ABASIAFAK NDIFREKE UDOSEN, *PhD* (Cand.,)

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GOOGLE scholar: https://scholar.google.com/citations?user=TNpErlUAAAAJ&hl=en

Education and Training

Purdue University | West Lafayette, United States

PhD in Computer and Information Technology, **GPA**: 3.84/4
*Expected on **05/2026***

- Cognate Areas: Mechanistic Model-based Reasoning, Machine Learning and Artificial Intelligence Applications
- Courses: Qualitative Research, Educational Methods in Engineering, Theories of Dev & Engineering thinking, Big Data Machine learning, Applied Statistics in Tech, IT Data Analytics, Machine learning & vision for IoT, Responsible Data Science (Explainable AI), Deep Learning in Cybersecurity etc.

Federal University of Technology Owerri | Imo State, Nigeria

MEng in Energy and Power Engineering
Graduated on 06/2015

- Major in Thermo-fluids energy and power systems design and simulations
- Completed courses: Advanced mathematics, Advanced combustion engines, Advanced heat and mass transfer, Internal combustion engines, etc.

Igbinedion University Okada | Edo State, Nigeria

BEng in Mechanical Engineering
Graduated on 12/2009

- Major in Thermo-fluids systems design

Course development & Teaching Experience

- **Instructor**, EMBRIO, Purdue University, USA 08/2022 – Present
  Innovation Hub Projects (Design and Implementation Phases)
  - I developed and instructed an instructional module within the course "Computational Understanding of Biological Systems and Data", a team-based, transdisciplinary course designed for undergraduate and graduate biology and biomedical engineering students. I designed the module with interactive pedagogy in mind. The models were deployed in Google Colaboratory virtual workstation, allowing students to manipulate variables in real time and visualize computational outcomes. The broader aim of this course is to prepare students with the mathematical and computational skills necessary for designing artificial extracellular vesicle drug delivery systems for tumor treatments in biomedical engineering.
- **Instructor**, Mech., Engr., Dept., & Numeracy Center, University of Cape Town, SA 08/2019 – 07/2022
  Teaching and mentoring responsibilities:

- At UCT, I provided academic support and instruction to undergraduate mechanical engineering students, helping them identify effective study strategies on an "Engineering Systems Design" course. I also assisted medical and humanities students in quantitative research methods using hands-on virtual lab sessions and classroom tutorials. In this role, I supported students in developing mathematical thinking alongside using statistical analysis tools to make sense of data.
- I regularly met with students offering this course to clarify and review complex concepts, solve specific problems, and facilitate deeper understanding of the course material.
- I conducted interactive Q&A sessions in small groups using the e-learning and instruction VULA online platform, where students engaged in collaborative problem-solving. I graded assignments using a programmable score card on Microsoft excel linked to MATHCAD software. I also created downloadable tutorial videos for asynchronous learning. To strengthen instructional coordination, I attended weekly meetings with colleagues and senior faculty on Microsoft Teams during the COVID pandemic.

- **Lecturer I & II**, Mechanical Engineering Dept., University of Nigeria, NG 12/2015 – 07/2022

  Teaching responsibilities:
  - As a faculty member in the Department of Mechanical Engineering, I delivered undergraduate lectures in core departmental courses including Measurement and Instrumentation, Thermodynamics, and Engineering Metallurgy.
- **Subject Teacher**, Mathematics and Science Dept., Middle & High Schools, NG 03/2010 – 10/2015

  Teaching responsibilities:
  - As a subject teacher at both middle and high school levels, I taught a broad range of STEM subjects, including Mathematics and Further Mathematics, Basic Technology, Technical Drawing, Agricultural Science, and Physics across JS1–SS3 classes. My teaching involved lesson planning, curriculum delivery, and classroom management. I contributed to student mentoring and academic guidance while helping students prepare for national (WASSE and NECO) examinations.

