Pengdi ZHANG Ph.D. (07/31 exp.)
412-692-1687 | Pengdizhang0123@gmail.com | LinkedIn

EXECUTIVE SUMMARY

Internationally recognized researcher and *R&D 100 Award of 2024* (aka *The Oscars of Innovation*) recipient for pioneering works in ultrasonic photonics and distributed fiber-optic sensing. Currently completing a Ph.D. at the University of Pittsburgh with 2 *patents* filed, 10 conference proceeding papers, and 4 conference presentations including an *invited talk*. With extensive experience in machine learning models for dimensionality reduction, feature extraction, and predictive modeling, particularly using autoencoders, neural networks, and advanced techniques like Bayesian optimization. Skilled in Python, MATLAB, embedded C++, ANSYS, and COMSOL, with deep expertise in finite element analysis (FEA), computational fluid dynamics (CFD), and thermal analysis, as well as digital twin system development.

EDUCATION

University of Pittsburgh, *Ph.D. in Mechanical Engineering & Materials Science* - Pittsburgh, PA 07/2025 (exp)

- Advisor*: Prof. Paul R. Ohodnicki (The Ohodnicki Lab)*

University of Pittsburgh, *M.Sc. in Mechanical Engineering & Materials Science* - Pittsburgh, PA 04/2021

- Certificate: *Stanford Certificate on Machine Learning*

University of Shanghai for Science & Technology, *B.Sc. in Energy & Power Engineering* - Shanghai, China 07/2018

WORK & RESEARCH EXPERIENCE

Leidos Research Support Team, National Energy Technology Laboratory - Pittsburgh, PA

Assigned Researcher: Modeling, Validation, and Data Analysis for Pipeline Failure Analysis and Prediction 06/2022 - Present

- **Advanced Modeling**: developed physics-based natural gas pipeline failure model that integrates mechanical integrity and computational fluid dynamics (CFD) simulations for accurate failure prediction
- **Fluid-structure Interaction**: incorporated fluid-structure interaction (FSI) analysis to evaluate pipeline responses under operational and stress-induced conditions, enhancing prediction reliability
- **Field Validation**: partnered with fiber optic sensor team to field test, validate and optimize the multi-physics model
- **Advanced Data Analysis**: 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.
- **Real Time VR Platform**: developed a cloud based VR platform with Docker for real-time collaboration & scalability
- **Intuitive VR Interface**: created an intuitive VR user interface to improve usability and stakeholder's engagement
- **High Fidelity Digital Twin**: invented a digital twin template for gas line leak prediction signature at 95% accuracy
- **High Efficiency**: reduced simulation time by 80% by using reduced-order modeling (ROM) & surrogate modeling
- **Mentorship**: mentored 2 interns to enhance immersive visualization of failures and defect propagation using Unity.
- **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 06/2022 - Present

- **FEA**: established transient mechanics, nonlinear elastic and guided wave propagation (GWP) model using Firedrake
- **Simulation**: integrated FEA into a simulation tool for GWP and dispersion phenomenon on high frequency range
- **Programming Tools**: embedded C++, CAD, Unity Engine, Spl for sensors system, Python, GitHub, AWS IoT
- **Achievement**: reduced runtime by 83% and increased processing capability compared to commercial FEA software

Machine-learning Enhanced Reduced Order Modeling for Uncertainty Quantification of GWP 01/2022 - Present

- **Simulation**: simulated high-fidelity GWP models using FEM, capturing material properties and fiber sensor bonding
- **ML-Model**: developed machine learning model for dimensionality reduction and predictive modeling in structural health monitoring with distributed fiber optic sensors, using autoencoders, neural networks, and Bayesian optimization for adaptive sampling
- **UQ Technique:** : applied advanced UQ techniques to improve GWP prediction reliability and SHM system robustness

***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**: Convolutional Autoencoders (CAE), Feed-Forward Autoencoders (FFNN), Feed-Forward Neural Networks (FFNN)*

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- **Programming Tools**: C++, Python, Linux
- **Achievement**: greatly reduced computational time and improved prediction reliability

Domain-Adapted DL for Structural Health Monitoring Using Fiber Optic Sensing, Acoustic NDE & Physics-Based AI 04/2021 - Present

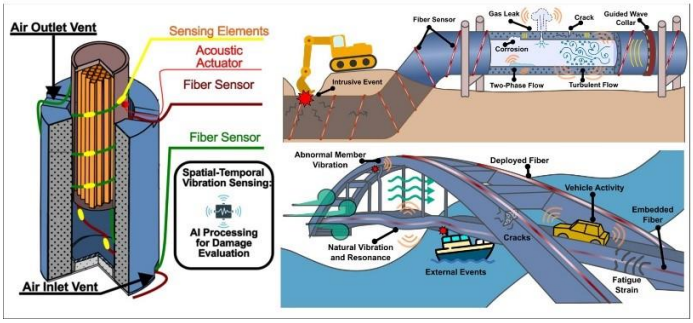
- **Specialization**: led acoustic signal processing to improve SHM and NDT for pipeline corrosion management
- **Collaboration**: collaborated with scientists from National Energy Technology Laboratory (NETL) on GWP modeling and DAS sensor simulations, focusing on acoustic signal processing for high-quality 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 Using ROM 08/2019 - 04/2021

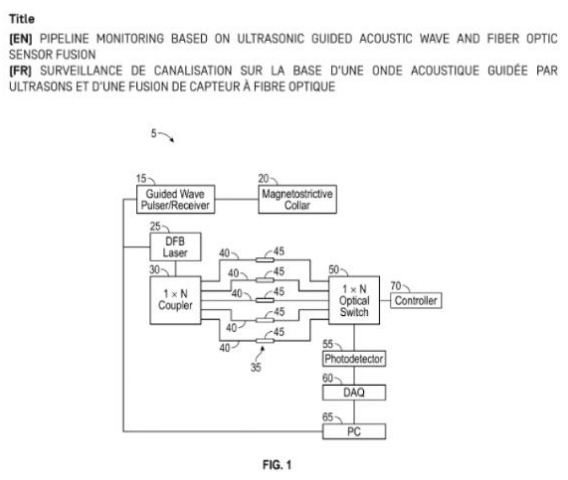
- **Reduced-order Modeling**: developed a transient ROM heat transfer model with SVD and Gaussian process regression.
- **Improve Compute Efficiency**: utilized Nektar to obtain high-fidelity data, improve compute performance and provide effective solutions for designing and optimizing transient forced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

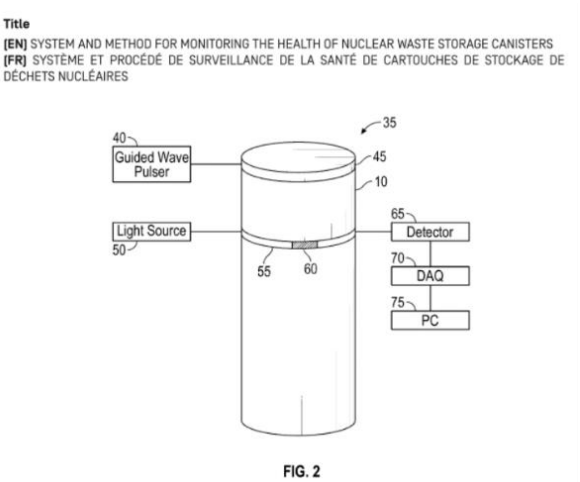
Appendix

Feature #1: *R&D 100 Award of 2024* *(aka The Oscars of Innovation)*



Feature #2: Filed Patent WO2024206395 and Patent WO2024206298 :





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