	Python (PyTorch, TensorFlow, Keras, scikit-learn, OpenCV) ▪ Tcl/Tk ▪ C++ ▪ JavaScript ▪ MATLAB ▪ Bash (Unix)
Specialities	Deep Learning ▪ Computer Vision ▪ Point Clouds ▪ Pose Estimation ▪ Semantic Segmentation ▪ Unsupervised Learning ▪ Signal Processing ▪ Time Series Analysis and Forecasting ▪ Novelty Detection ▪ Ensemble learning
Hardware/Embedded	Arduino ▪ I2C / SPI protocols ▪ ESP32 / ESP8266 ▪ MicroPython
Engineering Software	ANSYS APDL ▪ LS-DYNA ▪ ABAQUS ▪ SAP2000 ▪ OpenSees ▪ MATHCAD ▪ ETABS ▪ SPColumn ▪ AutoCAD ▪ Autodesk Revit

EDUCATION

Ph.D. in Civil Engineering - *The University at Buffalo, the State University of New York* **Aug ’19 – Feb ‘24**
Dissertation: *Machine Learning Approaches for Robust and Practical Structural Health Monitoring*
Advisor: Dr. Xiao Liang.

M.S. in Civil Engineering - *The University at Buffalo, the State University of New York* **Aug ’17 – Jun ‘19**
Dissertation: *Structural Health Monitoring using Unsupervised Learning Methods with a view on Post-Earthquake Damage Detection*
Advisors: Dr. Xiao Liang and Dr. Andreas Stavridis.

B.Sc. in Civil Engineering **Sep ’09 – Jul ‘14**
Suez Canal University, Ismailia, Egypt.

WORK EXPERIENCE

Stealth AEC Tech Startup., MA, USA | AI Researcher **Jan ’26 - present**

- Developing and deploying domain-specific machine learning solutions for AEC applications, automating complex engineering workflows and transforming architectural constraints into intelligent decision support systems.

Simpson Gumpertz & Heger, Waltham, MA, USA
Project Consultant **Feb ’24 – Jan ‘26**
Technical Intern **May ’23 – Aug ‘23**

- Led the development of a deep learning-based pixel-level concrete crack detection tool
- Developed a variety of machine-learning solutions, including an unsupervised learning-driven automatic structural system identification method and automatic rail fatigue assessment
- Participated in engineering research projects as a structural health monitoring expert and a fitness-for-service evaluator, utilizing state-of-the-art signal processing and machine learning techniques for a variety of structures, including nuclear facilities, train and rail facilities, offshore platforms, liquefied natural gas facilities, and cable-stayed bridges

ACE (Moharram.Bakhoum), Egypt

Site Civil Engineer **Jun '16 – Jul '17**

Project: Ismailia Tunnels, The Suez Canal.
Inspected the precast concrete lining manufacturing, repair, and installation process for the twin 4.5 km Ismailia tunnels under the Suez Canal constructed using two Tunnel Boring Machines (TBM) in collaboration with CDM Smith (Germany).

ENCOM Group, Egypt | *Structural Designer* **Aug '14 – May '16**

Designed and reviewed a variety of steel and reinforced concrete structures in medium to large projects, including bridges, water treatment stations, and manufacturing facilities.

ACADEMIC EXPERIENCE

SEAS, The University at Buffalo, SUNY, NY

Research Assistant **Aug '21 – Dec '23**
Graduate Assistant **Aug '19– Aug '21**

- Advancing structural health monitoring systems through machine learning-based solutions that improve accuracy and decision-making in infrastructure monitoring
- Contributed to NSF-funded projects by developing uncertainty-aware machine learning algorithms for human-robot interaction and collaboration, including human motion prediction models, robot motion planning, and vision-based human motion detection for safer human-robot collaboration

SEAS, The University at Buffalo, SUNY, NY | *Grader* **Aug '18 – May '19**

Courses: Reinforced concrete design (CIE429) and Engineering statistics (CIE308)

Faculty of Engineering, Suez Canal University, Egypt

Teaching Assistant **Mar '15 – Aug '17**

Courses: Steel Structures, Advanced Structural Analysis, Steel Bridges Design, Reinforced Concrete Foundations Design, Soil Mechanics.