Research Experience

- **Graduate Research Assistant**, ROCkETEd Lab, Purdue University, USA 08/2022 – Present

  PhD research (Three paper dissertation):
  - As part of my doctoral research, I focus on teamwork interactions in computational engineering projects, analyzing how collaboration shapes scientific reasoning and modeling outcomes. My scholarly contributions include research posters, journal manuscripts, and conference presentations. Methodologically, I employ mixed and multi-method research designs, combining qualitative and quantitative approaches with AI (LLMs) data analytics.
- **Independent Study Researcher**, EMBRIO, Purdue University, USA 01/2024 – Present

  ML & Artificial Intelligence Project (Bio-computer Vision and Microscopy Image Analysis):
  - The project combines principles from computer vision, deep learning, and cell biology. I developed convolutional neural network models to detect subtle disruptions in the actin cytoskeleton, leading to more reliable and reproducible results. The preliminary results revealed significant differences in mean actin corral area per egg for the unfertilized eggs which had the largest area (~0.3 μm^2), calcium-treated eggs showed a reduction (~0.2 μm^2, $p < 0.001$), and fertilized eggs displayed an intermediate area (~0.25 μm^2).

  Explainable unsupervised autoencoder framework for automated quantification of cortical actin cytoskeleton
  - The study is a continuation of ML/AI applications, where I aim to achieve localized and global model explanations for our already quantified eggs using truncated Monte-Carlo Shapley, Deep Shapley and LIME algorithms. We hope to learn a lot from this study while aiming to drastically reduce the current computational cost and resources of learning complex biodata and yet maintain high performance.

  Mathematical Modeling in Cell Division Project:
  - In this project, I developed computational models to simulate the mechanics of cell cytokinesis. To achieve this, I built models using Computational Fluid Dynamics (CFD) methods and the Navier-Stokes equations to represent the fluid domains of cells. The constriction site at the equator of the cell was

modeled using coupled constriction force and polar cap functions. I developed these models entirely in Python, integrating interactive features that enabled students to conduct virtual experiments exploring the influence of membrane curvature, surface tension, contractile ring force, bending energies, and osmotic pressure differences on vesicle shape.

- **Research Assistant**, University of Cape Town, SA 06/2019 –07/2022
  Research responsibilities:
  - I completed PhD candidature requirements and submitted preliminary findings on improving the flexibility and efficiency of coal-fired power plants through integration with phase change material (PCM) thermal energy storage systems. I simulated the impact of PCM-based thermal storage on a 200 MW subcritical coal-fired power plant, analyzing both transient and steady-state behaviors under minimum and maximum load cases, as well as across a range of turbine ramp and start-up rates using FLOWNEX SE.
- **Faculty Member**, Mechanical Engr., Dept., University of Nigeria, Nigeria 12/2015 – 07/2022
  Research responsibilities:
  - In addition to teaching responsibilities, my research works involved supervising senior B.Eng. (final year) research projects, mentoring students through the full cycle of project work. This included topic selection, literature review, research design, data collection and analysis, technical writing, and oral defense preparation. Through this supervision, I guided students in applying theoretical knowledge to practical engineering problems, building both their technical competencies and research skills.

Awards & Honors

- Certificate of reviewer recognition by the Int'l Journal of Heat and Mass Transfer – 2018
- Int'l doctoral research scholarship awards from the University of Cape Town – 2020,
- African APP Launchpad Scholarship from ITIDA Egypt – 2021
- Graduate research assistantship award by Purdue University - 2022
- RIA Student Poster Symposium Purdue 2nd place Award - Spring 2023
- National Award by NSBE50: Technical Research Exhibition 1st place Award – Spring 2024
- Research Travel Grant Award by (PGSG), Purdue University – Spring 2024
- Dean's Graduate Student Travel grant by CIT, Purdue Polytechnic – Spring, 2024.
- Purdue NSBE Scholarship – Spring, 2024.

Certification Training

- Project Management Professional Certification (In-progress)
- Finite Element Analysis (Purdue University)
- K-Means for Cluster Analysis and Unsupervised Learning Certificate (Udemy)
- Responsible Conduct of Research (RCR) Training (CITI Program)
- Social Behavioral Research Investigators and Key Personnel (CiTI Program)
- Python Programming (DataCamp)
- IBM Data Analyst Professional Certificate (Coursera)

Hands-On Skills

- **IT skills**
  PyToch • TensorFlow • Jupyter Notebook • Visual Studio • Linux • IBM Db2 • Desktop Support • IBM Cognos Analytics • Microsoft Excel • Dashboards • SQL• ML, Deep learning and GenAI algorithms. • Auto ML• eSRRF imaging
- **Programming skills**
  Python • MATLAB
- **Software skills**

