

Denizhan Kara

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EDUCATION

University of Illinois at Urbana-Champaign

Champaign, IL

Ph.D. in Computer Science - Siebel School of Computing and Data Science

Aug. 2022 – Expected May 2026

– **Research Focus:** Foundation Models, Multimodal Representation Learning, GenAI

University of Illinois at Urbana-Champaign

Champaign, IL

Master of Computer Science - Siebel School of Computing and Data Science

Aug. 2020 – Dec. 2021

Koç University

Istanbul, Turkey

B.Sc. in Electrical and Electronics Engineering & Physics (Double Major)

Sep. 2012 – Jun. 2017

WORK EXPERIENCE

Software Engineer Intern - Driver Understanding ML

May 2025 – Aug. 2025

Waymo

Mountain View, CA

- Architected and deployed systematic prompt engineering and automation framework with Gemini LLM, serving millions of daily autonomous vehicle events, automating Traffic Events Triage with 91% recall on high-impact scenarios representing 35% of all queries.
- Built production-grade few-shot inference pipeline, improving complex judgment recall by 9 points.
- Established Gemini LLM prompt engineering and automation best practices adopted across 3 teams, enabling efficiency gain in automation tasks. Guides and practices were adopted by other colleagues, reporting 90% recall on a separate automation task.
- Implemented dynamic prompting with context-aware sensory information, allowing context-aware automation.

Research Scientist Intern - Multimodal Foundation Models R&D

Jun. 2024 – Sep. 2024

US Army Research Laboratory (DEVCOM ARL)

Adelphi Laboratory Center, MD

- Led development of robust vehicle classification systems via sub-10M parameter foundation models trained on multimodal sensor data, achieving 12% improvement in detection accuracy while improving other downstream tasks performance (e.g. tracking) with real-time deployment on edge devices.
- Led integration of physical decay models into foundation model pretraining, developing novel loss functions that improved robustness to environmental variations by 10%. Model was deployed and demonstrated on low-cost edge devices.
- Deployed inference pipeline capable of real-time processing (sub-second inference latency) on edge devices, enabling distributed sensing applications for autonomous systems in resource-constrained environments.

Machine Learning Engineer

Jan. 2020 – Aug. 2022

Prometeia

Istanbul, Turkey

- Architected AI-based propensity scoring framework processing 3M+ customer transactions in a large bank, utilizing advanced time series embeddings and attention mechanisms to predict customer interests with improved accuracy.
- Developed a deep learning credit default prediction system, engineering novel temporal transaction features that improved recall by 25%.
- Enhanced Allianz Insurance's automated damage assessment system processing thousands of claims monthly, implementing state-of-the-art segmentation models with data augmentation pipeline that led to improved F1-score by 6%.

Software Design Engineer

Jul. 2017 – Dec. 2019

Turkish Aerospace - Autopilot Systems Division

Ankara, Turkey

- Developed and maintained signal processing libraries for autopilot control system software, reducing signal processing delay by up to 20%.
- Led the interpretation of electromagnetic and vibrational noise within sensor data, developing signal filtering solutions compliant with control algorithms.
- Created a sensor emulator framework, enabling realistic software-in-the-loop simulations for the autopilot department.

RESEARCH EXPERIENCE

Graduate Researcher - Foundation Models

Aug. 2022 – Present

Physics-Informed AI for Distributed IoT Systems

CyPhy Research Group at UIUC

- Developed foundation models integrating domain knowledge and physical laws with state-of-the-art self-supervised learning techniques for IoT Foundation Models.
- Aiming to build efficient, lightweight, and explainable AI systems for IoT applications deployable on edge devices.
- Collaborated with a multidisciplinary team, resulting in publications in top-tier conferences such as ACM SenSys, WWW, and NeurIPS.