FUNDED RESEARCH PROJECTS

- *Innovative Inspection Technology and Assessment Methodology for Integrity Management of Offshore Grating*, Ocean Energy Safety Institute, 2023–2025. Role: Contributor (PI: Onder Akinci).
- *Determination of Actual Derailment Loads on Transit Bridges*, National Academy of Sciences, TCRP Project D-24, 2022–2025. Role: Contributor (PI: Robert MacNeil).
- *Develop Methodologies for Cryogenic and Fireproofing Requirements for LNG Facilities*, US DOT, PHMSA Project No. 1010, 2023–2025. Role: Contributor (PI: Onder Akinci).
- *The Future of Remanufacturing: Human-Robot Collaboration for Disassembly of End-of-Use Products*, NSF CMMI Award No. 2422826, 2024–2025. Role: Research Assistant (PI: Minghui Zheng).
- *The Future of Remanufacturing: Human-Robot Collaboration for Disassembly of End-of-Use Products*, NSF CMMI Award No. 2026276, 2020–2025. Role: Research Assistant (PI: Minghui Zheng).
- *Determine the Maximum Permissible Temperature Drops for Steel when Exposed to Cryogenic Liquid*, US DOT PHMSA Project No. 980, 2022–2024. Role: Contributor (PI: Paul Summers).
- *The Future of Remanufacturing: Human-Robot Collaboration for Disassembly of End-of-Use Products*, NSF CMMI Award No. 2026533, 2020–2024. Role: Research Assistant (PI: Minghui Zheng).
- *Human-Robot Collaboration in Disassembly for Future Remanufacturing*, NSF EFMA Award No. 1928595, 2019–2021. Role: Research Assistant (PI: Minghui Zheng).

JOURNAL PUBLICATIONS

Eltouny, K., Sajedi, S., and Liang, X., (2024) "Dmg2Former-AR: Vision Transformers with Adaptive Rescaling for High-Resolution Structural Visual Inspection," *Sensors*. *24*(18), 6007.

Liu, W., **Eltouny, K.**, Tian, S., Liang, X., and Zheng, M., (2024) “Integrating Uncertainty-Aware Human Motion Prediction Into Graph-Based Manipulator Motion Planning,” *IEEE/ASME Transactions on Mechatronics*, vol. 29, no. 4, pp. 3128-3136.

Liu, W., **Eltouny, K.**, Tian, S., Liang, X., and Zheng, M., (2024) “KG-Planner: Knowledge-Informed Graph Neural Planning for Collaborative Manipulators,” *IEEE Transactions on Automation Science and Engineering*.

Eltouny, K., Liu, W., Tian, S., Zheng, M., & Liang, X. (2023) “DE-TGN: Uncertainty-Aware Human Motion Forecasting using Deep Ensembles,” *IEEE Robotics and Automation Letters,* 9(3), 2192-2199.

Eltouny, K., Liang, X. (2023) “Uncertainty-Aware Structural Damage Warning System Using Deep Variational Composite Neural Networks,” *Earthquake Engineering & Structural Dynamics*, 52(11), 3345-3368.

Eltouny, K., Gomaa, M., Liang, X. (2023) “Unsupervised Learning Methods for Data-Driven Vibration-Based Structural Health Monitoring: A Review,” *Sensors*, 23(6):3290. **Editor’s Choice, 2024.**

Zhang, X., **Eltouny, K.**, Liang, X., Behdad, S. (2023) “Automatic Screw Detection and Tool Recommendation System for Robotic Disassembly,” *Journal of Manufacturing Science and Engineering,* 145(3), 031008.

