Li Ai

Postdoctoral Fellow
College of Engineering and Computing
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EDUCATION

2021 Ph.D., Civil Engineering, University of South Carolina, SC, USA
2016 M.Eng., Civil Engineering, Stevens Institute of Technology, NJ, USA
2014 B.S., Civil Engineering, Zhengzhou University, China

RESEARCH INTERESTS

- Structural Health Monitoring
- Nondestructive Evaluation
- Acoustic Emission (AE) and Fiber Optic Sensing
- Signal Processing
- Image Processing
- Artificial Intelligence
- Cyber-Physical Systems
- Digital Twins

TECHNOLOGY SPECIALTIES

Programming:	Python, Matlab, C/C++, Fortran
Modeling:	Abaqus, ANSYS, COMSOL
Machine Learning:	Develop ML/DL models on platforms, i.e., TensorFlow, PyTorch, Matlab
Typography:	Microsoft Office, Latex

RESEARCH EXPERIENCE

Post-Doctoral Fellow, Sept 2021 – Present
University of South Carolina, supervisor: Prof. Paul Ziehl

Projects involved:
Innovative Manufacturing, Operation, and Certification of Advanced Structures for Civil Vertical Lift Vehicles, sponsored by NASA ULI.

- Conducted impact, and compression after impact testing.
- Monitoring composite demonstrator with fiber optic and acoustic emission sensors.
- Developed a deep learning-based framework for automated monitoring of barely visible impact damage (BVID) in aerospace components.

Building Smarter Cities via Intelligent Asset Management: South Carolina Case Study using IBM Maximo Application, sponsored by SCDOT.

- Drone-based bridge inspection.

- Developed a comprehensive crack detection and depth prediction framework for bridges using computer vision.

Graduate Research Assistant, Jan 2017 – Aug 2021
University of South Carolina, advisor: Prof. Paul Ziehl

Projects involved:
Acoustic emission wave propagation simulation of stress corrosion cracks in stainless steel nuclear spent fuel storage systems, sponsored by EPRI.

- Finite element simulation of acoustic emission elastic wave propagation in stainless steel.
- Developed an algorithm for non-destructive monitoring of stress corrosion cracking in dry cast storage system (DCSS) canisters based on acoustic emission.

Online health monitoring and assessment of alkali-silica reactive expansion cracks in concrete, sponsored by USDOE.

- Monitoring of ASR expansion of concrete structures using acoustic emission sensors
- Developed a real-time ASR damage stage diagnostics method using deep learning.
- Developed prognostic methods for ASR damage.

Digital Twins to Increase Mobility in Rural South Carolina, sponsored by SCDOT.

- Finite element modeling for slab bridges.
- Field monitoring for slab bridges (fiber optic strain gauges, acoustic emission sensors).
- Developed an automated load rating framework using digital twins.

Structural Health Monitoring (SHM) of Composite Structure for Airplanes and Helicopters based on Passive Sensing of Acoustic Emission, sponsored by GKN-Fokker.

- Monitoring aircraft elevator with acoustic emission sensors.
- Developed the algorithm for low velocity impacts localization and impact energy identification using acoustic emission signals and deep learning.

PROFESSIONAL SERVICE

Guest editor:
Coatings
Materials
Journal of Engineered Fibers and Fabrics

Reviewer:
Practice Periodical on Structural Design and Construction-ASCE
Structural Health Monitoring-SAGE
Construction and Building Materials
Neurocomputing
Structural Concrete
Transportation Research Record
Journal of Supercomputing
Journal of Zhejiang University-SCIENCE A
Journal of Applied Science and Engineering

AWARDS

2022, Adrian Pollock Student Award, AEWG-63 – The Acoustic Emission Working Group Annual Meeting

2022, M. Bert Storey Graduate Fellowship, Department of Civil and environmental Engineering, University of South Carolina.

2022, Outstanding Paper Award, CAMX – The Composites and Advanced Materials Expo. CAMX Conference Proceedings

PRESENTATIONS

2018, Finite Element Modeling of Acoustic Emission in Steel Plate. *The 60th meeting of the Acoustic Emission Working Group, Charleston, SC*

2018, Finite Element Modeling of Acoustic Emission in Dry Cask Storage Systems Generated by Cosine Bell Sources. *45th Annual Review of Progress in Quantitative Nondestructive Evaluation, Burlington, VT*

2020, Data-Driven Source Localization of Impact on Aircraft Control Surfaces. *IEEE Aerospace Conference, Big Sky, MT*

2020, Deep Learning Source Localization of Impact on Thermoplastic Control Surface. *The ASME 2020 Conference on Smart Materials, Adaptive Structures and Intelligent Systems, Virtual*

2020, A Minimally Intrusive Impact Detection System for Aircraft Moveable using Random Forest. *The Composites and Advanced Materials Expo (CAMX 2020), Virtual*

