Pengdi Zhang Ph.D. (08/01 exp.)
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EXECUTIVE SUMMARY

Internationally recognized researcher and R&D 100 Award recipient (2024) for pioneering works in ultrasonic photonics and distributed fiber-optic sensing. Completing Ph.D. at University of Pittsburgh with 2 patents filed, 10 conference proceeding papers, and 4 conference presentations including an invited talk. Experienced in machine learning for dimensionality reduction, feature extraction, and predictive modeling using tensor decomposition, neural networks, and Bayesian optimization.

Developed innovative guided wave-based NDT systems with various fiber sensors (FBG, SMS, distributed acoustic) for structural health monitoring with high-precision defect characterization. Implemented tensor-based signal processing algorithms enhancing fiber optic sensing system sensitivity. Proficient in Python, MATLAB, embedded C++, ANSYS, and COMSOL with expertise in FEA, CFD, thermal analysis, and digital twin development. Seeking challenging multidisciplinary projects and collaborative opportunities to advance next generation sensing and monitoring technologies. Available to start in Sept. 2025.

PROFESSIONAL SKILL

Optic Fiber Sensor System: Fiber Bragg Grating(FBG)， Single-Mode-Multimode-Single-Mode(SMS)，Distributed Acoustic Sensing (DAS).

FEA Skills: CAE, CFD, FEA, COMSOL, ANSYS, and Firedrake, Nektar.

Programming Skills: MATLAB, Python, Embedded C++, SQL, ANSYS APDL, Fortran and HPC Operation.

Numerical Method: Reduced order and multi-fidelity modeling, Gaussian Process Regression (GPR), Bayesian Optimization (BO).

Machine Learning: Deep Learning Architectures (AE, CAE, FFNN), Transfer Learning, Anomaly Detection, Time series Analysis.

EDUCATION

University of Pittsburgh — Pittsburgh, United States
Doctor of Philosophy: Mechanical Engineering (Ohodnicki Lab) — **04/2021 – 08/2025**
Dissertation: Domain-Adapted Artificial Intelligence for Acoustic Fiber Optic Sensor: Bridging Simulation and Experimental Data in Guided Wave-Based Defect Detection

University of Pittsburgh — Pittsburgh, United States
Master of Science: Mechanical Engineering and Materials Science — **09/2018 – 04/2021**
(Certificate: Stanford Certificate on Machine Learning)
Dissertation: Combining Low-Dimensional Models with High-Fidelity Data: A Multi-Fidelity Approach to Transient Heat Transfer Problems

University of Shanghai for Science and Technology — Shanghai, China
Bachelor of Science: Energy and Power Engineering — **09/2014 – 07/2018**

RESEARCH EXPERIENCE

Fusion of Fiber Optics Sensing, Acoustic NDE, and Physics-Based AI for Structure Monitoring | University of Pittsburgh & Leidos Research Support Team, National Energy Technology Laboratory (Proceeding)
06/2022 - present

- **Field Validation:** Partnered with fiber optic sensor team to field test, validate and optimize the fiber sensor's sensitivity to pipe distributed strain, including Fiber Bragg Grating (FBG), Single-Mode-Multimode-Single-Mode (SMS), Distributed Acoustic Sensing (DAS).
- **Fluid-structure Interaction:** Incorporated fluid-structure interaction (FSI) analysis to evaluate pipeline responses under operational and stress-induced conditions, enhancing prediction reliability.
- **Deep Learning Model:** Developed a convolutional neural network (CNNs) and integrated AI-driven analytics into a predictive maintenance framework to detect early signs of wear, corrosion, and leaks.
- **VR Platform:** Developed a cloud-based VR platform with Docker for real-time collaboration & scalability. (Mentored 2 interns to enhance immersive visualization of failures and defect propagation using Unity.)
- **High Efficiency:** Reduced simulation time by 80% by using reduced-order modeling (ROM).
- **Int'l Recognition:** R&D 100 Award in 2024, invited talk at the SPIE DCS 2024 conference, and filed 2 patents.

