Ahmed S. Aredah, MSc

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SUMMARY

Multi-disciplined engineer and researcher with expertise in Transportation Systems and Computer Science, dedicated to solving complex national challenges through cutting-edge software development and simulation technologies. With a proven track record in leading key projects involving AI-driven optimization, freight logistics modeling, and energy-efficient transportation solutions, I have developed scalable systems using C++, Python, etc. My work in advancing port simulation, infrastructure development, and environmentally sustainable transportation directly supports critical National Infrastructure and Environmental Goals. Backed by a strong academic foundation, extensive publication record, and international experience, I am committed to driving innovation in transportation engineering, software systems, and sustainability to contribute to the advancement of U.S. infrastructure and long-term sustainability goals.

EXPERIENCE

CIVIL ENGINEERING GRADUATE RESEARCH ASSISTANT   Jan 2022 – Current
Virginia Tech – Blacksburg, VA

- Led research on freight logistics and energy consumption for trucks, trains, and ships resulting in a 20% reduction in energy consumption and a 30% increase in operational efficiency across the entire U.S freight network.
- Published 5 peer-reviewed journal articles, presented at 3 major conferences, and contributed to over 19 technical reports and grant applications totaling over $1.5 million in funding.
- Developed advanced open-source simulators for predicting emissions and improving energy efficiency for freight transport by trucks, trains, and ships, directly impacting U.S. environmental goals.

INTERN II   May 2024 – Aug 2024
Moffatt and Nichol – Norfolk, VA

- Collaborated with cross-functional teams to optimize port operations resulting in a 375% increase in operational efficiency at Norfolk International Terminal.
- Contributed to the development of web-based applications and simulations using Azure, React.js, TypeScript, and FlexTerm.
- Led technical presentations and training sessions on dynamics modeling and web development methodologies for internal stakeholders.

COMPUTER SCIENCE GRADUATE RESEARCH ASSISTANT   Jun 2021 – Dec 2021
The University of Tennessee at Chattanooga – Chattanooga, TN

- Collaborated on research projects in transportation safety and autonomous vehicles.
- Assisted in the analysis and development of simulation environments to improve the realism of autonomous vehicle behavior through integrated technologies.

UNIVERSITY TEACHING LECTURER   Aug 2018 – Jun 2021

 GUC **The German University in Cairo – Cairo, Egypt**

- Delivered 10+ courses in Civil Engineering and Architecture to undergraduate civil engineering and architecture and contributed to student advisory and exam management.

UNIVERSITY TEACHING ASSISTANT   Sep 2016 – Aug 2018

 GUC **The German University in Cairo – Cairo, Egypt**

- Supported course delivery, accreditation efforts, and exam proctoring across engineering disciplines.

BUILDING INFORMATION MODELLING ENGINEER   Feb 2020 – Dec 2020

morph **Morph Engineering Solutions – Cairo, Egypt**

- Applied BIM technologies to infrastructure projects and ensured they aligned with sustainability standards.

TRANSPORTATION AND HIGHWAY ENGINEER   Apr 2020 – Jun 2020

Dr. Ehab Noureldin – Cairo, Egypt

- Designed a 95-mile highway using Civil 3D for the Egyptian Ministry of Transportation with a total project budget of approximately $95 million and conducted cost analysis and resource planning for large-scale infrastructure projects.

FREELANCER ENGINEER   Feb 2018 – Jul 2019

- Engaged in infrastructure projects resource planning and design focusing on sustainability.

UNDERGRAD ENGINEERING INTERN   Jul 2015 – Aug 2015

 Jet - The Egyptian Engineering & Trading Co. – Cairo, Egypt

Turner **Turner Construction – Cairo, Egypt**

 Ministry of Transportation – Cairo, Egypt

- Contributed to large-scale infrastructure projects, including scheduling, cost control, and construction supervision for the Damac mega project and Emaar Mivida housing project, and modeled traffic intersections for the Ministry of Transportation as part of national transportation planning.

EDUCATION

PhD – Civil Engineering   Expected in May 2025
Virginia Tech – Blacksburg, VA

M.Sc. – Computer Science   Expected in May 2025
Virginia Tech – Blacksburg, VA

M.Sc. – Civil Engineering   Aug 2018
The German University in Cairo – Cairo, Egypt

B.Sc. – Civil Engineering   Jun 2016

The German University in Cairo – Cairo, Egypt. Ranked **7th** in my class.