Sajedi, S., **Eltouny, K.**, Liang, X. (2023) “Twin Models for High-Resolution Visual Inspections,” *Smart Structures and Systems*. 31(4), 351-363.

Eltouny, K. A., Liang, X. (2022) “Large-scale structural health monitoring using composite recurrent neural networks and grid environments,” *Computer-Aided Civil and Infrastructure Engineering*, 38(3), 271– 287.

Sajedi, S., Liu, W., **Eltouny, K.**, Behdad, S., Zheng, M., Liang, X. (2022) “Uncertainty-Assisted Image-Processing for Human-Robot Close Collaboration,” *IEEE Robotics and Automation Letters*, 7(2):4236-4243.

Eltouny, K. A., Liang, X. (2021) “Bayesian-optimized unsupervised learning approach for structural damage detection,” *Computer-Aided Civil and Infrastructure Engineering*, 36: 1249– 1269.

CONFERENCE PROCEEDINGS

Parikh, M., Akinci, O., Palkovic, S., Li, G., Humphreys, A., **Eltouny, K.**, Catella, N., Summers, P. (2025, July 20-25). Stress Analysis and Fitness-for-Service Assessment of a Full Containment Steel-Steel Lng Tank for Major Leak Scenarios and Laboratory Testing of 9% Ni Steel Plates. T*he 2025 ASME Pressure Vessels & Piping Conference (PVP 2025)*, Montreal, Canada.

Palkovic, S., **Eltouny, K.**, Parikh, M., Catella, N., Akinci, O. (2025, July 20-25). Stress and Fitness-for-Service Assessment of Lng Steel Piping Subjected to Rapid Temperature Drops. T*he 2025 ASME Pressure Vessels & Piping Conference (PVP 2025)*, Montreal, Canada.

Akinci, O., Kalpakidis, I., **Eltouny, K.**, Palkovic, S., Humphreys, A., DelloRusso, S. (2025, May 5-8). Development of a Nondestructive Inspection Technology to Detect Offshore Grating Damage. *The 2025 Offshore Technology Conference (OTC 2025)*, Houston, TX, USA.

Akinci, O., Kalpakidis, I., Humphreys, A., DelloRusso, S., Lim, K., **Eltouny, K.**, Palkovic, S. (2024, Oct 22-24). Innovations in the Integrity Management of Offshore Grating. *The Mary Kay O'Connor Process Safety Center 3rd Ocean Energy Safety Symposium*, College Station, TX, USA.

Eltouny, K. A., Sajedi, S., & Liang, X. (2023, September 12–14). High-Resolution Vision Transformers for Pixel-Level Identification of Structural Components and Damage. *The 14th International Workshop on Structural Health Monitoring (IWSHM2023),* Stanford University, CA, USA.

Zhang, X., **Eltouny, K.**, Liang, X., & Behdad, S. (2022, June 27–July 1). Automatic Screw Detection and Tool Recommendation System for Robotic Disassembly. *The ASME 2022 International Manufacturing Science and Engineering Conference (MSEC2022)*, West Lafayette, IN, USA.

Eltouny, K. A., Liang, X. (2022, Jun. 27–Jul. 1). Hybrid multi-objective architecture for spatiotemporal structural health monitoring. In *the 12th National Conference on Earthquake Engineering (12NCEE)*, Salt Lake City, UT, USA.

Eltouny, K. A., Sajedi, S., Liang, X. (2022, Jun. 5–8). High-Fidelity Visual Structural Inspections through Transformers and Learnable Resizers. In *the proceedings of the 8th World Conference on Structural Control and Monitoring (8WCSCM)*, Orlando, FL, USA.

Eltouny, K. A., Liang, X. (2021, Sept. 27–Oct. 2). A nonparametric unsupervised learning approach for structural damage detection. In *the 17th World Conference on Earthquake Engineering (17WCEE)*, Sendai, Japan.