2020, Minimally Intrusive Sensing in Various Media enabled through Artificial Intelligence. *The 62nd meeting of the Acoustic Emission Working Group, Virtual*

2021, Assessment of Impact Damage Level for Composite Aircraft Components Using Acoustic Emission. *The Composites and Advanced Materials Expo (CAMX 2021), Dallas, TX*

2021, A Bridge Automated Load Rating Procedure Using Digital Twins. *The Fifth Annual Fall Conference of USDOT Center for Connected Multimodal Mobility (C2M2), Clemson, SC*

2021, Sensors working with Humans: A Case for Bridges. *USDOT Center for Connected Multimodal Mobility (C2M2) Distinguished Speaker Webinar, Virtual*

2022, Temporal ASR Damage Evaluation of Concrete Structures Leveraging Convolutional Neural Networks and Acoustic Emission. *ACI Spring Convention, Orlando, FL*

2022, Temporal Diagnosis of ASR Expansion in Simulated Nuclear Containment Leveraging Convolutional Neural Networks and Acoustic Emission. *The 63rd meeting of the Acoustic Emission Working Group, Huston, TX* (**Adrian Pollock Student Award**)

2022, Determination of Vehicle Loads on Bridges by Acoustic Emission and An Improved Ensembled Artificial Neural Network. *The 63rd meeting of the Acoustic Emission Working Group, Huston, TX*

PUBLICATIONS

Refereed Journal Articles

Published/accepted papers:

[1] **L Ai**; B Zhang; P Ziehl*****. A Transfer Learning Approach for Acoustic Emission Localization on Stainless Steel Structure Using Numerical Simulation and Unsupervised Domain Adaptation. *Mechanical Systems and Signal Processing*. 2023 June 1;192:110216.

[2] Laxman K C; N Tabassum; **L Ai***; C Cole; P Ziehl. Automated Crack Detection and Crack Depth Prediction for Reinforced Concrete Structures using Deep Learning. *Construction and Building Materials*. 2023 Mar 17;370:130709.

[3] Laxman K C; A Ross; **L Ai***; A Henderson; E Elbatanouny; M Bayat; P Ziehl. Determination of Vehicle Loads on Bridges by Acoustic Emission and an Improved Ensembled Artificial Neural Network. *Construction and Building Materials*. 2023 Jan 18;364:129844.

[4] **L Ai**; V Soltangharaei*****; P Ziehl. Developing a Heterogeneous Ensemble Learning Framework to Evaluate Alkali-silica Reaction Damage in Concrete using Acoustic Emission Signals. *Mechanical Systems and Signal Processing*. 2022 Jun 1;172:108981.

[5] **L Ai**; V Soltangharaei*****; P Ziehl. Evaluation of ASR in Concrete Using Acoustic Emission and deep learning. *Nuclear Engineering and Design*. 2021 Aug 15;380:111328.

[6] **L Ai**; V Soltangharaei; M Bayat; M van Tooren; P Ziehl*****. Detection of Impact on Aircraft Composite Structure Using Machine Learning Techniques. *Measurement Science and Technology*. 2021 May 19; 32(8):084013.

[7] **L Ai**; V Soltangharaei; M Bayat*****; B Greer; P Ziehl. Source Localization on Large-Scale Canisters for Used Nuclear Fuel Storage Using Optimal Number of Acoustic Emission Sensors. *Nuclear Engineering and Design*. 2021 Apr 15;375:111097.

[8] **L Ai**; V Soltangharaei; M van Tooren*****; P Ziehl. A Smart Impact Detection System for Aircraft Control Surface Based on Acoustic Emission Monitoring. *International Journal of COMADEM*. 2021 Sept. 24(3):27-34.

[9] V Soltangharaei; **L Ai**; R Anay; M Bayat*****; P Ziehl. Implementation of Information Entropy, b-value, and Regression Analyses for Temporal Evaluation of AE Data Recorded During ASR Cracking. *Practice Periodical on Structural Design and Construction-ASCE*. 2021 Feb 1;26(1):04020065.

[10] V Soltangharaei; R Anay; **L Ai**; ER. Giannini; J Zhu; P Ziehl*****. Temporal Evaluation of ASR Cracking in Concrete Specimens Using Acoustic Emission. *Journal of Materials in Civil Engineering-ASCE*. 2020 Oct 1;32(10):04020285.

[11] V Soltangharaei; JW Hill; **L Ai**; R Anay; B Greer; M Bayat*****; P Ziehl. Acoustic Emission Technique to Identify Stress Corrosion Cracking Damage. *Structural Engineering and Mechanics*. 2020;75(6):723-736.

