Jean Rodrigue Bitsinda Ikuzwe

Electrical & Computer Engineering Alumni (MSECE, Class of 2025), CMU-Africa, Kigali, Rwanda
jbitsind@andrew.cmu.edu — Google Scholar — linkedin.com/in/jrodrigue/ — +250 (785) 391-669

RESEARCH INTERESTS

Core: AI for Social Good • Ethical & Explainable AI • Sustainable AI
Technical: Multimodal Learning • Edge AI & TinyML • 3D Computer Vision
Applications: Assistive Technologies • Environmental Sustainability • Public Health

EDUCATION

- **Master of Science in Electrical and Computer Engineering (MSECE)** Aug 2023–May 2025
  Carnegie Mellon University Africa, Kigali, Rwanda

- **Master of Science in Condensed Matter Physics(MSCMP)** Dec 2021–Dec 2023
  ICTP-East African Institute of Fundamental Research, Kigali, Rwanda

- **Bachelor of Science in Physics** Sep 2016–Dec 2020
  University of Rwanda - College of Science and Technology, Kigali, Rwanda

RESEARCH EXPERIENCE

Graduate Research Assistant Sep 2024 — Dec 2024
Carnegie Mellon University Africa, Kigali, Rwanda

- Led a student team on a project focused on AI and CV for 3D prosthetic reconstruction.
- Managed AI tasks, including model optimization for 3D reconstruction of prosthetics.
- Co-authored a journal paper in the *Journal of Mechanical Design*, awarded and extended from IDETC-CIE ASME Conference 2024.
- Designed experiments, preprocessed data, and evaluated model pipelines.
- Refined AI techniques for prosthetic applications, enhancing reconstruction accuracy and usability.

Graduate Summer Research Intern June 2024 — Aug 2024
Carnegie Mellon University Africa, Kigali, Rwanda

- Optimized CV and AI models for precise 3D reconstructions.
- Designed experiments and collected data used in 3D reconstructions.
- Refined AI techniques and integrated them into prosthetic applications.
- Conducted 3D printing of digital prosthetic limbs, ensuring precision and functionality.
- Co-authored a research paper accepted and published at IDETC-CIE ASME Conference 2024.

Volunteer Contributor Jan 2024 — May 2024
Carnegie Mellon University Africa, Kigali, Rwanda

- Assisted in early-stage data collection and preprocessing for 3D reconstruction.
- Explored literature to identify state-of-the-art techniques for AI-driven prosthetic reconstruction.
- Contributed to initial discussions on experimental design and methodology.

Graduate Researcher Jan 2023 — July 2023
ICTP-East African Institute for Fundamental Research (ICTP-EAIFR), Kigali, Rwanda

- Developed a machine learning approach for constructing Sum-of-Product (SOP) Potential Energy Surfaces (PES) in quantum dynamics.
- Applied Neural Networks, Kernel Ridge Regression, and Gaussian Process Regression to fit PES efficiently.
- Investigated High-Dimensional Model Representation (HDMR) for scalable molecular modeling.
- Integrated fitted PES models into quantum simulations, enhancing predictions for molecular interactions.

PROJECTS

Building a Robust 3D Reconstruction System from Low-Fidelity 2D Images Jan 2024–Dec 2024
Carnegie Mellon University Africa, Kigali, Rwanda
Skills and Tools: *Research Formulation, Scientific Writing, Quantitative Analysis, Experimental Design, Technical Documentation, Python, 3D Reconstruction, Team Collaboration, Project Management, OpenCV, Blender, Colmap, Rhino.*

- Led AI and computer vision tasks for 3D prosthetic reconstruction.
- Optimized 3D reconstruction models and integrated them into prosthetic applications.
- Designed experiments, preprocessed data, and evaluated model performance.
- Conducted 3D printing of digital prosthetic limbs.
- Co-authored an award-winning journal paper in the *Journal of Mechanical Design*, extended from IDETC-CIE ASME Conference 2024.
- Co-authored a conference paper accepted at IDETC-CIE ASME Conference 2024.
- Currently co-authoring a third research paper on advancements in AI-driven 3D reconstruction for prosthetics.