TECHNICAL REPORTS

Determination of Actual Derailment Loads on Transit Bridges, National Academy of Sciences, Transit Cooperative Research Program, 2025, MacNeill, R. A., Catella, N. D., Hsieh, S., **Eltouny, K**.

Develop Methodologies for Cryogenic and Fireproofing Requirements for LNG Facilities, The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration, 2025, Akinci, O., Parikh, M., Castaneda, N., Gandage, S., Keremidis, K., **Eltouny, K.**, Palkovic, S., Staszak, A., Clutter, K.

Innovative Inspection Technology and Assessment Methodology for Integrity Management of Offshore Grating, Ocean Energy Safety Institute, 2025, Akinci, O., Kalpakidis, I. V., Palkovic, S., **Eltouny, K.**, Humphreys, A., DelloRusso, S.

Determining the Maximum Permissible Temperature Drops for Steel when Exposed to Cryogenic Liquid, The U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration, 2024, Akinci, O., Summers, P. O., Parikh, M., Palkovic, S., Humphreys, A., Catella, N., **Eltouny, K.**, Li, G., Meyts, M., Moxon, N.

CONFERENCE PRESENTATIONS

Catella, N., **Eltouny, K.**, (2025, October 20-23). Use of fitness-for-service methodologies in failure analysis. *International Materials, Applications & Technologies (IMAT 2025)*, Detroit, MI, USA.

Eltouny, K., Kalpakidis, I., Palkovic, S., Humphreys, A., DelloRusso, S., Lim, K., Akinci, O. (2025, May 27-30). Integrity Management of Offshore Gratings using Automated System Identification and Fitness-for-Service Assessments. *The 2025 Engineering Mechanics Institute Conference (EMI 2025)*, Anaheim, CA, USA.

Eltouny, K., Liu, W., Tian, S., Zheng, M., & Liang, X. (2025, May 19-23). DE-TGN: Uncertainty-Aware Human Motion Forecasting using Deep Ensembles. *The 2022 International Conference on Robotics and Automation (ICRA 2025)*, Atlanta, GA, USA.

Kalpakidis, I., Humphreys, A., Harmal, A., Akinci, O., **Eltouny, K.**, DelloRusso, S., Palkovic, S. (2025, April 6-10). Steel Grating Accelerated Corrosion Simulation and Vibration-Based Corrosion Damage Detection. The Association for Materials Protection and Performance Annual Conference + Expo 2025, Nashville, TN, USA.

Liu, W., **Eltouny, K.,** Tian, S., Liang, X., and Zheng, M. (2024, July 15-19). Integrating Uncertainty-Aware Human Motion Prediction Into Graph-Based Manipulator Motion Planning. *The 2024 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM 2024)*, Boston, MA, USA.

Eltouny, K. A., Gandage, S. S., and Catella, N. D. (2024, May 28-31). Enhancing the Visual Structural Inspections Using AI-Assisted Crack Detection Tools. *The 2024 Engineering Mechanics Institute / Probabilistic Mechanics and Reliability Conference (EMI/PMC 2024)*, Chicago, IL, USA,

Eltouny, K. A., Liang, X. Addressing Structural Health Monitoring Uncertainty in a Deep Learning-based Anomaly Detection System. (2023, June 6–9). *The 2023 Engineering Mechanics Institute Conference (EMI 2023)*, Atlanta, GA, USA.

Eltouny, K. A., Sajedi, S., Liang, X. (2022, May 31 – June 3). Super-Resolution Models for Visual Structural Inspections. *The 2022 Engineering Mechanics Institute Conference (EMI 2022)*, Baltimore, MD, USA.

Sajedi, S., Liu, W., **Eltouny, K.**, Behdad, S., Zheng, M., Liang, X. (2022, May 23-27). Uncertainty-Assisted Image-Processing for Human-Robot Close Collaboration. *The 2022 International Conference on Robotics and Automation (ICRA 2022)*, Philadelphia, PA, USA.

