Kelvin Kwakye

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Google Scholar Citation: 43

Education

- **North Carolina A&T State University** — Greensboro, USA
  Doctor of Philosophy (Ph.D.) in Industrial & Systems Engineering — *January 2021 - December 2024*
  - *Research Areas:* Human Factors, Transportation Safety, Autonomous Vehicles, Machine Learning, Naturalistic Driving, Internet of Things, NLP
- **North Carolina A&T State University** — Greensboro, USA
  Master of Science (MSc) in Industrial & Systems Engineering — *August 2018 - December 2020*
  - *Research Areas:* Transportation Planning, Transportation Safety, Ridesharing, Demand Modeling
- **Kwame Nkrumah University of Science and Technology** — Kumasi, Ghana
  Bachelor of Science (BSc.) in Chemical Engineering — *September 2013 - July 2017*
  - *Research Areas:* Chemical Plant Design, Heat & Mass Transfer

Research Interests

- **Human-Vehicle Interactions**:
- **Driver Behavior**:
- **Intelligent Transportation Systems**:
- **Autonomous and Connected Vehicles**:
- **Big Data Analytics in Transportation**:
- **Travel Demand Modeling and Forecasting**:
- **Transportation and Traffic Safety Research**:
- **Sensor Perception and Performance**:
- **Public Transportation**:
- **Congestion Management**:
- **Digital Twins and Smart Cities**:
- **Advanced Driver Assistance Systems**:

Skills Summary

- **Software**: VISSIM, Synchro, SimTraffic, AutoCAD, Microstation
- **Languages**: Python, ReactJs, R, SQL, Matlab
- **Frameworks**: Scikit, NLTK, SpaCy, Pytorch, TensorFlow, Keras, Django, Flask, NodeJS, LAMP
- **Tools**: Kubernetes, Docker, GIT, PostgreSQL, MySQL, SQLite
- **Platforms**: Linux, Web, Windows, Arduino, Raspberry Pi, AWS, GCP
- **Soft Skills**: Leadership, Event Management, Writing, Public Speaking, Time Management

Academic Appointments

- **Research Lead**: Aggies Autonomous Auto, North Carolina A&T State University — August 2021-Present

Professional Activities

- **Reviewer**: Human Factors & Ergonomics Society, August 2022-Present
- **Reviewer**: Transportation Research Board, January 2021-Present
- **Reviewer**: International Journal on Data Science and Technology, January 2020-Present

Courses Instructed

- **North Carolina A&T State University** — Greensboro, NC, USA
  ISEN665-Fall 2023: Human Machine Systems — *Fall 2023*
- **North Carolina A&T State University** — Greensboro, NC, USA
  ISEN260: Engineering Economy — *Spring 2021*
- **North Carolina A&T State University** — Greensboro, NC, USA
  ISEN415: Discrete Event Systems Model Simulation — *Fall 2019*
- **North Carolina A&T State University** — Greensboro, NC, USA
  ISEN480: Engineering Statistics — *Fall 2018*

Refereed Publications

J-5. **Kwakye, K.**, Aboah, A., Seong, Y., & Yi, S. (2024). All You Need is Data: A Multimodal Approach in Understanding Driver's Behavior. **Proceedings of the Human Factors and Ergonomics Society Annual Meeting.** https://doi.org/10.1177/10711813241275942

J-4. **Kwakye, K.**, Seong, Y., & Yi, S. (2024). Comparative Analysis of Driver Distraction Classification Using Various Deep Learning Frameworks. **Journal of Traffic and Transportation Engineering. (Submitted)**

J-3. **Kwakye, K.**, Aboah, A., Seong, Y., & Yi, S. (2023). Classification of Human Driver Distraction Using 3D Convolutional Neural Networks. **Proceedings of the Human Factors and Ergonomics Society Annual Meeting.** https://doi.org/10.1177/21695067231192576 (HFES)

J-2. **Kwakye, K.**, Seong, Y., Yi, S., & Aboah, A. (2023, October). DriveSAM: Cognitive Perspective on Driving Maneuvers Based on Drivers' Attention Using Eye Gaze Data. In 1st International Conference on Smart Mobility and Vehicle Electrification. https://doi.org/10.46254/EV01.20230071. (IEOM)

J-1. **Kwakye, K.**, Seong, Y., & Yi, S. (2020, August). An Android-based mobile paratransit application for vulnerable road users. **In Proceedings of the 24th Symposium on International Database Engineering & Applications** (pp. 1-5). (IDEAS)

Conference Presentations

P-5. Classification of Human Driver Distraction Using 3D Convolutional Neural Networks. (HFES 2023)

P-4. DriveSAM: Cognitive Perspective on Driving Maneuvers Based on Drivers' Attention Using Eye Gaze Data. (IEOM 2023)

P-3. Integrating Hardware and Software Systems for Enhanced Decision-Making in Autonomous Vehicles. (IEOM 2023)

P-2. An Android-based mobile paratransit application for vulnerable road users. (IDEAS 2020)

P-1. An Interactive Mobile-based Transportation Information Aid for VRUs: An Integration of Bus Tracking and Computer Vision for Awareness and Decision Making. (CATM 2019)

Papers Under Review

R-5. **Kwakye, K.**, Seong, Y., Aboah, A., & Yi, S. (2023). SigSegment: A Signal-Based Segmentation Algorithm for Identifying Anomalous Driving Behaviors in Naturalistic Driving Videos. arXiv preprint arXiv:2304.09247.

