Amr K. Shafik

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Professional Summary

PhD in Civil and Environmental Engineering with a research focus on traffic control, connected and automated vehicles, and traffic state estimation. My work integrates stochastic optimization, game theory, and data-driven methods to improve traffic operations and sustainability. I have published in IEEE Transactions on Intelligent Transportation Systems and presented extensively at TRB and IEEE venues. I am experienced in teaching transportation engineering courses and supervising graduate students, with strong interests in externally funded research and interdisciplinary collaboration.

Research Interests:

- Traffic control and signal optimization
- Connected and automated vehicles
- Traffic state estimation
- Stochastic optimization in transportation

Teaching Interests:

- Traffic Engineering
- Transportation Planning and Landuse
- ITS
- Transportation Data Analytics

Education

Virginia Tech College of Engineering, Blacksburg, VA - **Ph.D.** Graduated in **March 2025**

Key Research Areas:

- Stochastic Optimization of the trajectories of connected and autonomous vehicles in the vicinity of actuated signals considering surrounding traffic uncertain conditions.
- Vehicle queue length and traffic density estimation from Probe Vehicle Data using filtering algorithms such as Kalman Filters
- Development of a Game-theoretic based Traffic Signal controller.

Progress:

- Published two Journal papers at the IEEE Transactions on ITS (Q1).
- Published three conference papers at the IEEE Smart Mobility Conference in Niagara Falls, Canada, 2024.
- Published three conference papers at the Transportation Research Board (TRB) Annual Meetings 2023/2024/2025.

Future Professoriate Graduate Certificate Obtained in **March 2025**

Virginia Tech Graduate School, Blacksburg, VA

Completed coursework toward the Future Professoriate Graduate Certificate, a 9-credit program designed to prepare graduate students for academic careers and faculty roles. The certificate includes core seminars on contemporary pedagogy, faculty roles and responsibilities, and higher education practices, along with elective graduate courses related to teaching and academic leadership.

Cairo University, Faculty of Engineering, Cairo, Egypt - **M.Sc.** Graduated in **December 2020**

Key Research Areas:

- Calibration of microscopic simulation models using machine learning models.
- Traffic survey analysis of a road network section in downtown Cairo, Egypt, and performed origin-Destination demand matrix estimation and calibration.

Achievements:

- Proposed Vissim calibration parameters to mimic observed driving behavior in the field.
- Published a research paper on research activities and findings.

Cairo University, Faculty of Engineering, Cairo, Egypt - **B.Sc.** Graduated in **May 2016**

Specialization: Civil Engineering

Achievements:

- Graduated With Honors and appointed to join the faculty of engineering as a graduate teaching assistant.
- Received a funded scholarship to prepare for a master's degree.

Work Experience

Research Scientist November 2025 - Present
Research Engineer March 2025 – November 2025
Arizona Transportation Institute (AZTI)
University of Arizona, Center of Applied Transportation Sciences (CATS)
Tucson, AZ
AZTI Duties:

- Led and contributed to externally funded transportation research projects (ABOR, NCHRP).
- Conducted applied research in traffic control, ITS, and transportation modeling.
- Supervised and mentored graduate students on modeling and optimization topics.
- Led proposal development and contributed to securing external research funding.
- Coordinated with ADOT stakeholders to support the research program.

CATS Duties:

- Solving real-world transportation challenges through applied research.
- Conduct advanced research in transportation modeling, traffic control, and intelligent transportation systems.
- Supervise and mentor graduate students while collaborating on large-scale mobility projects.
- Project Manager for the following projects:
  - Traffic Engineering Technical Support for the City of Yuma, Arizona
  - Inexperienced Driver Mitigation (ABOR-funded Project)
  - Helping to increase funding for the Center of Applied Transportation Sciences.
- Participated in the research Team for the following projects:
  - NCHRP 07-34: Artificial Intelligence for Transportation Systems Management and Operations Applications.
- Participates in the writing and research for publications and presentations:
  - Develop and write grant proposals and prepare reports of research results for publications and presentations and contribute to securing external research funding.
  - Plans, organizes, and conducts research projects, including methodologies, databases, and protocols, using innovative approaches to solve complex problems.