Taxi Fare Prediction Application (Cloud Computing Coursework) Nov 2024–Dec 2024
Carnegie Mellon University Africa, Kigali, Rwanda
Skills and Tools: *GCP (AI Platform, App Engine), XGBoost, Flask, Cloud Vision API, AutoML, Python, Feature Engineering, Pipeline Integration*

- Completed as part of a rigorous cloud computing project replicating real-world challenges faced by specialists.
- Developed an end-to-end ML pipeline converting speech queries into fare estimates.
- Engineered features from NYC taxi data and optimized an XGBoost model on GCP.
- Deployed a Flask API on App Engine for scalable, low-latency predictions.
- Integrated bonus functionalities including landmark recognition and custom model training.

Unified Data Aggregation and Visualization Pipeline: Scalable Data Integration and Analytics Framework Nov 2024–Dec 2024
Carnegie Mellon University Africa, Kigali, Rwanda
Skills and Tools: *Python, Prefect, Dash, Plotly, MongoDB, PostgreSQL, ETL, Big Data Analytics*

- Developed an automated ETL pipeline using Prefect to extract, transform, and load data from diverse sources.
- Integrated data from PostgreSQL and MongoDB into a unified dataset, ensuring consistency across heterogeneous sources.
- Built an interactive dashboard with Dash and Plotly Express to visualize key metrics and generate actionable insights.
- Designed the framework for future scalability with the potential to incorporate advanced tools such as Kafka and Cassandra for real-time processing.

Smart Sorter: Neural Network-Enhanced Recycling Bin Feb 2024–April 2024
Carnegie Mellon University Africa, Kigali, Rwanda
Skills and Tools: *Python, PyTorch, ResNet50, Stable Diffusion Model (SDM), Transfer Learning, Data Augmentation, Model Optimization, Image Classification, Dataset Engineering, Cross-Validation*

- Final project for the *Introduction to Deep Learning* course.
- Developed a real-time waste classification system using a modified ResNet50.
- Enhanced dataset diversity with a Stable Diffusion Model:
  - Applied diffusion and autoregressive modeling to generate realistic synthetic samples.
  - Trained the SDM to refine data quality for robust classification.
- Achieved 94% classification accuracy via synthetic data integration and transfer learning.
- Validated performance on the TrashNet dataset using cross-validation and key evaluation metrics.

Developing a Scalable Machine Learning-Based Potential Energy Surface (PES) Fit for Molecules: Sum-of-Product Approach Jan 2023–July 2023
***ICTP-EAIFR*, Kigali, Rwanda**
Skills and Tools: *Machine Learning, Deep Learning, Python, TensorFlow, Model Optimization, Cluster Computing, Computational Chemistry, Neural Networks, Scientific Computing.*

- Developed a machine learning approach to construct Sum-of-Product (SOP) Potential Energy Surfaces (PES) for quantum dynamics.
- Applied Neural Networks, Kernel Ridge Regression, and Gaussian Process Regression to efficiently fit PES models.
- Investigated High-Dimensional Model Representation (HDMR) to optimize scalability for larger molecular systems.
- Integrated the fitted PES models into quantum dynamical simulations, enhancing accuracy for molecular interaction predictions.

PUBLICATIONS

- **Increasing Accessibility of 3D-Printed Customized Prosthetics in Resource-Constrained Communities** — Published: November 13, 2024
  Carnegie Mellon University Africa
  DOI: doi.org/10.1115/DETC2024-143810
  Status: Published in IDETC-CIE ASME 2024 Conference
  Credited as Coauthor

- **Accessible Digital Reconstruction and Mechanical Prediction of 3D-Printed Prosthetics** — Published: January 23, 2025
  Carnegie Mellon University Africa
  DOI: doi.org/10.1115/1.4067716
  Status: Published in the *Journal of Mechanical Design*
  Credited as Coauthor

- **Optimizing Wireless Sensor Network Topology for Leak Detection to Reduce Non-Revenue Water in Resource-Constrained Environments** — Submitted: February 14, 2025
  Carnegie Mellon University Africa
  Status: Submitted at 2025 European Conference on Networks and Communications & 6G Summit (EuCNC/6G Summit).
  Credited as Author

SELECTED COURSES

Master's Courses in Condensed Matter Physics

- Mathematical Methods in Physics
- Numerical Methods I
- Numerical Programming II
- Advanced Statistical Mechanics
- Statistical Physics