  Virtual Plant Simulator • SPSS • Orange• ANSYS Fluent • FLOWNEX SE • Mathcad • Arduino Mega/Uno • Mathcad • Autodesk (3D Fusion)

Accomplishments

1. Major Engineering Projects supervised and conducted – 2014 to 2025
    - Project title(s) –
        - Mathematical modeling of cell cytokinesis using CFD methods *(Conducted at Purdue University 2023-2024)*
        - Thermal Storage in Coal-Fired Power Plants for Operational Flexibility Enhancement Using Phase Change Materials *(Conducted at the University of Cape Town, South Africa 2019-2021)*
        - Large Eddy Simulation of Diesel Engine Spray Combustion of alternative fuels *(Proposal submitted to the UNISA, South Africa 2019)*
        - Innovative Mechanical Solution for Ethanol Derived Internal Combustion Engine *(Proposal submitted to the UNICAMP, Sao-Paulo Brazil in Sept 2018)*
        - Development of as solar-powered evaporative space cooling test rig *(Supervised at theUniversity of Nigeria 2016-2017)*
        - Development of night sky radiation hybrid apparatus for chilling water *(Supervised at the University of Nigeria 2016-2017)*
        - Design, Construction, and Testing of a PCM-packed solar water heating collector *(Completed at the University of Nigeria 2017-2018)*
        - Experimental and Numerical study of a Solar Water heater with Thermal Energy Storage *(Completed at the University of Nigeria 2018-2019)*
        - Experimental study of The Performance of Diesel Engine Fueled with Diesel-BiodieselBlends *(Completed at the University of Nigeria 2018-2019)*
        - Numerical Study of High-Density Polyethylene –PCM Capsules for Passive Cooling Application in Intermodal Steel Building Space Envelope *(Completed at the Federal University of Technology, Owerri Nigeria 2014-2015)*
2. Reviewer (Journal and conferences)
    a. International Journal of Heat and Mass Transfer – 3rd Oct 2018
    - Manuscript title(s) –
        - Emulsion-templating formation of pH-responsive microencapsulated phase changematerials for thermal energy storage and controlled release performance

    b. Journal of Mechanical Engineering and Sciences (JMES) – 10th Aug 2018
    - Manuscript title(s)
        - Analysis of combustion, performance, and exhaust emission characteristics of biodiesel from South African sunflower and canola oils.

    c. Sustainable Engineering and Industrial Technology Conference – 2020
    - Manuscript title(s) –
        - Study on the Engine Performance of Blends of Palm Kernel Oil Biodiesel Under Varying Speed Constant Torque.
        - A Bidirectional DC-DC Converter for Electric Vehicle Application.
        - Application of The Well-established Reliability Assessment Method in the Nigerian Grid.
        - Development of an Automatic Solar Panel Wiper with Water Sprinkler Evaluation.
        - Design and Construction of Cooking Gas (LPG) Leakage Detector.

    d. Sustainable Engineering and Industrial Technology Conference – 2021
        - Manuscript title(s) –
        - Impact of grid-connected renewables on Coal-fired power plant emission: A V-TCHR based CO_2 emissions factor model.

Professional Societies

- South African Society of Mechanical Engineers (MSAIMechE) – 2020

- Institute of Engineering and Technology, UK (MIET) – 2020
- Institute of Information Technology Professionals, SA, (MIITPSA) – 2020
- American Society of Mechanical Engineers (MASME) – 2023
- American Society of Engineering Education (MASEE) – 2023
- Cooperative and Experiential Education Division Membership (MCEED) – 2023
- Computing and Information Technology Division Membership (MCITD) – 2023
- Data Science and Analytics (MDSA) – 2023
- Equity, Culture & Social Justice in Education Division Membership (MECSED) – 2023
- Engineering Design Graphics Division Membership (MEDG) – 2023
- Engineering Ethics Division Membership (MEED) – 2023
- Educational Research and Methods Division Membership (MERM) – 2023
- Multidisciplinary Engineering Division Membership (MMED) – 2023

Symposium

1. **Udosen, A. N**., Simoorkar, A., Piennar, E.,& Magana A. J. (2025). Interdisciplinary Mechanistic Reasoning at The Undergraduate Level within Computational Modeling Projects [Poster presentation]. Thrust Project #4, EMBRIO 2025, Annual Retreat, Purdue University, June 12-13.