PROJECTS

FlexTerm Web App Development   May 2024 – Aug 2024

Moffat and Nichol – Norfolk, VA

- Developed a web-based platform to improve simulation capabilities and the user interface of FlexTerm which contributes to port operations efficiency and infrastructure optimization.

Norfolk International Terminal Port Simulation   May 2024 – Aug 2024

Moffat and Nichol – Norfolk, VA

- Conducted simulations of the Norfolk International Terminal proposing multiple throughput-enhancing scenarios that provided actionable insights for increasing port capacity and operational efficiency of 375% improved throughput.

M&N Maintenance Management System   May 2024 – Aug 2024

Moffat and Nichol – Norfolk, VA (2024)

- Spearheaded the development of a comprehensive maintenance management system to improve company-wide operational efficiency and enhance system integration.

Agent-Based Approaches in Freight Systems: Towards a Door-To-Door Freight Optimization Sep 2024 – Sep 2025

Virginia Tech – Funded by the UTC Program, US Department of Transportation ($100,000)

- Led the research and development of agent-based modeling for optimizing freight systems to improve the U.S. nationwide transportation efficiency and reduce energy consumption in alignment with U.S. infrastructure sustainability goals.
- Analyzed simulation results to identify key bottlenecks and inefficiencies within the U.S. freight network, providing actionable insights for policymakers and transportation planners.
- Prepared comprehensive technical reports detailing the simulation outcomes, model performance, and proposed optimizations, which contributed to national-level discussions on improving the efficiency of U.S. freight logistics.

Energy Consumption Modeling of Ships: Towards a Door-To-Door Freight Optimization   Sep 2023 – Sep 2024

Virginia Tech – Funded by the UTC Program, US Department of Transportation ($100,000)

- Led the research and development of simulating vessel dynamics in global settings to estimate energy consumption and emissions for different freight routes and operational conditions.
- Generated detailed reports that documented simulation methodologies, findings, and proposed solutions for minimizing fuel consumption and reducing the environmental footprint of maritime freight transport.

Multi-decadal Decarbonization Pathways for U.S. Freight Rail (A-STEP)   Jan 2022 – Jul 2023
Virginia Tech – Funded by US Dept. of Energy (DOE) & Advanced Research Projects Agency-Energy (ARPA-E), Amount $1.5M
- Led the research on developing and simulating train dynamics for estimating energy consumption for multiple fuel types; Diesel, Bio-Diesel, and Hydrogen supporting the decarbonization of the U.S. freight rail network.
- Analyzed simulation results to evaluate the energy efficiency and emissions of various alternative fuel technologies under different rail operating conditions, providing data-driven recommendations for sustainable energy transitions in freight transportation.
- Prepared technical reports and documentation, outlining the methodologies used, simulation outcomes, and strategic pathways for the decarbonization of the U.S. freight rail sector over the next several decades.
- Collaborated with the U.S. Department of Energy and ARPA-E to align the project outcomes with the U.S. National Decarbonization Strategy which contributes to the national goals of reducing greenhouse gas emissions and fostering clean energy innovations in transportation.

COVA Digital Twin – System Development and Demonstration   Jan 2023 – Jun 2023
Virginia Tech – Funded by Virginia Department of Transportation, Amount $150,000.
- Developed autonomous vehicle methodology that follows the eco-driving concept on the CARLA simulator.

Integration of Head-Mounted Display (HMD) into the Carla Simulator   Jun 2021 – Dec 2021
University of Tennessee at Chattanooga – Funded by UTC
- Led the integration of Head-Mounted Display (HMD) technology into the Carla Simulator within the Real-Engine Environment using C++ and Python. This enhances the simulator's capabilities to reflect real-life pedestrian movement interactions.
- This advanced integration significantly improved the ability to simulate pedestrian safety in scenarios involving vehicles and autonomous vehicles which contributes to improving transportation safety and advancing autonomous vehicle technology.
- The project supported national transportation safety goals by providing a more robust framework for testing pedestrian-vehicle interactions with potential applications in urban planning, public safety, and autonomous systems development.

