Amir Rafe, Ph.D.

Postdoctoral Researcher

Ingram School of Engineering, Texas State University
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Research Interests

Focus Areas: Causality and Computational Epistemology in Engineering; Human Behavior and Safety; Evacuation and Disaster Management; Machine Learning and Applied AI.

Research Statement: My research advances computational epistemology for transportation resilience by unifying causal inference, AI-driven reasoning, and behavioral modeling to uncover the mechanisms underlying safety and decision-making in complex systems.

Education

2022–2025 **Ph.D. in Civil & Environmental Engineering**, *Utah State University*, Transportation Engineering specialization, GPA: 4.0
Dissertation: EvacuAIDi: An AI-Driven, Causal-Informed Framework for Probabilistic and Disability-Inclusive Evacuation Guidance

2010–2013 **M.S. in Civil & Environmental Engineering**, *Azad University*, Transportation Engineering specialization, GPA: 4.0
Thesis: Pedestrian Dynamics Modeling Using the Social Force Model: A Heterogeneous Approach

2005–2009 **B.S. in Civil Engineering**, *Azad University*, GPA: 4.0

Academic Appointments

2025–Present **Postdoctoral Researcher**, *AI in Transportation (AIT) Lab, Texas State University, Ingram School of Engineering*

2022–2025 **Graduate Research Assistant**, *Singleton Transportation Lab, Utah State University, Department of Civil & Environmental Engineering*

2012–2022 **Algorithm Engineer**, *Ramona T&I and IUST Research Institutes*

Publications

Peer-Reviewed Journal Articles

2025 Somvanshi, S., Islam, M.M., **Rafe, A.**, Tusti, A.G., Chakraborty, A., Baitullah, A., Chowdhury, T.I., Alnawmasi, N., Dutta, A. & Das, S. "Bridging the Black Box: A Survey on Mechanistic Interpretability in AI." *ACM Computing Surveys*. https://doi.org/10.1145/3787104

Rafe, A., Singleton, P. A., Boyer, S., & Mekker, M. "Pedestrian Crossing Behaviors at Signalized Intersections in Utah: Factors Affecting Spatial and Temporal Violations." *International Journal of Transportation Science and Technology*. https://doi.org/10.1016/j.ijtst.2024.12.005

2024 **Rafe, A.**, Arman, M. A., & Singleton, P. A. "A Comparative Study Using Generalized Ordered Probit, Stacking Ensemble, and TabNet: Application to Determinants of Pedestrian Crash Severity." *Data Science for Transportation*, 6(2), 13. https://doi.org/10.1007/s42421-024-00098-x

Rafe, A., & Singleton, P. A. "Imputing Time Series Pedestrian Volume Data With Consideration of Epidemiological-Environmental Variables." *Transportation Research Record*. https://doi.org/10.1177/03611981241240758

Rafe, A., & Singleton, P. A. "Exploring the Complexity of Pedestrian Dynamics: Impact of Societal Behaviors and Personal Attributes in Urban Environments." *Transportation Research Record*. https://doi.org/10.1177/03611981241260707

Conference Proceedings

2025 **Rafe, A.**, Lawrence, P. J., Lovreglio, R., Spearpoint, M., & Singleton, P. A. "Enhancing Occupant Evacuation Simulation Using LLMs and Retrieval-Augmented Generation." *ICTD 2025*. https://doi.org/10.1061/9780784486191.034

Afand, K., **Rafe, A.**, Khademi, N., Mazloum, S., Ahmadi, A., Zabihpour, A., & Singleton, P. A. *Virtual reality analysis of leadership dynamics and pedestrian route choice during mass gathering evacuations. ICTD 2025.* DOI: https://doi.org/10.1061/9780784486207.004.

Mazloum, S., Khademi, N., Ahmadi, A., Afand, K., Zabihpour, A., **Rafe, A.**, & Singleton, P. A. *Exploring pedestrian evacuation behavior using a virtual reality (VR) environment: An eye-tracking study. ICTD 2025.* DOI: https://doi.org/10.1061/9780784486207.035.

2024 **Rafe, A.**, & Singleton, P. A. *Exploring the Determinants of Pedestrian Crash Severity Using an AutoML Approach. ICTD 2024*, pp. 442–455. DOI: https://doi.org/10.1061/9780784485514.039.

