

# Jeremy Davis

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## Objective

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To find a research position where I can apply my knowledge and skills in the fields of computer vision, scene understanding and natural language processing.

## Experience

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### **Babel Street, Inc. Starkville, MS. August 2017 – Present**

Staff Machine Learning Engineer

- Content based image retrieval
  - Developed a CBIR algorithm using state-of-the-art computer vision techniques
  - System retrieved stored similar images given a prompt image
  - System developed using the Keras/Tensorflow framework
- Volume Alerting
  - Used statistical methods to determine when system users should be alerted to an increase in traffic across various data sources in real time
  - Developed visualization tool using Bokeh
- Multi-lingual violence/intent classification
  - Created convolutional neural network binary classifier that used multilingual transformer embeddings to vectorize text input for classification
    - CNN used to determine if text snippet contained mentions of violence
  - Fine-tuned XLMRoBERTa transformer model for intent classification
    - XLMRoBERTa model used as a binary classification method for determining if text contained intent to cause harm
    - Used CNN model positive class outputs as a filter mechanism to limit input to the transformer model due to high computation costs
  - Models created using the PyTorch, PyTorch Lightning, HuggingFace, and Optuna frameworks and libraries
- Topic Modeling
  - Developed multilingual clustering and modeling algorithm that segments text into an appropriate number of topics across a variety of data sources

**US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS June 2009 – August 2017**

Computer Scientist

- Developed algorithms to detect features, classify objects, and perform scene understanding on real-time streaming imagery using the OpenCV and Tensorflow libraries
- Used the OpenCV computer vision library to segment regions of interest in images for classification
  - Optimized a parameter set for the segmentation algorithm using a novel particle swarm optimization and novel genetic algorithm implementation
  - Created and trained a support vector machine that classifies road signs in images
- Used the OpenCV computer vision library to create a color and shape filter for various objects in order to perform object detection in real-time on both real and simulated images
- Used the OpenCV computer vision library to create disparity maps from remote camera inputs
  - Implemented Stereo Rectification code using OpenCV and C++
- Computed 3D point clouds based on disparity maps and remote camera inputs using a C++ implementation of the point cloud library (PCL)
- Created voxel grids from individual point clouds to allow visualization of large data sets
  - Parallelized voxel grid computation
- Visualized voxel grids/point clouds using the Point Cloud Library and C++
- Developed various heuristic search algorithms for a military research project to simulate autonomous vehicle navigation based on environment sensor data
  - Worked with the ERDC HPC and members of the Geostuctures Laboratory to parallelize the heuristic search algorithms for execution on the HPC
- Simulated dynamic human behavior in a simulated environment, including squad formation change using heuristic search techniques
  - Worked with the ERDC HPC and members of the Geostuctures Laboratory to parallelize the simulations for execution on the HPC
- Developed heuristics and heuristic search algorithms to compute the shortest path for shipping routes in the inter-coastal waterway network
- Designed, implemented and maintained a web interface for an inventory management system for coastal structures maintained for the US Army Corps of Engineers

**Scholarship For Service (SFS) Recipient, Mississippi State University, Starkville, MS August 2009 – May 2011**

Graduate Research Assistant

- Performed research on topics in the field of cyber security including computer forensics and cryptography

**The Optics Project on the Web (WebTOP), Mississippi State University, Starkville, MS March 2007 – May 2011**

Research Assistant

- Simulated optical phenomena graphically using the Java programming language and the X3D library

- Using X3D, created animation for optical phenomena based on a set of user inputs

## Education

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**Doctor of Philosophy, Computer Vision/Scene Understanding Research Focus, Mississippi State University, Starkville, MS**

Graduation: May 2022. GPA: 4.0/4.0.

**Master Of Science, Computer Science/Artificial Intelligence Research Focus, Mississippi State University, Starkville, MS**

Graduation: May 2011. GPA: 4.0/4.0.

**Bachelor of Science, Computer Science, Mississippi State University, Starkville, MS**

Graduation: December 2008. GPA: 3.8/4.0.

## Skills

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- Extensive experience with the PyTorch, PyTorch Lightning, and Optuna deep learning frameworks
- Extensive experience with the Python, C++, and C# programming languages
- Extensive experience with the OpenCV computer vision library
- Extensive experience with AWS technology including the Sagemaker framework
- Experience with the Tensorflow deep learning framework
- Extensive research performed in the fields of computer vision, natural language processing, machine learning and deep learning

## Publications

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- Davis, Jeremy E. et al. "Spatial Relationship-Driven Computer Vision Data Set Annotation." IEEE World Congress on Computational Intelligence. Padula, Italy. July 2022.
- Davis, Jeremy. "Incorporating Spatial Relationship Information in Signal-To-Text Processing." Dissertation, Mississippi State University. May 2022.
- Durst, Phillip J. et al. "A Novel Framework for Verification and Validation of Simulations of Autonomous Robots." Simulation Modelling Practice and Theory. Volume 117, February 2022.
- Davis, Jeremy E., et al. "Computational Intelligence-Based Optimization of Maximally Stable Extremal Region Segmentation for Object Detection." International Society of Optics and Photonics: Defense and Commercial Sensing. Anaheim, CA. *Publication Date: April 2017.*
- Davis, Jeremy E., Bednar, Amy E., Goodin, Christopher T. "Optimizing MSER Parameters Using the Particle Swarm Optimization Algorithm." USACE Engineer Research and Development Center/Information Technology Laboratory Technical Report. *Submitted November 2016. Report Date September 2019.*
- Guillermo A. Riveros, et al. "A Procedure for Predicting the Deterioration of Steel Hydraulic Structures to Enhance Their Maintenance, Management, and Rehabilitation," (ERDC/ITL TR-14-1, Engineer Research and Development Center, June 2014).

- Jeremy E. Davis, Joseph D. Maclean, Sam J. Dornan, "Comparing Weight Generation Methods for Neural Networks Applied to the Road Pixel Identification Problem," Intelligent Engineering Systems Through Artificial Neural Networks, Vol. 20, ASME Press, New York, 2010.
- Jeremy Davis, Joe Maclean, David Dampier, "Methods of Information Hiding and Detection in File Systems," Proceedings of the Fifth International Workshop on Systematic Approaches to Digital Forensics Engineering, IEEE, Oakland, 2010.
- B.J. Thomas, et al, "WebTOP: an X3D-Based, Web-Delivered, Interactive System for Optics Instruction," Proceedings of the 13<sup>th</sup> International Symposium on 3D Web Technology, ACM, Los Angeles, 2008.

## Honors and Activities

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- Upsilon Pi Epsilon Computer Science Honor Society
- Phi Kappa Phi Collegiate Honor Society
- Phi Theta Kappa Community College Honor Society
- Department of the Army Achievement Medal for Civilian Service Given December 2015

## References

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Available upon Request