Papers under review:

[1] **L Ai**; Laxman K C; E Elbatanouny; M Bayat; M Bayat; M van Tooren; P Ziehl*****. Monitoring and Automatic Characterization of Low-velocity Impacts on Composite Components Through Acoustic Emission. *Composites Part B: Engineering*. (under

review)

[2] **L Ai**; V Soltangharaei; B Greer; M Bayat*****; P Ziehl. Structural Health Monitoring of Stainless-Steel Nuclear Fuel Storage Canister Using Acoustic Emission. *Construction and Building Materials*. (under review)

[3] **L Ai**; M Bayat*****; P Ziehl. Localizing Damage on Stainless Steel Structures Using Acoustic Emission Signals and Weighted Ensemble Regression-based Convolutional Neural Network. *Measurement*. (under review, R2)

[4] Laxman K C; A Henderson; E Elbatanouny; A Ross; **L Ai***; M Bayat; B Ross; T Cousins; P Ziehl. Flexural Strengthening of One-way RC Precast Flat Slabs Using Steel Sections on Top of the Slab. Target journal: *Engineering Structures*. (under review)

[5] E Elbatanouny; **L Ai***; E Deaver; P Ziehl. Impact of Graphene on Microstructure and Compressive Strength of Cement Mortars Utilizing Two Different Dispersion Methods. *Development in the Built Environment* (under review)

[6] X Yan**;** H Su*****; **L Ai;** V Soltangharaei; X Xu; K Yao. Study on Stage Characteristics of Hydraulic Concrete Fracture Under Uniaxial Compression Using Acoustic Emission. *NDT&E international* (under review)

Working papers:

[1] **L Ai***; S Flowers; P Ziehl. Acoustic Emission and Regression Model-Based Detection and Localization of Low-Velocity Impacts in Thermoplastic Aircraft Components. Invited by: *Applied Sciences*. (ready to submit)

[2] **L Ai***; R Krol; A Henderson; V Soltangharaei; B Ross; T Cousins; P Ziehl. Rehabilitation of Timber Piles Using FRP: A Study of Acoustic Emission Characteristics Under Uniaxial Compression. Target journal: *NDT&E international*. (ready to submit)

Referred Conference Proceedings

[1] **L Ai**; B Henderson; S Houck; S Dickson; P Ziehl. Identifying the Energy of Low-velocity Impacts on Composite Components Using Acoustic Emission. *2023 IEEE Aerospace Conference*. 2023 Mar 4.

[2] **L Ai**; M Bayat; G Comert; P Ziehl*****. An Autonomous Bridge Load Rating Framework Using Digital Twins. *The 13th International Workshop on Structural Health Monitoring (IWSHM 2021).*

[3] **L Ai**; E Elbatanouny; Laxman K C; M Bayat; V Soltangharaei; M van Tooren; P Ziehl*****. Detection and Evaluation of Impact Damage on Aircraft Control Surface Using Acoustic Emission and Convolution Neural Network. *The 13th International Workshop on Structural Health Monitoring (IWSHM 2021).*

[4] **L Ai**; Laxman, K C; E Elbatanouny; V Soltangharaei; M van Tooren; P Ziehl*****. Assessment of Impact Damage Level for Composite Aircraft Components Using Acoustic Emission. 2021 Sept 21; *CAMX 2021*. TP21-0000000329.

[5] **L Ai**; V Soltangharaei; Wout de Backer; P Ziehl*****; M van Tooren. A Minimally Intrusive Impact Detection System for Aircraft Moveable using Random Forest. 2020 Sept 21; *CAMX 2020*.TP20-0000000091 (**Outstanding Paper Award**)

[6] **L Ai**; V Soltangharaei; R Anay; M van Tooren; P Ziehl*****, Data-Driven Source Localization of Impact on Aircraft Control Surfaces. *2020 IEEE Aerospace Conference* 2020 Mar 7

(pp. 1-10). IEEE.
[7] **L Ai**; B Greer; J Hill; V Soltangharaei; R Anay; P Ziehl*****, Finite Element Modeling of Acoustic Emission in Dry Cask Storage Systems Generated by Cosine Bell Sources. May 2019, *AIP Conference Proceedings* 2102(1):13000.
[8] V Soltangharaei; R Anay; **L Ai**; Y Le Pape; Z John Ma; P Ziehl*****, Monitoring Alkali Silica Reaction of Large and Medium Scale Concrete Specimens Using Acoustic Emission, *SMIRT 25*. 2019

Book Chapter

[1] V Soltangharaei; **L Ai**; P Ziehl. Implementation of Data-Driven Approaches for Condition Assessment of Structures and Analyzing Complex Data. Leveraging Artificial Intelligence in Engineering, Management, and Safety of Infrastructure 2022 Nov 17 (pp. 91-119). CRC Press.

Technical Report

[1] J Zhu; H Sun; C Malone; P Ziehl; **L Ai**; M Bayat; Y Zhang; Taeyong Shin, and Eric Giannini. Online Monitoring System for Concrete Structures Affected by Alkali-Silica Reaction. No. DOE-UNL-NE8544. Univ. of Nebraska, Lincoln, NE (United States), 2021.

*Note: * refers to the corresponding author*