Laser Scanning of Luxor Temple and Way of Rams   Sep 2018 – Sep 2018
German University in Cairo – Funded by the German University in Cairo, Cairo, Egypt
- Conducted laser scanning of the Luxor Temple and Way of Rams using Leica Laser Scanner - C10 which helps in preserving and documenting Egypt's cultural heritage.

BIM Structural Modeling for New Olympic City Sports Facilities   Feb 2020 – Dec 2020
Morph Engineering Solutions – Cairo, Egypt.
- Developed BIM structural models using Revit and Navisworks for five large-scale sports facilities in the New Olympic City with a total project budget of approximately $350 million.

- Extracted quantity surveying of materials and produced detailed drawings for the project owner for accurate resource planning and cost control.

Design and Modeling of a 95-Mile Highway   Apr 2020 – Jun 2020
Dr. Ehab Noureldin – Cairo, Egypt.
- Designed a 95-mile highway for the Egyptian Ministry of Transportation using Civil 3D, aligning the design with safety, efficiency, and sustainability standards, with a total project budget of approximately $95 million.

Scheduling of Water and Wastewater Lines   Feb 2018 – Jul 2019
Freelance Project – Mansoura, Egypt (2018)
- Developed a schedule for Water and Wastewater lines using Primavera P6 for a large-scale infrastructure project, ensuring optimized resource allocation and timely project delivery.

Steel Formwork Design for Suez Canal Infrastructure   Feb 2018 – Jul 2019
Freelance Project – Cairo, Egypt (2018)
- Designed the steel formwork for a Suez Canal infrastructure project that enhances one of Egypt's most strategic transportation assets.

Structural Design of Kalyoub Station and Water Desalination Plant   Feb 2018 – Jul 2019
Freelance Project – Cario, Egypt (2018)
- Led the design of the Kalyoub station steel project and a water desalination concrete plant with a focus on sustainability and structural efficiency.

JOURNAL PAPERS
ResearchGate, ORCiD, Google Scholar

- Aredah, A. S., Fadhloun, K., & Rakha, H. A. (2024). Netrainsim: A Network-Level Simulator For Modeling Freight Train Longitudinal Motion And Energy Consumption. *Railway Engineering Science*, 1-19.
- Aredah, A., Fadhloun, K., & Rakha, H. A. (2024). Energy Optimization In Freight Train Operations: Algorithmic Development And Testing. *Applied Energy*, 364, 123111.
- Aredah, A., Du, J., Hegazi, M., List, G., & Rakha, H. A. (2024). Comparative Analysis Of Alternative Powertrain Technologies In Freight Trains: A Numerical Examination Towards Sustainable Rail Transport. *Applied Energy*, 356, 122411.
- Ahn, K., Aredah, A., Rakha, H. A., Wei, T., & Frey, H. C. (2023). Simple Diesel Train Fuel Consumption Model For Real-Time Train Applications. *Energies*, 16(8), 3555. MDPI AG. DOI: 10.3390/en16083555
- Ahmed S. Aredah, Omer Faruk Ertugrul, Ahmed A. Sattar, Hossein Bonakdari, Bahram Gharabaghi (2022); Extreme Learning Machine Model For Assessment Of Stream Health Using The Habitat Evaluation Index. *Water Supply* 2022; ws2022166. DOI: 10.2166/ws.2022.166
- Aredah, A. S., Baraka, M., & Elkhafif, M. (2021). The Fourth Dimension Of Building Information Modelling (4d Bim): An Investigation And Simulation Approach. *International Journal of Construction Project Management*, 13(2), 195-213.

- Aredah, A. S., Baraka, M. A., & ElKhafif, M. (2019). Project Scheduling Techniques Within A Building Information Modeling (BIM) Environment: A Survey Study. *IEEE Engineering Management Review*, 47(2), 133-143., DOI: 10.1109/EMR.2019.2916365

THESIS
- Aredah, A. (2018). "Project Scheduling Techniques within a Building Information Modeling". Masters Thesis. German University in Cairo, Cairo, Egypt.
- Aredah, A. (2016). "Analysis and design of sustainable structures using reinforced concrete: Application of Euro-code project, A comparison between the ECP 2007 and Euro-code". Bachelor Thesis. German University in Cairo, Cairo, Egypt.