Graduate Researcher - Adversarial ML & Security

Aug. 2020 – May 2022

Autonomous Vehicle & UAV Security Research

Systems Security Research Group at UIUC

- Designed embedded misbehavior detection framework (OVERTON) for V2X networks, integrating temporal anomaly detection, vehicular trust mechanisms, and novel ML architecture to combat adversarial attacks on autonomous vehicle communication.
- Developed stealthy sensor-spoofing attack framework for UAV swarms, formulating ML-driven adversarial strategies that manipulate IMU readings to bypass control systems without triggering security alerts.
- Expanded research on ML-driven adversarial mechanisms across vehicular and aerial platforms, leading to improved network security protocols and defensive strategies for autonomous systems.

PUBLICATIONS

Peer-Reviewed Publications

- [1] **Kara, D.**, Kimura, T., Li, J., He, B., Chen, Y., Hu, Y., Zhao, H., Liu, S., & Abdelzaher, T. (2025). *AdaTS: Learning Adaptive Time Series Representations via Dynamic Soft Contrasts*. In Proc. Advances in Neural Information Processing Systems (NeurIPS 2025).
- [2] **Kara, D.**, Kimura, T., Liu, S., Li, J., Liu, D., Wang, T., Wang, R., & Abdelzaher, T. (2024). *FreqMAE: Frequency-Aware Masked Autoencoder for Multi-Modal IoT Sensing*. In Proc. ACM Web Conference 2024 (WWW 2024), Singapore.
- [3] **Kara, D.**, Kimura, T., Chen, Y., Li, J., Wang, R., Chen, Y., Kaplan, L., Bhattacharyya, J., & Abdelzaher, T. (2024). *PhyMask: An Adaptive Masking Paradigm for Efficient Self-Supervised Learning in IoT*. In Proc. 22nd ACM Conference on Embedded Networked Sensor Systems (SenSys 2024).
- [4] **Kara, D.**, Kimura, T., Sun, D., Li, J., Chen, Y., Hu, Y., Zhao, H., Bhattacharyya, J., & Abdelzaher, T. (2025). *DiffPhys: Differential Physics Augmentations for Enhanced Representations*. In Proc. 34th International Conference on Computer Communications and Networks (ICCCN), Tokyo, Japan.
- [5] Wang, T., Yang, Q., Wang, R., Sun, D., Li, J., Chen, Y., Hu, Y., Yang, C., Kimura, T., **Kara, D.**, & Abdelzaher, T. (2024). *Fine-grained Control of Generative Data Augmentation in IoT Sensing*. In Proc. Advances in Neural Information Processing Systems (NeurIPS 2024).
- [6] Kimura, T., Li, J., Wang, T., **Kara, D.**, Wigness, M., Bhattacharyya, J., Srivatsa, M. B., Liu, S., Diggavi, S., & Abdelzaher, T. (2024). *VibroFM: Towards Micro Foundation Models for Robust Multimodal IoT Sensing*. In Proc. IEEE International Conference on Mobile Ad-Hoc and Smart Systems (MASS 2024).
- [7] Wang, T., Li, J., Wang, R., **Kara, D.**, Liu, S., Wertheimer, D., Martin, A., Ganti, R., Srivatsa, M., & Abdelzaher, T. (2023). *SudokuSens: Enhancing Deep Learning Robustness for IoT Sensing Applications using a Generative Approach*. In Proc. 21st ACM Conference on Embedded Networked Sensor Systems (SenSys 2023).
- [8] Kalasapura, D., Li, J., Liu, S., Chen, Y., Wang, R., **Kara, D.**, & Abdelzaher, T. (2023). *TwinSync: A Digital Twin Synchronization Protocol for Bandwidth-limited IoT Applications*. In Proc. 32nd International Conference on Computer Communications and Networks (ICCCN), Honolulu, HI.
- [9] Wang, T., **Kara, D.**, Li, J., Liu, S., Abdelzaher, T., & Jalaian, B. (2022). *The Methodological Pitfall of Dataset-Driven Research on Deep Learning: An IoT Example*. MILCOM 2022 IEEE Military Communications Conference.