R-4. **Kwakye, K.**, Seong, Y., & Yi, S. (2022). Travel Time, Distance and Costs Optimization for Paratransit Operations using Graph Convolutional Neural Network. arXiv preprint arXiv:2205.10507.

R-3. **Kwakye, K.**, Dadzie, E., Seong, Y., and Yi, S., "Social Responsibility Considerations for Autonomous Vehicles Implementation: Design and Legislature for Equity towards Vulnerable Groups," SAE MobilityRxiv™ Preprint, submitted February 9, 2022, https://doi.org/10.47953/SAE-PP-00234.

R-2. Dadzie, E., & **Kwakye, K.**(2021). Developing a Machine Learning Algorithm-Based Classification Models for the Detection of High-Energy Gamma Particles. arXiv preprint arXiv:2111.09496.

R-1. **Kwakye, K.**, & Dadzie, E. (2021). Machine learning-based classification algorithms for the prediction of coronary heart diseases. arXiv preprint arXiv:2112.01503.

Proposal Writing and Funded Research Grants

G-2. Sponsor: Federal Funds (USDOT UTC Program)
Title: "VRU-MAP – Vulnerable Road User-Mobility Assistance Platform"
Amount: $240,835
Contribution: 5%
Duration: 2016 - 2019
CENTER FOR ADVANCED TRANSPORTATION MOBILITY

G-1. Sponsor: General Motors & SAE
Title: "AutoDrive Challenge II Project"
Contribution: Student Research Lead
Duration: 2021 - 2025
AGGIES AUTONOMOUS AUTO

Supervised Students

Undergraduate

G-1. Craig Fitzpatrick (Co-advised with Younho Seong)

G-2. Joseph Bertrand (Co-advised with Sun Yi)

G-3. Seth Barnes (Co-advised with Sun Yi)

G-4. Jordan Haliburton (Co-advised with Sun Yi)

Masters

G-1. Orlanzel Washington (Co-advised with Sun Yi)

G-2. Michael Famakinde (Co-advised with Sun Yi)

G-3. Richard Holdbrook (Co-advised with Sun Yi)

G-4. Byron Hall (Co-advised with Sun Yi)

Honors and Awards

- Won Second place in the Autodrive Challenge II 2024 (Project Leadership) organized by GM & SAE
- Led a team that placed 3rd in the Autodrive Challenge II 2024 (Systems Safety and Technical Reports) organized by GM & SAE
- Won Second place at Data Science for Pavements Symposium 2024 (DSPS24)
- Recipient of Cadence's Diversity in Technology Scholarship for 2023
- Won Second place in the Human Factors and Ergonomics Competition Awards organized by IEOM - October 2023
- Led a team that placed 3rd in the Autodrive Challenge II 2021 (Concept Design) organized by GM & SAE
- Led a team that placed 4th in the Autodrive Challenge I 2020 (Social Responsibility) organized by GM & SAE
- Outstanding Departmental President - Ghana Engineering Student Association Awards (2015/2016 Academic Year)

Research Projects

- **Traffic Anomaly Detection (Computer Vision)**: In this project, we developed a framework for detecting traffic anomalies in video data. The proposed methodology relies on an augmented annotation pipeline that pre-annotates the training dataset using an object detection model trained on the COCO dataset. Annotations are subsequently used to build a vehicle detection model using the YOLOv5 network. Next, we estimate the background of each traffic video by computing the median of frames randomly sampled from a uniform distribution over a thirty-second period. Vehicle detections on extracted backgrounds are classified as anomaly candidates. Factors such as vehicle detection size, likelihood, and road feature masks were used to construct a decision tree to eliminate false anomalies. The start and end of an anomaly were computed by superimposing detections from anomaly candidates and their foreground detections.
- **Traffic Signal Performance Evaluation for Vulnerable Road Users (Machine Learning)**: This project has 2 main objectives: 1) to categorize pedestrians into subcategories in order to address their safety requirements at intersections; 2) to estimate the time required to cross an intersection and determine whether the pedestrian can safely cross within the pedestrian signal time allotted at intersections. The objectives were accomplished using data collected from three Ouster digital LiDAR sensors installed at an intersection in Chattanooga, Tennessee. The data was collected over a period of 3 hours. The datasets contain pedestrian and signal phase data. The LiDAR dataset included information about the physical characteristics of pedestrians such as their speeds, positions, directions, and size. The study defined heuristics to subclassify the pedestrian and evaluated the accuracy of the sub-classification using machine learning models. The study also carried analysis to determine if pedestrians were able to cross the intersection or not during the pedestrian allocated time.
- **Machine Learning Framework for Real-Time Assessment of Traffic Safety Utilizing Connected Vehicle Data (Machine Learning)**: The study proposes a framework that involves utilizing disaggregate vehicle trajectory data from connected vehicles deployed within the transportation network. This framework defines a process for extracting different variables from a high-resolution data source and exploring their potential application as useful signals for detecting potential safety-critical situations.
- **Artificial intelligence-enabled traffic monitoring system (Computer Vision)**: A novel approach to automatically monitor real-time traffic footage using deep convolutional neural networks and a stand-alone graphical user interface
- **Traffic Lights Detection & Tracking (Computer Vision)**: In this project I developed a Traffic light detection model using YOLO v5 and Deepsort for tracking. The task involved annotating 1000s of images and training the state-of-the-art single-stage object detection model YOLOv5 with the custom dataset. Tech: Python, Pytorch, Pandas