Graduate Teaching and Research Assistant
Virginia Tech Transportation Institute (VTTI), Aug 2021 – Mar 2025
Blacksburg, VA
Research responsibilities, conducting various analysis tasks, including:

- Extracting bike trajectories (speed profiles) from recorded campus videos to support the development of bike-following models.
- Processing large drone-based probe vehicle datasets to derive traffic demand and dynamics (e.g., vehicle speeds and accelerations), intended for advanced prediction and estimation algorithms such as Kalman filters and game-theoretic optimization.
- Optimizing connected and automated vehicle (CV/CAV) trajectories in stochastic environments near actuated traffic signals, accounting for traffic uncertainties.
- Estimating queue lengths and traffic density using probe vehicle data.
- Analyzing traffic performance metrics through advanced algorithms, including Kalman Filters.
- Optimizing traffic signals within a game-theoretic framework to enhance traffic flow and reduce delays.

Traffic Engineer
District Department of Transportation (DDOT) - Summer Internship, June 2023 – August 2023
Washington, DC

- Reviewing Traffic Impact Technical Reports and Traffic Analysis Models:
  - Assessed traffic impact reports and traffic management plans for I-395 in Washington, DC, aimed at mitigating congestion due to bridge rehabilitation projects.

    - Reviewed Synchro models for multiple consecutive signalized corridors in Washington, DC.
- Conducting Site Visits to Monitor Project Progress:
    - Performed site visits and participated in on-site follow-up meetings with consultants and contractors to discuss current progress and address challenges at the Florida Ave./New York Ave. intersection in Washington, DC.

Graduate Teaching and Research Assistant
Cairo University, Faculty of Engineering, Jan 2017 – Aug 2021
Cairo, Egypt
Research responsibilities:

- Worked on project teams to develop a strategy for e-mobility, and for the market potential assessment for the short to medium terms, advised by the (EBRD).
- Worked on calibrating Microscopic simulation parameters using machine learning on Vissim.
- Integrating Coding languages with PTV software through APIs.
- Using Genetic Algorithms to calibrate demand models for proposed railway networks.
- Performed sensitivity analysis of proposed scenarios for various railway projects and providing results for the economic feasibility team for evaluation.

Freelance Transportation Planning and Traffic Engineer Jan 2017 – Aug 2021
Highlight Projects:

- Replicated and updated Egypt's national transportation demand model, originally developed in CUBE software by the Japan International Cooperation Agency (JICA) in 2010, to incorporate current demand patterns, for both passengers and freight movements.
- Calibration of demand models using traffic survey data collected at several projects of railway and roadway feasibility studies.
- Developing macroscopic transportation models for various railway and road strategic projects using "PTV Visum Software".
- Analyzing traffic impact assessment of new developments for more than 10 projects in Egypt and the gulf region, including schools, shopping malls, residential neighborhoods, and educational and healthcare facilities.

Design Engineer
Hesham Hamed Consulting Office Aug 2016 – Jan 2017
Giza, Egypt
Main Duties:

- Steel Structure design – sub consulting for Tiger Steel Engineering in the UAE.
- Develop steel connection design documents.
- Coordinating and communicating with clients in the UAE about revisions in design and requirements.

Teaching Experience

Graduate Teaching Assistant
Virginia Tech, Department of Civil Engineering, Blacksburg, VA Jan 2022 – Mar 2025

- **Courses**: CEE4604 – CEE4602
- Mentored the students of Traffic Engineering and Transportation Planning and Land Use courses during office hours through one-to-one communication.
- Grading Assignments for both courses.
- Demonstration and clarification of traffic analysis procedures to undergraduate and graduate students using HCM.
- Demonstrating Traffic simulation modeling to students.

Graduate Teaching Assistant
Cairo University, Faculty of Engineering, Cairo, Egypt Jan 2017 – Aug 2021

- **Courses**: PBW301 – PBW401 – PBW501
- Demonstrated Assignments and solved problems related to the coursework for undergraduate students.
- Checked assignments, proctored tests, and provided grades according to university standards.
- Documented attendance and completed assignments to maintain full class and student.

- Prepared lessons according to the course outline to convey required material and deepen student understanding of the subject matter.
- Taught small groups of students focused on specific parts of the coursework.
- Mentored students through office hours and one-on-one communication.
- Assisted faculty with copying papers, collecting assignments, and preparing materials for upcoming classes.
- Helped in writing and submitting documents and reports associated with accreditation.