- [10] Kim, K. H., **Kara, D.**, Paruchuri, V., Mohan, S., Kimberly, G., Osipychiev, D., & Pajic, M. (2022). *Insights on Using Deep Learning to Spoof Inertial Measurement Units for Stealthy Attacks on UAVs*. MILCOM 2022 IEEE Military Communications Conference.
- [11] Wang, R., Zhang, Y., Li, J., Liu, S., Sun, D., Wang, T., Wang, T., Chen, Y., **Kara, D.**, & Abdelzaher, T. (2024). *MetaHKG: Meta Hyperbolic Learning for Few-shot Temporal Reasoning*. In Proc. 47th International ACM SIGIR Conference on Research and Development in Information Retrieval, Washington, DC.
- [12] Li, J., Chen, Y., Kimura, T., Wang, T., **Kara, D.**, Hu, Y., Hanafy, W. A., & Abdelzaher, T. (2024). *Acies-OS: A Content-Centric Platform for Edge AI Twinning and Orchestration*. In Proc. 33rd International Conference on Computer Communications and Networks (ICCCN), Big Island, HI.
- [13] Sun, D., Lyu, Y., Li, J., Liu, X., **Kara, D.**, Lebiere, C., & Abdelzaher, T. (2025). *The Irrational LLM: Implementing Cognitive Agents with Weighted Retrieval-Augmented Generation*. In Proc. 34th International Conference on Computer Communications and Networks (ICCCN), Tokyo, Japan.
- [14] Sun, D., Li, J., Liu, X., Lyu, Y., Zhao, H., **Kara, D.**, & Abdelzaher, T. (2025). *Perturbation-based Graph Active Learning for Semi-Supervised Belief Representation Learning*. In Proc. 34th International Conference on Computer Communications and Networks (ICCCN), Tokyo, Japan.
- [15] Hu, C., Chen, Y., **Kara, D.**, Liu, S., Abdelzaher, T., Wu, F., & Chen, G. (2025). *OpenMAE: Efficient Masked Autoencoder for Vibration Sensing with Open-Domain Data Enrichment*. In Proc. ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (ACM IMWUT), also presented in UbiComp, Espoo, Finland.
- [16] Wang, T., Chen, Y., Zhao, H., Lyu, Y., Li, J., Kimura, T., Hu, Y., **Kara, D.**, Wigness, M., Twigg, J., & Abdelzaher, T. (2025). *On Network-Efficient Multimodal Multi-Vantage Foundation Models for Distributed Sensing*. In Proc. 22nd IEEE International Conference on Mobile Ad-Hoc and Smart Systems (IEEE MASS), Chicago, IL.
- [17] Abdelzaher, T., Hu, Y., **Kara, D.**, Kimura, T., Misra, A., Ramani, V., Tardieu, O., Wang, T., Wigness, M., & Youssef, A. (2025). *The bottlenecks of AI: Challenges for Embedded and Real-Time Research in a Data-centric Age*. Real-Time Systems Journal, Volume 61, Issue 2.
- [18] Wang, T., Li, J., Chen, Y., Sun, D., Wang, R., **Kara, D.**, & Abdelzaher, T. (2025). *DynaGen: Conditional Diffusion Models for Enhancing Acoustic and Seismic-Based Vehicle Detection*. In Proc. IEEE Conference on Computer Communications (Infocom), London, UK.
- [19] Kimura, T., Li, X., Hanna, O., Chen, Y., Chen, Y., **Kara, D.**, Wang, T., Li, J., Ouyang, X., Liu, S., Srivastava, M., Diggavi, S., & Abdelzaher, T. (2025). *InfoMAE: Pairing-Efficient Cross-Modal Alignment with Informational Masked Autoencoders for IoT Signals*. In Proc. ACM TheWebConference (WWW), Sydney, Australia.
- [20] Kimura, T., Chen, Y., **Kara, D.**, Li, J., Wang, T., Wang, R., Bhattacharyya, J., Kim, J., Shenoy, P., Srivastava, M., Wigness, M., & Abdelzaher, T. (2024). *The Case for Micro Foundation Models to Support Robust Edge Intelligence*. In Proc. 10th IEEE International Conference on Collaboration and Internet Computing (IEEE CIC), Washington, DC.
- [21] Li, J., Han, R., Sun, D., Wang, R., Zeng, J., Yan, Y., Tong, H., & Abdelzaher, T. (2024). *Large Language Model-Guided Disentangled Belief Representation Learning on Polarized Social Graphs*. In Proc. 33rd International Conference on Computer Communications and Networks (ICCCN), Big Island, HI.
- [22] Wang, T., Chen, Y., Yang, Q., Sun, D., Wang, R., Li, J., **Kara, D.**, & Abdelzaher, T. (2024). *Data Augmentation for Human Activity Recognition via Condition Space Interpolation within a Generative Model*. In Proc. 33rd International Conference on Computer Communications and Networks (ICCCN), Big Island, HI.
- [23] Wang, R., Huang, J., Zhang, Y., Li, J., Wang, Y., Zhao, W., Liu, S., Mendis, C., & Abdelzaher, T. (2024). *TGOnline: Enhancing Temporal Graph Learning with Adaptive Online Meta-Learning*. In Proc. 47th International ACM SIGIR Conference on Research and Development in Information Retrieval, Washington, DC.