2. **Udosen, A. N.,** Kyner Z.T. & Evans, J (2025). *"Investigating Cortical Actin Dynamics in the Egg-to-Embryo Transition Using Computational and Deep Learning Techniques"* [Poster presentation] AI Fusion Poster Session, College of Science, Purdue University, West Lafayette, IN, USA, February 4th, 2025.

3. **Udosen, A. N**., Arigye, J., Magana, A. J. & Pienaar, E. (2024). *Characterizing Teamwork Interactions and Interdisciplinary Learning in the Context of Computational Modeling andSimulation Projects* [Poster presentation]. National Society of Black Engineers 50th Convention/Engineering Community Technical Research Exhibition, United States. March 21,2024 [Best Poster Award – 1st Place]

4. **Udosen, A. N**., Arigye, J., Magana, A. J. & Pienaar, E. (2024). *Predicting Quantized StudentsTeam-based Reflection Data Using Supervised Machine Learning Approaches* [Poster presentation]. National Society of Black Engineers 50th Convention/Engineering Community Technical Research Exhibition, United States. March 21, 2024.

5. **Udosen, A. N.,** Arigye, J., Joshi, P. P., & Magana, A. J. (2023). *Enactment of UndergraduateStudents' Computational Model-Based Reasoning through Epistemic Thinking Practices* [Poster presentation]. Purdue Polytechnic Research Impact Areas, Spring 2023 Student Poster Symposium, Purdue University, United States. March 24, 2023 [Best Poster Award – 2nd Place]

Journals (Peer Reviewed)

1. **Udosen, A. N**., Magana, A. J, & Pienaar, E. (under review, major revision) (2025) Teamwork Interactions and Collaborative Learning in the Context of Computational Modeling and Simulation Projects. Submitted to the Journal of the Learning Sciences. (Submission ID: 256755580)

2. Arigye, J., **Udosen, A.N**., Pravin, J.P., and Magana, A.J. (under review, major revision) (2025) *Commitment to Team Coordination: Reflections from Undergraduate Engineers Across Three Team-Based Projects*. IEEE Transactions on Education.

3. Okafor, P.-E., Udosen, A. N., & Igboanugo, B. I. (2025). Artificial intelligence tools: a potential for error-free scholarly communication in Nigerian universities. AI and Ethics 2025 5:4, 5(4), 3537–3548. https://doi.org/10.1007/S43681-025-00714-8

4. Magana, A. J, Arigye, J., **Udosen, A. N**., Lyon, J. A., Joshi, P. P., & Pienaar, E (2024) *Scaffolded Team-Based Computational Modeling and Simulation Projects for Promoting Model-BasedReasoning, Conceptual Understanding, and Regulatory Processes*. International Journal of STEM Education, 11(1), 1–33. DOI: 10.1186/S40594-024-00494-3

5. Onydinma, C. A., Okamkpa, T., Odoabuchi, U., **Udosen, A.N**., Amarachukwu, I. O. (2024) *Development of an IoT-Based Waste Management System for Schools-A Case Study of theUniversity of Nigeria Nsukka*. Heliyon Publication Status: Preprint.

6. Udosen, A. N, Tochukwu C. Nwachukwu, Kelvin O. Imeje (2020). *Simulation and Experimental Validation of solar water heater operating with selected Phase ChangeMaterials*. Journal of Energy Technologies and Policy. DOI: 10.7176/JETP/10-5-05

7. **Udosen, A. N** (2019). *Numerical Study of High-Density Polyethylene PCM Capsules for Passive Cooling Application in Intermodal Steel Building Space Envelope*. Nigerian Journal ofTechnology 38(2), 384-398. DOI:10.4314/njt.v38i2.15.

8. **Udosen, A**. N (2018). *Transient numerical models for predicting the performance of encapsulated PCM under varying ambient temperatures for cooling applications.* InternationalJournal of Scientific & Engineering Research,9(3),253-260. DOI:10.14299/ijser.2018.03.011.

