Zachary Langford, PhD

R&D Staff, Oak Ridge National Laboratory
Security Clearance: Q/SCI Clearance
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INTERESTS

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

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 kits (SDKs). 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

2017 **University of Tennessee – Knoxville**
PhD in Energy Science & Engineering
Concentration: Environmental Remote Sensing, Machine Learning, Computer Vision

2013 **Pennsylvania State University – University Park**
MS in Civil Engineering
Concentration: Geospatial Science, Machine Learning

2011 **University of Alabama – Huntsville**
BS in Atmospheric and Earth Science, Minor: Mathematics

CERTIFICATIONS

2022 **MIT xPRO**
Applying Machine Learning to Engineering and Science

WORK EXPERIENCE

R&D Staff Aug. 2019 – Present
Oak Ridge National Laboratory *Cyber Resilience & Intelligence Division*

- 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 Jan. 2019 – Aug. 2019

Virginia Tech *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 Aug. 2016 – Jan. 2019

Boeing Research & Technology *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

Graduate Research Assistant 2014 – 2016

Bredesen Center *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 2011 – 2013

Department of Civil and Environmental Engineering *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

- 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, Ploly, 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

Google Scholar Link

[1] **Understanding Nuclear Facility Events Using Interpretable Machine Learning**.
In *Institute of Nuclear Materials Management 63rd 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

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