- [24] Kimura, T., Li, J., Wang, T., **Kara, D.**, Chen, Y., Hu, Y., Wang, R., Wigness, M., Bhattacharyya, J., Srivatsa, M., Liu, S., Diggavi, S., & Abdelzaher, T. (2024). *On the Efficiency and Robustness of Vibration-based Foundation Models for IoT Sensing: A Case Study*. In Proc. Workshop on Foundation Models for System Applications (FM-Sys).

Preprints and Under Review

- [1] Kim, K. H., **Kara, D.**, Paruchuri, V., Mohan, S., Kimberly, G., & Kim, J. (2024). *Requiem for a Drone: A Machine-Learning Based Framework for Stealthy Attacks Against Unmanned Autonomous Vehicles*. arXiv preprint arXiv:2407.15003.
- [2] **Kara, D.**, Kim, K. H., Mohan, S., Hasan, M., Shimizu, T., & Lu, H. *OVERTON: A Misbehavior Detection and Trust Framework for Vehicular (V2X) Networks*. (Target: USENIX Security Symposium 2025).
- [3] **Kara, D.**, Akyuz, B., & Arslan, S. *TRANSPROP: AI-based Propensity Scoring Framework Utilizing Transactional Data Stream*. (Preprint, Target: Proceedings of the AAAI Conference on Artificial Intelligence).

TECHNICAL SKILLS

Foundation Models & LLMs: Large-scale pretraining, Transformer architectures, Model compression & optimization
Deep Learning Frameworks: **PyTorch** (Expert), TensorFlow, Hugging Face Transformers, JAX
Machine Learning: Time series analysis, Physics-informed learning, Contrastive learning, Multimodal learning
Programming & Systems: **Python** (Expert), C++, CUDA, Distributed training
Production Infrastructure: AWS/GCP, Docker, Spark, Model deployment, Real-time inference

ACHIEVEMENTS

- **TUBITAK National Scholarship Programme for M.S studies:** Awarded for ranking among the top 50 students nationwide in TUBITAK (NSF of Turkey) Weighted ALES and GPA.
- **Koç University Vehbi Koç High Honors Award:** Recognized for outstanding academic performance with a GPA over 3.50.
- **Turkish Prime Ministry Special Success Scholarship and Koç University Full-Merit Scholarship:** Granted for ranking among the top 100 students in the National University Entrance Exam out of 2 million candidates.