Master's Courses in Electrical and Computer Engineering

- Introduction to Machine Learning for Engineers
- Introduction to Deep Learning by Prof. Bhiksha Raj
- Data Structures and Algorithms for Engineers
- Applied Computer Vision
- Data Inference and Applied Machine Learning by Prof. Patrick McSharry
- Data Analytics by Prof. Patrick McSharry
- Applied Stochastic Processes
- Advanced Database Systems
- Cloud Computing by Prof. Majd F. Sakr
- Geographic Information Systems by Prof. Kristen Kurland

ACHIEVEMENTS

Best Paper Award, *IDETC-CIE ASME 2024 Conference* — Washington, DC, USA
Co-authored " Increasing Accessibility of 3D-Printed Customized Prosthetics in Resource-Constrained Communities," selected as the best paper at IDETC-CIE ASME 2024 Conference and rewarded to publish it in the ***Journal of Mechanical Design*** — August 25-28, 2024

TWAS Scholarship for Master of Science in Condensed Matter Physics — Kigali, Rwanda

Secured the TWAS scholarship for the Master of Science in Condensed Matter Physics pursued at ICTP-East African Institute of Fundamental Research — Dec 2021

Government of Rwanda Scholarship for Carnegie Mellon University Africa — Kigali, Rwanda
Secured a scholarship from the Government of Rwanda to pursue Master of Science in Electrical and Computer Engineering at Carnegie Mellon University Africa. — Aug 2024

OTHER EXPERIENCES

Co-Founder and Representative — Kigali, Rwanda
Rwanda Physics Olympiad (incubated by AIMS Rwanda) — Aug 2024 — Present

- Conduct weekly sessions training coaches to solve Physics Olympiad-style questions and strategize organizational growth.
- Secured partnerships with Rwanda Math Olympiad for advisory support and AIMS Rwanda for STEM outreach collaboration.
- Organizing Rwanda's first Physics Olympiad (May 2025) and training the participants for the 2026 International Physics Olympiad in Colombia.
- Preparing and applying for funding from institutions such as the Global Talent Fund to support organizational activities.

Data Entry Clerk — Northern Province, Rwanda
Tare Health Center — June 2021 — Dec 2021

- Accurately managed 5,000+ daily records with a 97% data accuracy rate.
- Updated and organized child development records for 2,000+ children in the NCDA database.
- Enhanced COVID-19 vaccination data management, achieving a 23% increase in efficiency and timely reporting.

Research Commissioner — Northern Province, Rwanda
Rwanda Youth Volunteers in Community Policying(RYVCP), Bushoki Sector — 2018 — 2021

- Led COVID-19 research and interventions, reaching 23,000+ community members and reducing infection rates by around 25%.
- Identified and developed new community health and sanitation projects.
- Contributed to building toilet houses, providing sanitation for underserved households.

TEST RESULTS & ACHIEVEMENTS

IELTS (Academic): 6.5 (overall score)

Listening: 7.0 — Reading: 6.0
Speaking: 6.5 — Writing: 6.0
Test date: April 2023

SKILLS/TECHNICAL EXPERTISE

Programming

- Python (Proficient)
- SQL
- C++/Java/MATLAB
- R/Scala/Bash

Artificial Intelligent

- Machine Learning
- Deep Learning
- Computer Vision
- Model Optimization
- Time Series Analysis
- Big Data Analysis

Data Engineering

- Apache Spark/Hadoop
- Kafka Streams
- ETL Pipelines
- Airflow
- NoSQL Databases (Cassandra, MongoDB)

Cloud & DevOps

- AWS/GCP/Azure
- Docker/Kubernetes
- CI/CD Pipelines
- Git/GitHub

Frameworks

- PyTorch
- TensorFlow
- Scikit-learn
- OpenCV

Data Tools

- Pandas/NumPy
- Tableau/XML
- Jupyter/Ms Office
- ArcGIS
- LaTeX

Methodologies: PCA/t-SNE | A/B Testing | Experimental Design
Leadership: Technical Strategy | Cross-Functional Teams | Project Management |Communication |Adaptability |Critical Thinking |Time Management