9. Inya-Oko R. E., Eze S. E., **Udosen, A.N**., and Okoani A. O (2018). *Performance Evaluation ofNative- Kankan Padded Evaporative Space Cooler using Arduino Mega*. Journal of Energy Technologies and Policy, 8(4),1 -9. DOI: 10.0000/iiste.org/Journals/JETP/43715. ISSN:2225- 0573.

10. **Udosen, A. N** & Umeh C (2018). Emmanuel "*Development of Latent Heat Storage (PCM) based Solar Water thermal collector for Industrial and Domestic Utilizations*," International,Vol 15(2), pp9-20. Journal of Engineering and Technology Research

Conference Proceedings (Peer Reviewed)

1. J. Arigye., **A. Udosen**., P. Joshi & A. Magana, "*The Evolution of Team Coordination Commitments in the Context of Computational Projects*," in 2023 IEEE Frontiers in EducationConference (FIE), College Station, TX, USA, 2023 pp. 1-5. doi: https://doi.ieeecomputersociety.org/10.1109/FIE58773.2023.10343201

2. **Udosen, A.N**., Magana, A. J., & Pienaar, E. "*Characterizing Teamwork Dynamics and Computational Model-Based Reasoning in Biomedical Engineering Projects*" 2024 ASEE Annual Conference, Portland, OR, USA. 2024 pp. 1-16 https://doi.org/10.18260/1-2--48455

3. Ibukun, S., Viyon, Bamidele, B., Yeaple, S., Brijmohan, Y., **Udosen A. N**., Moyaki, D., Arinze,L., Hicks, M., Oje, V., & Cutler, S. L., "*Generative Artificial Intelligence (GAI) Assisted Learning: Pushing the Boundaries of Engineering Education"*. 2024 ASEE AnnualConference June 23rd - 26th | Portland, OR. (Paper ID #41602)

4. Obi, A. I, **Udosen, A. N**, Anyaoha, C. O "*Design, Construction, and Testing ofMultipoint Humidity, Temperature Data Logger*", Proceedings of the 1st International Multidisciplinary Conference on Technology, Nsukka, Nigeria. 2024 pp 101-109

5. Etiubon, R. U & A. N. Udosen, "*Innovative Practical Activities in Science and Technology inSouth-South Geopolitical Zone of Nigerian Universities for Sustainable Economic Reforms*",World Conference on Science and Technology Education., 29 September-3 October 2013., Sarawak, Borneo, Malaysia, 2013.

6. **A. N. Udosen**, *"Numerical Study of High-Density Polyethylene PCM Capsules for Passive Cooling Application in Intermodal Steel Building Space Envelope"*. Proceedings and book of abstracts, First International Conference on Research and Innovations in Engineering, Uyo, Nigeria, December 4th -5th, 2018.

Current Work in Progress

1. **Udosen, A. N**., Magana, A. J., & Pienaar, E. *Model-Based Reasoning in STEM education: A Systematic Literature Review* [to be submitted in Fall 2025]

2. **Udosen, A. N**., Magana, A. J., & Pienaar, E. *Characterizing Mechanistic Reasoning in STEM Education: A Systematic Literature* Review [to be submitted in Fall 2025]

3. **Udosen, A. N**., Kyner Z.T. & Evans, J. *Investigating Cortical Actin Dynamics in the Egg-to-Embryo Transition Using Computational and Deep Learning Techniques* [In Progress for CVPR, NeurIPS]

4. **Udosen, A. N**., Kyner Z.T. & Evans, J. *Systematic Review of Computer Vison Techniques for Biomedical Image Analysis* [In Progress for Nature Methods]

5. **Udosen, A, N**., Sirnoorkar, A., Magana, A. J. Pienaar, E., *Leveraging engineering design to promote students' mechanistic reasoning in STEM* [to be submitted in Fall 2025]

6. Sirnoorkar, A., **Udosen, A, N**., Magana, A. J. Pienaar, E., *Exploring Students' Socially Shared Regulated Learning while engaging on Engineering Design Problem* [to be submitted in Spring 2026]

7. PhD Thesis Dissertation: *Computational Model-based Reasoning and Teamwork Interactions in Scaffolded Engineering Modeling and Simulation Projects*. Advisors: Prof. Alejandra J. Magana (ENE-Purdue University) & Prof. Elsje Pienaar (BME-Purdue University)

Abasiafak Ndifreke Udosen _____10/23/2025