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Amir Babaei

Research Summary

Researcher focused on applied spatio-temporal deep learning models and traffic state estimation using large-scale Floating Car Data (FCD). Currently developing Physics-Informed Graph Neural Networks (GNN) and experimenting with data fusion methods. Leveraging engineering background to build and deploy data pipelines (ETL) across high-performance computing environments for urban mobility research and policy evaluation. Experience with traffic simulation; agent-based simulations (MATSim).

Education

2022–2024 **M.Sc. Global Logistics**, *Frankfurt University of Applied Sciences*, Frankfurt am Main, Germany

2015–2021 **B.Sc. Electrical Engineering**, *Ferdowsi University of Mashhad*, Mashhad, Iran

Research & Academic Experience

Sep 2023–Present **Research Assistant**, *ReLUT (Research Lab for Urban Transport)*, Frankfurt am Main, Germany

DZwEI Project (mFund)
- Built Airflow and Apache Spark ETL pipelines on AWS and local HPC clusters (Slurm, A100 GPUs) to filter, map-match, run inferences, and aggregate millions of INRIX FCD trips per minute and street edge, extracting traffic state variables such as Space Mean Speed (SMS).
- Mapped the on-street parking infrastructure of the Alleenring in Frankfurt onto OpenStreetMap (OSM) to estimate total parking capacities.
- Created an interactive policy before/after analysis dashboard utilizing FCD, allowing users to visualize how specific transport policies affect traffic state variables within custom-defined study areas.

NEXTLOGIC Project (EU Horizon)
- Serve as Technical Lead for Digital Twins and Simulation integration.
- Establishing data ingestion pipelines and traffic simulation integrations to optimize urban space across European Mission Cities.

Jun 2022–Sep 2023 **Student Assistant**, *ReLUT (Research Lab for Urban Transport)*, Frankfurt am Main, Germany

ASIMOW Project (LOEWE)
- Executed agent-based traffic simulations using MATSim for > 3 million agents in the Rhine-Main area.
- Developed an agent-tracking module to measure the exposure to emissions by individual agents
- Modeled mobility patterns to predict the welfare effects and time costs of transport measures (e.g., speed limits).
- Scaled computation performance on Azure, achieving a 70% reduction in simulation execution time.

Publications

Peer-Reviewed Journal Articles

2022 Mashayekhy, Y., Babaei, A., Yuan, X.M., & Xue, A. Impact of Internet of Things (IoT) on Inventory Management: A Literature Survey. *Logistics*, 6(2), 33.

Articles Under Review

Babaei, A., & Hagen, T. Toward Understanding the Dynamics of Commercial FCD Penetration Rates: A Large-Scale Empirical Study for Frankfurt am Main. *European Transport Research Review (ETRR)* special issue for ETC 2025.

Conferences & Proceedings

2026 Babaei, A., & Hagen, T. Toward identifying factors influencing commercial FCD penetration rates in urban road networks. WCTR 2026 [Accepted]

2025 Babaei, A., & Hagen, T. Data Fusion: Traffic Flow Estimation Based on a Graph Neural Network (GNN) Approach for Loop Detector Data Leveraging Floating Car Data (FCD). European Transport Conference 2025[Accepted]

2023 Babaei, A., Mashayekhy Fard, Y., Sunder, M., & Hagen, T. Using a Grid Approach for Modeling the Spatial Distribution of Air Pollution in an Agent-Based Traffic Simulation of the Rhein-Main Region. European Transport Conference 2023[Accepted]

2023 Mashayekhy, Y., Babaei, A., Hagen, T., & Sunder, M. Traffic Policies for Sustainable Cities: A Heterogeneous Analysis. POMS 2023 International Conference. [Accepted]

Teaching Experience

Instructor, *Frankfurt University of Applied Sciences*

Teach Python programming and data analysis methodologies to finance students utilizing interactive environments (Google Colab).

Technical Skills

Machine Learning & AI	PyTorch, PyG, Pandas, NumPy.
Traffic & Spatial Tools	MATSim, SUMO, OpenStreetMap (Overpass API).
Data Engineering & Infra	Apache Spark, Airflow ETL, AWS, Azure, HPC (Slurm), Linux/Zsh, Docker.
Programming Languages	Python, Java, C++, SQL.

Previous Industry Experience

2020–2022 **Technical Product Owner**, *WeBlast.EU*, Istanbul, Turkey

Led a 15-member cross-functional team to launch 5 digital products, maintaining a 93% on-time delivery rate. Structured business proposals and technical architectures.

2018–2020 **Software Developer**, *Arashweb.com*, Mashhad, Iran

Engineered backend systems processing > 150k daily requests. Implemented CI/CD pipelines and automated infrastructure deployments.