Eltouny, K. A., Liang, X. (2021, May 25-28). Bayesian-optimized density-based unsupervised learning approach for post-earthquake damage detection. *The 2021 Engineering Mechanics Institute / Probabilistic Mechanics and Reliability Conference (EMI/PMC 2021)*, New York, NY, USA.

AWARDS AND HONORS

- **Fulbright Scholarship**, 2017. *The Fulbright Program and US Department of State*.
- **Editor's Choice Award**, 2024. *Sensors*.
- **2023 CSEE Award for Excellence in Research.** *University of Buffalo*.
- **The 2021 International Competition for Structural Health Monitoring (IC-SHM).** Achieved first place rank**.**
- **The 2023 University at Buffalo CSEE Poster Competition.** Achieved third place rank.
- **Academic Excellence** for ranking first in the class of 2014, 2014. The Ministry of Higher Education, Egypt.

PROFESSIONAL SERVICE

Conference sessions organizing:

- Co-chair (forthcoming), EMI 2026 Mini-Symposium "Multi-Scale Digital Twins for Infrastructure Resilience Monitoring: Overcoming Data Scarcity and Multi-Hazard Degradation"
- Co-chair (forthcoming), EMI 2026 Mini-Symposium "Digital Twin and AI Innovations in Smarter Civil Infrastructure Monitoring and Management"
- Co-chair (forthcoming), EMI 2026 Mini-Symposium "Learning-Based Structural Health Monitoring Under Limited Damage Data: Adaptation, Transfer, and Unsupervised Approaches"

Professional organizations membership:

- Member, American Society of Civil Engineers (M. ASCE)
- Member, American Concrete Institute (ACI)
- Member, Structural Engineering Institute (SEI)
- Member, Engineering Mechanics Institute (EMI)
- Member, Boston Society of Civil Engineers (BSCE)
- Member, ACI 444 Structural Health Monitoring Committee
- Member, EMI Structural Health Monitoring & Control Committee (SHMC)

Peer reviewing services:

Journal of Structural Engineering ▪ *Structural Control and Health Monitoring* ▪ *IEEE Robotics and Automation Letters* ▪ *Sensors* ▪ *Archives of Computational Methods in Engineering* ▪ *Smart Structures and Systems* ▪ *Mechatronics* ▪ *Measurement* ▪ *IEEE Transactions on Components, Packaging and Manufacturing Technology* ▪ *Scientific Reports* ▪ *Applied Artificial Intelligence* ▪ *Manufacturing Letters* ▪ *IEEE International Conference on Intelligent Robots and Systems* ▪ *SME North American Manufacturing Research Conference*

VOLUNTEER ACTIVITIES

- Vice President of CSEE Graduate Student Association, University at Buffalo — Sep '21 – Sep' 22
- Senator of CSEE Graduate Student Association, University at Buffalo — Sep '19 – Sep '20
- Senator of UB-EERI Student Chapter, University at Buffalo — Sep '17 – May '19
- Member of the students' union of Faculty of Engineering, Suez Canal University — Sep '09 – Jul '14
- Co-Founder of Eureka Scientific Society, Suez Canal University — Mar '11
- Project Leader at SIFE Suez Canal University — Oct '11 – May '12

TRAINING

- German-Arab-Turkish Dialogue: *Civilian Security in Times of Climate Change*, Turkey. — Sep '12 & Sep '13
  The German Academic Exchange Service (DAAD), The Federal Foreign Office of Germany, Universität Siegen.
- *Professional Professor Preparation,* Suez Canal University — May '15
- *Leaders of Egypt Program*, Joint Project: Life Makers and Gulf Innovation Foundation. — Mar '12 – Apr '13
- *Pathways to Higher Education* – Cairo University.
  Enhancement of Entrepreneurship Skills, International Labor Organization — Sep '12
  Development of Thinking and Managerial Skills, Behavioral Approach — Feb '12