Ultrasonic Wave Propagation Simulation Tool Development | University of Pittsburgh (Proceeding)

06/2022 - present

- **FEA:** Established guided wave propagation (GWP) model using high-order spectral/hp discretization method.
- **Programming Tools:** Embedded C++, CAD, Unity Engine, Python, AWS IoT.
- **Achievement:** Reduced runtime by 83% and increased processing capability compared to commercial FEA software.

Reduced Order Modeling for Guided Wave Propagation| University of Pittsburgh (Proceeding)

04/2022 - present

- **Decomposition:** Applied Tucker tensor decomposition to guided wave propagation data, creating compact representations of wave-defect interactions in pipeline structures.
- **Model:** Integrated tensor-based feature extraction with deep neural networks using strategic regularization techniques to predict defect parameters from compressed representations.
- **Achievement:** Achieved 1000× computational acceleration compared to FEM while maintaining exceptional prediction accuracy (R^2>0.989) for defect parameters.

Domain adapted AI for Structural Health Monitoring based on Guided Wave Propagation| University of Pittsburgh

01/2021 – Present

- **Specialization:** led acoustic signal processing to improve SHM and NDT for pipeline corrosion management.
- **Collaboration:** collaborated with scientists from National Energy Technology Laboratory (NETL) on GWP modeling and DAS sensor simulations, focusing on acoustic signal processing for high-quality training data.
- **Machine-Learning:** utilized machine learning, including Maximum Mean Discrepancy-Domain Adaptation Neural Networks (MMD-DANN), to align simulation and experimental data, improving acoustic signal analysis and corrosion detection accuracy.
- **ANSYS Modeling:** developed ANSYS Twin Builder for SHM using Distributed Fiber Optics, Acoustic NDE, and Physics-Based AI for real-time monitoring and predictive maintenance.

Multi-Fidelity modeling for Transient Heat Transfer| University of Pittsburgh

08/2019 – 04/2021

- **Reduced-order Modeling:** developed a transient ROM heat transfer model with SVD and Gaussian process regression.
- **Improve Compute Efficiency:** utilized Nektar (spectral/hp discretization) to obtain high-fidelity data, improve compute performance and provide effective solutions for designing and optimizing transient forced convection systems.
- **Achievement:** achieved enhanced efficiency of the design and optimization of heat transfer models.

SELECTED PUBLICATIONS

PUBLICATIONS

A. Published

1. N. Lalam, H. Bhatta, S. Bukka, P. Zhang, N. Diemler, A. Shumski, P. Ohodnicki, M. Buric, R. Wright, "Deep Neural Network Assisted Distributed Strain and Temperature Fiber Sensor System for Natural Gas Pipeline Monitoring", IEEE Transactions on Instrumentation and Measurement, 2025. (Impact factor: 5.6)
2. P. Zhang, A. Venketeswaran, R.F. Wright, N. Lalam, E. Sarcinelli, P.R. Ohodnicki, "Quasi-Distributed Fiber Sensor-Based Approach for Pipeline Health Monitoring: Generating and Analyzing Physics-Based Simulation Datasets for Classification", Sensors, 23(12), 5410, 2023. (Impact factor: 3.4)

B. Submitted

3. P. Zhang, K. Naeem, E. Sarcinelli, A. Venketeswaran, S.R. Bukka, N. Lalam, R. Wright, P.R. Ohodnicki, "Enhancing Machine Learning Models for Guided Wave-Based Pipeline Monitoring: Integrating Experimental Noise Characteristics into Simulation Data for Improved Reliability and Defect Detection", Available at SSRN 5129217.

C. In Preparation

4. P. Zhang, H. Babaee, A. Venketeswaran, S.R. Bukka, K. Naeem, E. Sarcinelli, R. Wright, P.R. Ohodnicki, “Construction of a reduced-order model based on tensor decomposition and its application at guided wave propagation simulations”.
5. K. Naeem, P. Zhang, Dolendra Karki, Tulika Khanikar, Enrico Sarcinelli, and Paul Ohodnicki, “Pipeline condition monitoring using thin No-core fiber sensors and Acoustic-ultrasonics”.