2023 **Rafe, A.**, Kretz, T., & Singleton, P. A. *Importance of social behaviors on pedestrian dynamics: A case study of Islamic clothing in Iran. TRB Annual Meeting 2023.*

2019 Arman, M. A., **Rafe, A.**, & Kretz, T. *Applied hybrid binary mixed logit to investigate pedestrian crossing safety at midblock and unsignalized intersection.* arXiv. DOI: https://doi.org/10.48550/arXiv.1905.09403.

2015 Arman, M. A., **Rafe, A.**, & Kretz, T. *Pedestrian Gap Acceptance Behavior, A Case Study: Tehran. TRB Annual Meeting 2015.*

2014 **Rafe, A.**, Karimi, M. *Calibrating Social Force Model based on design experiments method. 13th International Conference on Traffic and Transportation Engineering.*

Rafe, A., Khavarzade, R. *Investigation of Pedestrian's Gap Acceptance behavior at Crosswalk. 13th International Conference on Traffic and Transportation Engineering.*

Rafe, A., Shariat, A., Kalantari, N., Arman, M. A., & Yazdanpanah. *Pedestrian simulation with Viswalk at various walking facilities. 13th International Conference on Traffic and Transportation Engineering.*

Under Review

2026 **Rafe, A.** & Das, S. *Community Driving-Safety Deterioration as a Push Factor for Public Endorsement of AI Driving Capability.* Submitted to *Accident Analysis & Prevention.* Available at https://doi.org/10.48550/arXiv.2604.04775.

Rafe, A., Baitullah, A., & Das, S. *Latent Profiles of AI Risk Perception and Their Differential Association with Community Driving Safety Concerns: A Person-Centered Analysis.* Submitted to *Transportation Research Part F: Traffic Psychology and Behaviour.* Available at https://doi.org/10.48550/arXiv.2604.04849.

Barua, S., Starewich, M., Chowdhury, T. I., **Rafe, A.**, & Das, S. *Decoding Pedestrian Severity at Crosswalks using Hybrid Clustering and Random Parameter Models.* Submitted to *Scientific Reports.* Available at https://doi.org/10.21203/rs.3.rs-9003568/v1.

Rafe, A. & Das, S. *Heterogeneous Ordinal Structure Learning with Bayesian Non-parametric Complexity Discovery.* Submitted to *NeurIPS 2026.* Available at https://doi.org/10.48550/arXiv.2605.04191.

Rafe, A. & Das, S. *Coupled-NeuralHP: Directional Temporal Coupling Between AI Innovation Exposure and Public Response.* Submitted to *NeurIPS 2026*. Available at https://doi.org/10.48550/arXiv.2605.04194.

Rafe, A. & Das, S. *Socio-Conformal Calibration in Complex Survey Data: Marginal Validity Is Not Enough for Subgroup Reliability.* Submitted to *NeurIPS 2026*. Available at https://doi.org/10.48550/arXiv.2605.05562.

Rafe, A. & Das, S. *From Aha Tokens to Convergent Insight: An Externalist Audit for Emergent LLM Self-Correction.* Submitted to *ACM AI Letters*.

Rafe, A. & Das, S. *The Double-Edged Algorithm: A Causal-Epistemic Framework for Generative AI and Researcher Creativity.* Submitted to *Technological Forecasting and Social Change*.

2025 **Rafe, A.** & Das, S. *Causal AI and Computational Epistemology -A Survey.* Submitted to *ACM Computing Surveys*. Available at https://dx.doi.org/10.2139/ssrn.6045495.

Chhetri, G., Brotee, S., Ansari, M. W., Bellamkonda, V. S., **Rafe, A.**, Alnawmasi, N., Dutta, A. & Das, S. *Machine Unlearning in the Era of Foundation Models: Taxonomy, Methods, and Guarantees.* Submitted to *ACM Computing Surveys*. Available at https://dx.doi.org/10.2139/ssrn.5968054.

Brotee, S., Chhetri, G., Polock, S. B. B., Bellamkonda, V. S., **Rafe, A.**, & Das, S. *A Survey on Joint Embedding Predictive Architectures and World Models.* Submitted to *ACM Computing Surveys*. Available at http://dx.doi.org/10.2139/ssrn.5772122.

Afand, K., **Rafe, A.**, Khademi, N., & Das. S. *Leadership and pedestrian route choice in outdoor evacuation: environmental and behavioral influences during gatherings.* Submitted to *Transportation Research Record*.