CONFERENCE PAPERS & PRESENTATIONS
- Aredah, A.S., & Rakha, H.A. (2024). Modeling Longitudinal Dynamics, Energy Efficiency, and Carbon Footprint of Cargo Vessels. Transportation Research Board (TRB) 2024 Annual Meeting, Washington DC, USA, January 8-13, 2024.
- Aredah, A.S., & Rakha, H.A. (2024). ShipNetSim: A Multi-Ship Simulator for Evaluating Longitudinal Motion, Energy Consumption, and Carbon Footprint of Ships. IEEE International Conference on Smart Mobility, Niagara Falls, Ontario, Canada, September 16-18, 2024.
- Aredah, A. S., & Rakha, H. A. (2024). Integrating A* Algorithm and Goal Programming for Energy Optimization in Freight Train Operations, IFAC Symposium on Control in Transportation Systems. Ayia Napa, Cyprus, July 1-3, 2024.
- Aredah, A., Fadhloun, K., Rakha, H., & List, G. (2023). Comparative analysis of alternative powertrain technologies in freight trains. Transportation Research Board (TRB) 2023 Annual Meeting, Washington DC, USA, January 8-13, 2023.
- Aredah, A., Fadhloun, K., Rakha, H., & List, G. (2022). NeTrainSim: A Network Freight Train Simulator for Estimating Energy/Fuel Consumption. Transportation Research Board (TRB) 2022 Annual Meeting, Washington DC, USA, January 9-13, 2022.
- Aredah, A., BIM Workflow (2019). The first Joint International Conference on Design and Construction of Smart City Components, German University in Cairo Campus, Cairo, Egypt.
- Aredah, A., Leica Laser Scanners (2019). The first Joint International Conference on Design and Construction of Smart City Components, German University in Cairo Campus, Cairo, Egypt.

REPORTS
- Energy consumption modeling of ships: towards a Door-to-Door (D2D) freight optimization, funded by UTC Program, US Department of Transportation, Amount $100,000 (Sep. 2023 – Sep. 2024).
- Multi-decadal Decarbonization Pathways for U.S. Freight Rail (A-STEP), funded by US Dept. of Energy (DOE) & Advanced Research Projects Agency-Energy (ARPA-E), Amount $1.5M (Jan 2022 – Jul. 2023).
- COVA Digital Twin – System Development and Demonstration, Funded by Virginia Department of Transportation, Amount $150,000 (Jan. 2023 – Jun. 2023).

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PEER REVIEWER
- Transportation Research Board (TRB), 2 articles reviewed, 2024-present.
- Green energy and intelligent transportation, 2 articles reviewed, 2024-present.
- Transportation research record, 3 articles reviewed, 2021-present.
- IEEE Intelligent Transportation Systems Transactions, 1 article reviewed, 2023-present,
- IFAC Symposium on Control in Transportation Systems, 1 article reviewed, 2024-present.

SKILLS
- Skilled in freight logistics modeling and optimization, traffic analytics, project management, superstructure, and Infrastructure Modeling, Building Information Modeling (BIM), Artificial Intelligence (AI), Machine Learning (ML), Deep Learning applications in Transportation Engineering, Autonomous Vehicles, etc.
- **Traffic Planning And Simulation Tools**: PTV Vissim, SUMO, ArcGIS Pro, QGIS, OpenRoads ConceptStation, etc.
- **Driving Simulation Advanced Tools**: Carla Simulator, MiniSim Driving Simulator, Virtual Reality.
- **Programming Languages**: C++, C#, Python, VB.NET, React.JS, R, MATLAB, SQL, NoSQL, etc.
- **Python Modules**: All main modules including Pandas, Scipy, NumPy, Scikit-learn, Tensorflow, Pytorch, Seaborn, etc.
- **Statistical Analysis Tools**: SPSS, Minitab, Tableau, JavaScript on Observable, etc.
- **Scheduling Software**: MS Project, Primavera P6, etc.
- **Analysis and Design Software**: SAP2000, ETABS, SAFE, AutoCAD, AutoCAD3D, Microstation, etc.
- **BIM Software Packages**: Autodesk Revit, Teckla, ArchiCAD, SYNCHRO 4D, Navisworks, VICO software, etc.
- **MS Office**: All Microsoft products including PowerPoint, Word, Excel, MS Access, etc.

