

# Zachary Langford, PhD

R&D Staff, Oak Ridge National Laboratory

Security Clearance: Q/SCI Clearance

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## INTERESTS

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AI/ML Applications Across Multiple Domains (Energy, National Security, Biometrics, Environment), Building Solutions for Customers, Time Series Analysis, High-Performance Computing, Computer Vision, Distributed Computing, Cloud Computing, MLOps, NLP, Generative AI, Scaling AI/ML to HPC

## PERSONAL STATEMENT

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I'm currently looking for position that utilizes my passion for helping customers to solve complex business problems through the use of distributed computing and associated software development kit. I enjoy working with customers on AI/ML problems across multiple industries using state-of-the-art methods in computer vision, natural language processing, time-series analysis, and generative AI.

## EDUCATION

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2017	<b>University of Tennessee – Knoxville</b> PhD in Energy Science & Engineering Concentration: Environmental Remote Sensing, Machine Learning, Computer Vision
2013	<b>Pennsylvania State University – University Park</b> MS in Civil Engineering Concentration: Geospatial Science, Machine Learning
2011	<b>University of Alabama – Huntsville</b> BS in Atmospheric and Earth Science, Minor: Mathematics

## CERTIFICATIONS

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2022	<b>MIT xPRO</b> Applying Machine Learning to Engineering and Science
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## WORK EXPERIENCE

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<b>R&amp;D Staff</b> <i>Oak Ridge National Laboratory</i>	Aug. 2019 – Present <i>Cyber Resilience &amp; Intelligence Division</i>
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- Delivering pipelines for high-performance computing (HPC) AI/ML GPU algorithm development for scientific research.
- Managing and delivering AI/ML projects (e.g., Docker containers, web apps) to national security customers.
- Developing AI/ML methods (e.g., Transformers, XGBoost) for human activity recognition using physiological signals.
- Fine-tuning LLMs for categorizing text using k-means clustering for weakly supervised learning.
- Working with customers to optimize AI/ML projects (on-premise and Cloud) and suggesting the best path forward.
- Building, delivering, and presenting demos/proofs-of-concept to potential customers around AI/ML use cases.
- Data integration (text/signals) methods within industrial facilities for correlating events to specific sensing modalities.
- Weakly supervised learning methods based on text inputs to derive insights from time series signals.
- Performing testing/evaluation and debugging of academic computer vision projects for the Federal Highway Administration.
- Developing Bayesian methods for sensor fusion of UAVs for object detection probabilities with multiple targets.
- Writing research proposals and white papers around data science and ML applications across multiple domains.
- Explainable artificial intelligence techniques for understanding important sequences and features for time series datasets.
- Contributing to (e.g., visualizations, AI/ML models) over-the-air ML research for wireless communication research.

## Research Scientist

Virginia Tech

Jan. 2019 – Aug. 2019

Hume Center for National Security & Technology

- Developed new approaches for signal classification using deep learning methods and spectrograms.
- Developed siamese convolutional neural networks for better classification of wireless signals with low signal-to-noise ratio.
- Generative Adversarial Network (GAN) modeling of latent space for extracting wanted features of synthetic images.
- Contributed to Bayesian networks for understanding the likelihoods of known causes and contributing factors.

## Advanced Technologist

Boeing Research & Technology

Aug. 2016 – Jan. 2019

Boeing

- Managing projects and building relationships across multiple divisions around geospatial applications.
- Geospatial Deep Learning applications using synthetic modeling of environments and hyper/multispectral sensors.
- Hyperspectral remote sensing sensor modeling for methane detection in the oil industry using computer vision.
- Creating near real-time visualizations with Tableau for discovering trends in manufacturing datasets.
- Geospatial modeling (raster, vector, LiDAR processing) for inputs into autonomous aircraft taxiing.

## UNIVERSITY RESEARCH EXPERIENCE

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### Graduate Research Assistant

Bredesen Center

2014 – 2016

University of Tennessee

- Developed scalable approaches using HPC for environmental research.
- Provided geospatial datasets of Arctic ecosystems for parameterizing HPC land surface models for climate change research.
- Developed multi-sensor fusion frameworks of satellite imagery and ground measurements for retrieving surface parameters.
- Developed automated algorithms for identifying and understanding disturbance threats (e.g., wildfires) using spatiotemporal datasets in Google Earth Engine.