Somvanshi, S., Sheley, R., Shuvo, S.A., **Rafe, A.** & Das, S. *A Survey on Automated Vehicles in Low Visibility and Infrastructure-Limited Roadway Settings.* Submitted to *IEEE Transactions on Intelligent Transportation Systems*. Available at https://dx.doi.org/10.2139/ssrn.5387394.

Polock, S.B., Starewich, M., Somvanshi, S., Javed, S.A., Barua, S., **Rafe, A.** & Das, S. *Red-Light Running Involved Crash Severity: Heterogeneity, Temporal Stability, and Policy Implications.* Submitted to *Transport Policy*.

Research Projects

2026-Present FMCSA: *Telematics-Informed Crash Risk Modeling to Support Targeted Traffic Enforcement for CMV Safety*, Federal Motor Carrier Safety Administration.

2025-Present NCHRP 17-113: *Incorporating Safe System Approach into the NCHRP Report 500 Series*, Transportation Research Board of The National Academies of Sciences, Engineering, and Medicine.

NCHRP Synthesis 20-05 / Topic 56-05: *Traffic Analysis Practices for Non-Motorists*, Transportation Research Board of The National Academies of Sciences, Engineering, and Medicine.

NCHRP 17-134: *Center Line Buffer Areas for Safety: Implementation Guidelines and Tool*, Transportation Research Board of The National Academies of Sciences, Engineering, and Medicine.

BTSCRP BTS-39: *Toolkit for Reducing Substance-Impaired Driving for the Last Leg of the Journey*, Behavioral Traffic Safety Cooperative Research Program (BTSCRP), Transportation Research Board of The National Academies of Sciences, Engineering, and Medicine.

BTSCRP BTS-42: *Guidelines for Authorizing, Implementing, and Operating Automated Traffic Enforcement Programs*, Behavioral Traffic Safety Cooperative Research Program (BTSCRP), Transportation Research Board of The National Academies of Sciences, Engineering, and Medicine.

AAA Foundation: *Examining the Pre-Crash Circumstances Leading to Pedestrian Fatalities*, AAA Foundation for Traffic Safety.

2024 *AI-Powered Tools for Safe Evacuation of Individuals During Emergencies*, Center for Transformative Infrastructure Preservation and Sustainability (CTIPS).

2022-2024 *The UDOT Pedestrian Data Platform*, Utah State University.

2022 *Prediction of Traffic Congestion Patterns Using Deep Learning*, in cooperation with KU Leuven.

2021 *Fire Simulation and Crowd Emergency Evacuation Studies of Parsabad and Khoy Airports*, Iriana Consulting Engineers Co.

2017-2020 *Traffic safety and Impact Studies (Tehran, Rasht, Qom, Isfahan)*, Iriana Consulting Engineers Co.

2016 *Emergency Evacuation Modeling of Underground Parking at the Shrine of Fatima Masoumeh*, Iriana Consulting Engineers Co.

2015 *Measuring the Resilience of Tehran's Transportation Network*, Iran University of Science and Technology.

Sayad Tunnel Emergency Evacuation Simulation Studies, Transportation Research Laboratory, Iran University of Science and Technology.

2015-2019 *Production of Software for Traffic Guide Sign Design*, Ramona Research Institute.

2014 *Online Simulation Studies of Sadr Highway Emergency Evacuation*, Transportation Research Laboratory, Iran University of Science and Technology.

2013 *Pedestrian Modeling and Simulation Studies in Tehran*, Transportation Research Laboratory, Iran University of Science and Technology.

Submitted / Under Review Proposals (Co-PI)

2026 NSF: *AIMing: Neuro-Symbolic Verification for the Autonomous Energy-Mobility Nexus*, Artificial Intelligence, Formal Methods, and Mathematical Reasoning (AIMing).

Amazon: *RoadSafe Agents: Governed Multi-Agent AI for Proactive Road Safety Scoring*, Amazon Research Awards.

Amazon: *SafetyLens and SafeLM: Risk-Calibrated Multimodal Foundation Models for Auditable Traffic Crash Understanding*, Amazon Research Awards.

2025 NSF: *Sheaf-Theoretic Identifiability for Multi-Sensor Safety Systems*, Mathematical Foundations of Artificial Intelligence (MFAI) program.