AWARDS
- Last Mile Leadership Scholarship of **$6,000**, Virginia Clean Cities, funded by the U.S. Department of Energy through the Logistics Decarbonization in Strategic Environmental Justice Areas (LODESTAR) Program. 2024.
- Graduate Research Assistantship, **$2,750/month**, Virginia Tech**,** 25-Aug-2024 to 24-Dec-2024.
- Graduate Research Assistantship, **$2,667/month**, Virginia Tech**,** 25-Dec-2023 to 09-May-2024.
- Graduate Research Assistantship, **$2,553/month**, Virginia Tech**,** 10-Aug-2023 to 24-Dec-2023.
- Graduate Research Assistantship, **$2,429/month**, Virginia Tech**,** 25-Dec-2022 to 09-May-2023.
- Graduate Research Assistantship, **$2,253/month**, Virginia Tech**,** 25-Dec-2021 to 09-May-2022 & IO-Aug-2022 to 24-Dec-2022.
- Awarded a **$300** travel reimbursement for the Transportation Research Board (TRB) 2022 Annual Meeting by the Travel Fund Program (TFP) at Virginia Tech.
- Excellent bachelor graduation project, Egyptian Engineering Syndicate, Cairo, Egypt, 2016.
- Best simulation project, Nile basin hydrology, German University in Cairo, Egypt, 2013.
- Best research project for TransMilenio Bogota BRT System - case study, Transportation Modelling, German University in Cairo, Egypt, 2012.
- Best research in nanotechnology in concrete materials, German University in Cairo, Egypt, 2012.

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AFFILIATIONS

- Transportation Infrastructure and Systems Engineering at Virginia Tech.
- Transportation and Development Institute (TDI), American Society of Civil Engineers (ASCE).
- American Railway Engineering and Maintenance-of-Way Association (AREMA).

TEACHING EXPERIENCE

Teaching Lecturer   Aug 2018 – Jun 2021
The German University in Cairo – Cairo, Egypt | August 2018 – July 2021

- Prepared and delivered teaching materials for a variety of civil engineering and architecture courses, including Highway and Railway Design, Geodetic and Satellite Surveying, Civil Aviation and airport planning and design, Building Information Modeling, Sustainable Energy Systems and Built Environment, and more.
- Contributed to the student advisory committee offering academic and personal guidance to support students.
- Assisted in the examination control office, overseeing exam administration and maintaining academic integrity.

Teaching Assistant   Sep 2016 – Aug 2018
The German University in Cairo – Cairo, Egypt | June 2016 – August 2018

- Assisted in delivering teaching materials for civil engineering and architecture courses including Surveying for Architecture and Construction Management.
- Participated in the accreditation committee, ensuring compliance with academic standards and assisting with institutional reviews.
- Served as a proctor during exams, ensuring a fair and controlled testing environment.
- Assisted with teaching civil engineering and architecture courses, helping students understand key concepts and course materials.

OTHER DEGREES AND COURSES

- Machine Learning nano-degree, Udacity**,** 2021
- Data Science nano-degree, Udacity, 2021.
- Sensor Fusion and Non-linear Filtering for Automotive Systems, Chalmers University of Technology [Online].
- Advanced-Data Analysis Nanodegree, Udacity [Online].
- Programming For Data Science Nanodegree, Udacity [Online].
- Machine Learning, Stanford University, Coursera [Online].
- Machine Learning Foundations: A Case Study Approach, University of Washington [Online].
- Data Analysis and Statistical Inference by Mine Çetinkaya-Rundel, Duke University [Online].

EXTRACURRICULAR

- A former International Student Leader/Ambassador at Virginia Tech, VA, USA | 2022.
- A former member of the International Student Leadership Council at UTC, TN, USA | 2021.

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- An organizer and presenter in the first Joint International Conference on Design and Construction of Smart City Components on GUC Campus, Cairo, Egypt | 2019.
- An organizer in the Ground Penetrating Radar Workshop, Cairo, Egypt | 2018
- An organizer in the Eurocodes 2017 Workshop – The Eurocodes for Building Design Eurocodes and Egyptian Codes of Practice: Code and Design Experiences, the German University in Cairo, Egypt | 7th to 8th of October 2017.