CONFERENCE PROCEEDINGS

6. (Invited Talk) P. Zhang, K. Naeem, E. Sarcinelli, A. Venketeswaran, S.R. Bukka, N. Lalam, R.F. Wright, P.R. Ohodnicki, "Investigation of data augmentation techniques for ultrasonic acoustic fiber sensing signals in guided wave-based pipeline damage detection", Optical Waveguide and Laser Sensors III, 13044, 79-95, 2024.
7. K. Naeem, P. Zhang, E. Sarcinelli, D. Karki, T. Khanikar, Y. Su, N. Lalam, R. Wright, P. Ohodnicki, "Pipeline damage detection using multimode fiber-optic acoustic sensor and ultrasonic guided waves", Optical Waveguide and Laser Sensors III, 13044, 103-113, 2024.
8. E. Sarcinelli, P. Zhang, K. Naeem, R.F. Wright, N. Lalam, P.R. Ohodnicki, "Numerical modeling of cylindrical non-axisymmetric elastic waves for damage detection using fiber optic sensors", Optical Waveguide and Laser Sensors III, 13044, 97-111, 2024.
9. P.R. Ohodnicki, K. Naeem, P. Zhang, Y. Su, D. Karki, N. Lalam, R. Wright, "Recent Developments in Fiber Optic Sensing for Energy Infrastructure Applications", Bragg Gratings, Photosensitivity, and Poling in Glass Waveguides, BM4A-6, 2024.
10. S.R. Bukka, N. Lalam, P. Zhang, R. Wright, P. Ohodnicki, "Reduced Order Model for Guided Wave Propagation on Gas Pipelines to Enable Real-Time Simulation", National Energy Technology Laboratory (NETL), 2024.
11. K. Naeem, P. Zhang, K. Naheem, E. Sarcinelli, D. Karki, N. Lalam, R.F. Wright, P. Ohodnicki, "Non-destructive pipeline monitoring using intelligent fiber-optic acoustic sensor system", Applications of Machine Learning 2024, 13138, 99-107, 2024.

12. P.R. Ohodnicki, E. Sarcinelli, P. Zhang, K. Naeem, D. Karki, R. Meyer, N. Lalam, R. Wright, "Nuclear canister integrity monitoring using quasi-distributed fiber acoustic sensors and physics-based modeling", Optical Waveguide and Laser Sensors II, 12532, 79-90, 2023.
13. E. Sarcinelli, P. Zhang, A. Venketeswaran, R.M. Meyer, R. Wright, H. Babaee, P.R. Ohodnicki Jr, "Feature analysis acoustic signals for fiber-optic-sensing-based NDE for welded structures", Optical Waveguide and Laser Sensors II, 12532, 61-74, 2023.
14. P. Zhang, A. Venketeswaran, S.R. Bukka, E. Sarcinelli, N. Lalam, R.F. Wright, P.R. Ohodnicki, "Machine learning data analytics based on distributed fiber sensors for pipeline feature detection", Optical Waveguide and Laser Sensors II, 12532, 49-60, 2023.
15. N. Lalam, P. Zhang, R. Wright, et al., "AI-Enhanced Distributed Fiber Optic Sensors for Pipeline Monitoring", National Energy Technology Laboratory (NETL), 2023.
16. P. Zhang, A. Venketeswaran, R. Wright, K. Denslow, H. Babaee, P.R. Ohodnicki Jr, "Feature extraction for pipeline defects inspection based upon distributed acoustic fiber optic sensing data", Fiber optic sensors and applications XVIII, 12105, 14-29, 2022.
17. P.R. Ohodnicki, P. Zhang, N. Lalam, D. Karki, A. Venketeswaran, H. Babaee, R. Wright, "Fusion of distributed fiber optic sensing, acoustic NDE, and artificial intelligence for infrastructure monitoring", Optical Fiber Sensors, Tu1-1, 2022.