### Graduate Research Assistant

Department of Civil and Environmental Engineering

2011 – 2013

Pennsylvania State University

- Utilized high-resolution, 50 cm – 2 m, panchromatic & multispectral satellite imagery (QuickBird, WorldView-2, and GeoEye) using an object-based image classification to characterize soil moisture profiles in the McMurdo Dry Valleys, Antarctica.
- Create a feed-forward neural network to estimate soil moisture values using multispectral satellite imagery and ground-based measurements.

## TECHNICAL STRENGTHS

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- Programming
  - Frequent: Python, MATLAB, Bash
  - Familiar: R, JavaScript, SQL
  - Learning: Scala, C++, CUDA, MPI
- Frameworks
  - Deep Learning: Tensorflow, Keras, Pytorch, Hugging Face
  - Machine Learning: XGBoost, LightGBM, scikit-learn, OpenCV, MLflow, ClearML
  - Data Processing & Viz: Pandas, Numpy, SciPy, Matplotlib, Ployly, Seaborn
  - Distributed Applications: RAPIDS, Dask, Horovod, PySpark, CUDA Python
- Other
  - Cloud Applications: AWS SageMaker, Azure ML, Google Earth Engine
  - Geospatial: GRASS GIS, QGIS, ArcGIS, DIRSIG
  - Tools: Slurm, Jupyter Notebooks, Git, Docker, Tableau, Kibana, Elasticsearch

## RECENT JOURNAL ARTICLES & CONFERENCE PROCEEDINGS

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Google Scholar Link

- [1] **Understanding Nuclear Facility Events Using Interpretable Machine Learning.**  
In *Institute of Nuclear Materials Management 63<sup>rd</sup> Annual Meeting*, 2022.  
Zachary L. Langford and Thomas P. Karnowski and Aaron Werth.
- [2] **Scalable Wildfire Classification Using Distributed Memory Parallel, GPU-enabled Support Vector Machines.**  
In *2022 American Geophysical Union (AGU) Fall Meeting*, December 15, 2022, Chicago, IL, USA.  
Richard T. Mills and Zachary L. Langford and Marek Pecha and Jitendra Kumar and Forrest M. Hoffman and David Horak.
- [3] **Wildfires Identification: Semantic Segmentation Using Support Vector Machine Classifier.**  
In *Programs and Algorithms of Numerical Mathematics 21*, 2022.  
Marek Pecha and Zachary L. Langford and David Horák and Richard Tran Mills.
- [4] **Leveraging gradient weighted class-activation mapping to improve classification effectiveness: Case study in transportation infrastructure characterization.**  
In *Electronic Imaging*, 2022.  
Thomas P. Karnowski and Deniz Aykac and Regina K. Ferrell and Christy Gambrell and Zachary Langford and Lauren Torkelson.
- [5] **Robust Signal Classification Using Siamese Networks.**  
In *Proceedings of the ACM Workshop on Wireless Security and Machine Learning, WiseML 2019*, page 1–5, New York, NY, USA, 2019. Association for Computing Machinery.  
Zachary L. Langford and Logan Eisenbeiser and Matthew Vondal.
- [6] **Deep Transfer Learning with Field-Based Measurements for Large Area Classification.**  
In *Proceedings of the 2019 IEEE International Conference on Data Mining Workshops (ICDMW 2019)*. Institute of Electrical and Electronics Engineers (IEEE), November 2019.  
Zachary L. Langford and Jitendra Kumar and Forrest M. Hoffman.
- [7] **Arctic Vegetation Mapping Using Unsupervised Training Datasets and Convolutional Neural Networks.**  
*Remote Sensing*, 11(1):69, January 2019.  
Zachary L. Langford and Jitendra Kumar and Forrest M. Hoffman and Amy L. Breen and Colleen M. Iversen.
- [8] **Wildfire mapping in Interior Alaska using deep neural networks on imbalanced datasets.**  
In *Proceedings of the 2018 IEEE International Conference on Data Mining Workshops (ICDMW 2018)*. Institute of Electrical and Electronics Engineers (IEEE), November 2018.  
Zachary L. Langford and Jitendra Kumar and Forrest M. Hoffman.
- [9] **Convolutional neural network approach for mapping arctic vegetation using multi-sensor remote sensing fusion.**  
In *Proceedings of the 2017 IEEE International Conference on Data Mining Workshops (ICDMW 2017)*. Institute of Electrical and Electronics Engineers (IEEE), November 2017.  
Zachary L. Langford and Jitendra Kumar and Forrest M. Hoffman.

## PATENTS

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- [10] Robert J. Klein and John H. Aughey and Zachary L. Langford.  
**Apparatus, system, and method for generating an image**, 2017.  
US20190158805A1.