Research Projects

- **NCHRP 07-34: Artificial Intelligence–Enabled Decision Support Systems for Transportation Systems Management and Operations (TSMO)**
  Sponsor: Federal Highway Administration (FHWA) through NCHRP
  Role: Research Scientist / Key Technical Contributor
- **Inexperienced Driver Mitigation**
  Sponsor: Arizona Board of Regents (ABOR)
  Role: Project Manager
- **Traffic Engineering Technical Support for the City of Yuma, Arizona**
  Sponsor: City of Yuma
  Role: Project Manager
- **Freeway and Arterial Traffic State Estimation Using Kalman Filtering and Connected Vehicle Data**
  Sponsor: FHWA - UTC
  Role: Doctoral Researcher
- **Advanced Traffic Signal Control and Eco-Driving Applications for Connected and Automated Vehicles**
  Sponsor: FHWA - UTC
  Role: Doctoral Researcher
- **Stochastic Optimization of Vehicle Trajectories, VT**
  - Use stochastic optimization methods and theories to implement a class project to optimize vehicle trajectories, considering uncertainty in actuated traffic signals.
- **GIS Evaluation of Proposed Micromobility Stations Locations**
  - Worked with classmates to provide sufficient analytical evidence for implementing micro-mobility stations at vacant areas in Alexandria, VA.
- **Optimal Cost Policy for Inter-Campus Shared Mobility at Virginia Tech: A Transportation Problem Analysis**
  - Determined the optimal pricing policy for e-scooter mobility within the Virginia Tech campus area.
  - Modeled multiple cost policies and calculated market share based on students' perceived cost of travel.
  - Analysis highlighted the importance of aligning pricing with students' perceived value of time to maintain profitability.
  - Used Gurobi for solving the optimization problem.

Leadership and Volunteering

- STP – 2012: Volunteer in the Entrepreneurship Sessions.
- K-Vector 2013-2015: Moderator and head for the academic sessions that provide technical training and tutorials of engineering software for undergraduate civil engineering students.

Technical Skills

- Software:
  - AutoCAD 2D and Road Design using AutoCAD Civil 3D.
  - Strong proficiency in Transportation modeling, Traffic Analysis and Simulation: PTV Vissim, PTV Visum, Synchro, HCS, SIDRA.
  - GIS: ArcMap, ArcGIS Pro, QGIS.
  - Microsoft Office and LaTeX
- Programming:
  - Basic coding knowledge using: C++, Java, VBA, MySQL.
  - Proficient in Python, R.
  - Machine Learning framework: TensorFlow, Keras.

- Modeling and Optimization:
  - Transportation Network Modeling.
  - Transportation Demand Estimation and Modeling.
  - Traffic Simulation and Analysis.
  - Traffic Survey Analysis.
- System Optimization:
  - Building Optimization Models using CPLEX, Gurobi.
  - Optimization of Traffic Control Systems (Such as Traffic Signals and Public Transit).
- Languages Spoken:
  - Arabic (Native).
  - English (Excellent written and Spoken).
- Certification: FE – Civil (In Progress)

Highlight Published Articles

Journal Articles

A. K. Shafik, S. Eteifa and H. A. Rakha, "Optimization of Vehicle Trajectories Considering Uncertainty in Actuated Traffic Signal Timings," in ***IEEE Transactions on Intelligent Transportation Systems***, doi: 10.1109/TITS.2023.3253424

A. K. Shafik, and H. A. Rakha, "Real-Time Traffic State Estimation and Short-Term Prediction Using Probe Vehicle Data: A Kalman Filter Approach," in Sensors.

A. K. Shafik, Hassan, A., Saied, A. M., & Abdelmegeed, A. E. (2022). Development of Online Vissim Traffic Microscopic Calibration Framework Using Artificial Intelligence for Cairo CBD Area. Ekistics and The New Habitat, 81(1), 2-9. https://doi.org/10.53910/26531313-E2021811505

Conference Papers and Presentations

A. K. Shafik, Eteifa, S, & Rakha, H. (2023). Optimization of Vehicle Trajectories Considering Uncertainty in Actuated Traffic Signal Timings. Transportation Research Board (TRB) 102nd Annual Meeting

A. K. Shafik and H. A. Rakha, "Queue Estimation and Consideration in Vehicle Trajectory Optimization at Actuated Signalized Intersections," in *IEEE Smart Mobility Conference 2024*.

A. K. Shafik and H. A. Rakha, "Kalman Filter-Based Real-Time Traffic State Estimation and Prediction Using Vehicle Probe Data," in *IEEE Smart Mobility Conference 2024*.

A. K. Shafik and H. A. Rakha, "Enhancing and Evaluating a Decentralized Cycle-Free Game-Theoretic Adaptive Traffic Signal Controller on an Isolated Signalized Intersection," in *IEEE Smart Mobility Conference 2024*.

Scholarships

The Last Mile Leadership Scholarship in the amount of $6,000 for the 2024-2025 school year

References

Available Upon Request.