PATENTS

18. P. Ohodnicki, N. Lalam, R. Wright, P. Zhang, "PIPELINE MONITORING BASED ON ULTRASONIC GUIDED ACOUSTIC WAVE AND FIBER OPTIC SENSOR FUSION", US Patent WO/2024/206,298, Oct. 3, 2024.
19. P. Ohodnicki, P. Zhang, "SYSTEM AND METHOD FOR MONITORING THE HEALTH OF NUCLEAR WASTE STORAGE CANISTERS", US Patent WO/2024/206,395, Oct. 3, 2024.

WORK EXPERIENCE

Internship **Shanghai Energy Conservation Center | China** 01/2018~08/2018

Collected and analyzed energy consumption data of non-industrial companies in Shanghai, compared 2017 data with previous years, and identified reasons for changes in energy consumption through carbon emissions analysis.

Internship **Shanghai Jianxin Internet |Shanghai, China** 01/2016~10/2016

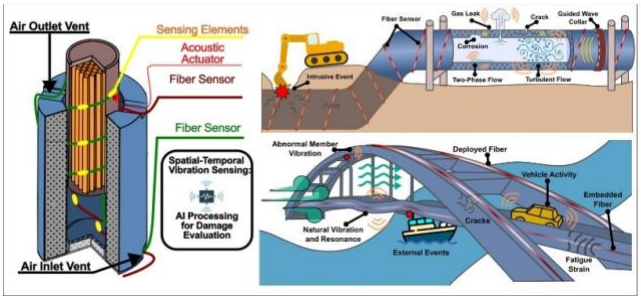
I am responsible for using Python to crawl data and design the database for "provincial and urban streets" in our project. The goal is to automate order placement with factories closest to the destination, reducing logistics costs and delivery time. Additionally, I am working on simplifying the map to a 2D representation to facilitate combining tree-structured and small-scale data, enabling us to create the most efficient order processing system.

SERVICE

- **ANS Student member -** Contributed to the 2022 American Nuclear Society (ANS) Winter Meeting Recording and Organization.
- **Ambassador -** Volunteered to present nuclear science and technology to local officials and community leaders in Piketon, Ohio.
- **Speaker -** Presented on nuclear energy research and applications for Ms. Alice Caponiti, Deputy Assistant Secretary for Strategic Crosscuts, DOE.

APPENDIX

Feature 1: R&D 100 Award of 2024:



Feature 2: Filed Patent WO2024206395 and Patent WO2024206298:

Title

[EN] PIPELINE MONITORING BASED ON ULTRASONIC GUIDED ACOUSTIC WAVE AND FIBER OPTIC SENSOR FUSION
[FR] SURVEILLANCE DE CANALISATION SUR LA BASE D'UNE ONDE ACOUSTIQUE GUIDÉE PAR ULTRASONS ET D'UNE FUSION DE CAPTEUR À FIBRE OPTIQUE

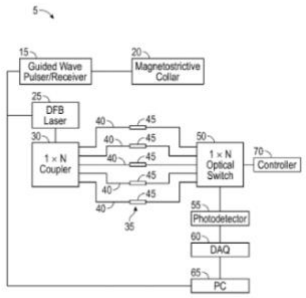


FIG. 1

Title

[EN] SYSTEM AND METHOD FOR MONITORING THE HEALTH OF NUCLEAR WASTE STORAGE CANISTERS
[FR] SYSTÈME ET PROCÉDÉ DE SURVEILLANCE DE LA SANTÉ DE CARTOUCHES DE STOCKAGE DE DÉCHETS NUCLÉAIRES

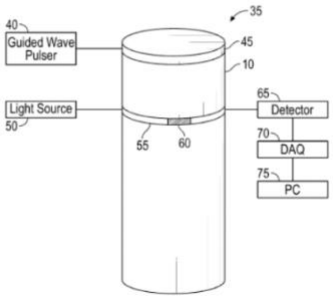


FIG. 2