- **Anomaly Detection (Computer Vision)**: Developed a traffic anomaly detection model using deep learning powered with a decision tree. Tech: Python, YOLO v5, Pytorch, & OpenCV.
- **Next Word Prediction (Natural Language Processing)**: The goal of this project is to use transformer models to predict the next word or a masked word in a sentence. The transformer model is a type of neural network architecture that has been shown to be highly effective in natural language processing tasks such as language translation and language understanding. In this project, the transformer model will be trained on a large corpus of text data using a technique called masked language modeling. In this technique, a portion of the words in the input sentence are randomly masked and the model is trained to predict the original word based on the context of the remaining words in the sentence. Tech: Python, Pytorch, Transformer.
- **Speech & Emotion Recognition (NLP, Computer Vision)**: The goal of this project is to develop a convolutional neural network (CNN) model to classify various speech files into different emotions. The model will be trained on a dataset of speech files that have been labeled with different emotions such as happy, sad, angry, neutral, etc. Tech: Python, Pytorch, CNN
- **CamVid Project (Computer Vision, Naturalistic Studies)**: The goal of the CamVid project is to develop a deep learning model for multiclass semantic segmentation using the Unet architecture. The CamVid project is a computer vision project that focuses on naturalistic studies, which aims to develop models that can understand the visual world in the same way that humans do. The project's goal is to develop a model that can segment an image into different classes of objects, such as cars, pedestrians, buildings, etc. Tech: Python, Pytorch, CNN, Unet
- **3D Image Reconstruction (Computer Vision)**: The goal of this project is to perform a 3D reconstruction of Google Street View images for direct distance measuring using computer vision techniques. 3D reconstruction is the process of creating a 3D model of an object or a scene from 2D images. In this project, the focus is on reconstructing 3D models of buildings and other structures from Google Street View images. Tech: Python, Pytorch
- **Paratransit Routing Problem**: The goal of this project is to use GTFS and ArcPy to develop a bus routing system for paratransit users. The routing problem is a problem of optimizing paratransit operations cost and determining the most efficient routes for buses to take in order to serve the needs of the vulnerable users. This problem is especially challenging for paratransit operators where there are high operation costs, destinations, and routes to consider. Tech: Android, GCP, Arcpy

- **Text Generation (NLP)**: Built a Markov chains function that creates a dictionary for text generation.
- **DeepInsight (NDS)**: The study develops an end-to-end pipeline for automatic, frame-by-frame labeling of NDS videos into various driving events by using vehicle telemetry data. To achieve this goal, we formulated the problem as a time series segmentation and classification problem. The segmentation task was achieved by developing a novel segmentation algorithm that utilizes the principle of energy-maximization to detect the start and end of any driving event.
- **Eye Detection (NDS and Computer Vision)**: Developed a deep learning model to detect the eye positioning of drivers while driving in a naturalistic driving environment using YOLOv5 for detection and deepsort for tracking.
- **Weather Prediction**: Developed an LSTM model to perform a multiclass classification of weather.
- **Accident Analysis**: Developed a machine learning model to understand the various causes of vehicle crashes.

Volunteer Experience

- **Computer Vision Tutorials** — Virtual, USA
  Organized free computer vision tutorials for everyone interested in the summer. — *June 2021 - August 2021*
- **FIRST Tech Challenge State Championship** — Greensboro, NC, USA
  Served as Robotics Judge for high school students state competition — *January 2023*

Professional Affiliations

- **Member**: Human Factors & Ergonomics Society, HFES
- **Member**: Transportation Research Board, TRB
- **Member**: Industrial Engineering and Operations Management, IEOM
- **Member**: Society of Automotive Engineers, SAE
- **Member**: National Society of Black Engineers, NSBE