NSF: *PIVOT: Privacy-Preserving Infrastructure for Video Synthesis and Analysis in Open Transportation Safety*, Cyberinfrastructure for Sustained Scientific Innovation (CSSI) program.

ARPA-I: *EvacuVerse: A National Causal Digital Twin for Disability-Inclusive Evacuation and Multi-Modal Re-Routing.*

CREATE University Transportation Center: *Role of Emerging Transportation Technologies and Safety Initiatives in Mitigating Crashes in Coastal Communities.*

Intellectual Property and Innovation

2026 **CausalSafe**: System and method for multimodal neuro-symbolic causal inference, SCM-based counterfactual traffic-risk assessment, and proactive safety intervention using grounded large language models. *Invention disclosure submitted*, Texas State University.

PIVOT: System and method for privacy-preserving synthesis, co-reported privacy–utility certification, and federated sharing of transportation video, trajectories, and safety analytics. *Invention disclosure submitted*, Texas State University.

Sheaf-Theoretic Multi-Sensor Fusion: System and method for trustworthy multi-sensor fusion in roadway safety applications using sheaf-theoretic consistency modeling. *Invention disclosure submitted*, Texas State University.

EvacuAIDi: Accessibility-aware AI framework for probabilistic emergency evacuation guidance. *Innovation disclosure submitted*, Utah State University.

Teaching Experience

2025–2026 Guest Lecturer: *Traffic Engineering*; *AI in Civil Engineering*; *Roadway Infrastructure Safety*, Texas State University.

2022–2024 Guest Lecturer: *Transportation Planning*; *Transportation Data and Safety Analysis*, Utah State University.

2023 Curriculum Developer, *Empowering Teaching Excellence (ETE-10)*: Prepared asynchronous modules for undergraduate/graduate students in statistics, data science, and applied AI.

Mentoring

Texas State University
- Ph.D.: Sawgat Ahmed Shuvo.
- M.S.: Arka Chakraborty; Anika Baitullah; Sazzad Bin Bashar Polock; Tausif Islam Chowdhury.
- B.S.: Biplov Pandey, Irfan Sarwar Pranjol, Bidisha Shrestha.
- B.S. (Computer Science): Gaurab Chhetri, Radha Yadav.

Lund University M.S. (Co-supervisor): Yousef Zoghi.

Academic & Professional Service

Conference Review Transportation Research Board (TRB) Annual Meeting Reviewer, 2022–Present; IEEE International Conference on Intelligent Transportation Systems (ITSC), 2024.

Journal Review
- Safety Science
- Transportation Research Part A
- Transportation Research Part D
- Transportation Research Part F
- Accident Analysis & Prevention
- European Transport Research Review
- International Journal of Transportation Science and Technology
- Journal of Transport & Health
- Journal of Transport Geography
- Transportation Research Record
- Transportation Research Interdisciplinary Perspectives

Awards & Certifications

Scholarship Graduate Enhancement Scholarship, Utah State University.

Certification
- Empowering Teaching Excellence (ETE-10), Utah State University.
- Neural Networks and Deep Learning (DeepLearning.AI).
- Data Science Professional Certificate (IBM).
- Intro to Traffic Flow Modeling and Intelligent Transport Systems (EPFL).
- Assessment of Safety using PTV VISSIM (University of Waterloo).
- Operations Research using GAMS (Sharif University).

Technical Skills

Programming & Data Science	Python; R; SQL (PostgreSQL, BigQuery); Apache Spark; Docker.
Simulation Tools	MATSim; SUMO; PTV Vissim/Viswalk; Pathfinder; MassMotion; PyroSim.
Cloud Computing	Google Cloud Platform; AWS.
Geospatial Technologies	QGIS; ArcGIS.

Professional Memberships

American Society of Civil Engineers (ASCE).

Institute of Transportation Engineers (ITE).

Language Skills

English — fluent

Persian — fluent

Spanish — moderate

References

- **Dr. Subasish Das** — Associate Professor, Ingram School of Engineering, Texas State University. Email: subasish@txstate.edu, Phone: 512-245-1826
- **Dr. Patrick Singleton** — Associate Professor, Department of Civil and Environmental Engineering, Utah State University. Email: patrick.singleton@usu.edu, Phone: 435-797-7109
- **Dr. Enrico Ronchi** — Associate Professor, Department of Fire Safety Engineering, Lund University. Email: enrico.ronchi@brand.lth.se, Phone: +46 46 222 7694