Matthew Danish

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Summary

My work spans ML, computer vision, and programming languages, with a particular focus on practical AI systems that are both efficient and safe. Key areas include: computer vision systems in a resource-constrained edge computing context and ML for spatial imagery processing and human perception modeling. I have extensive experience in bridging academic research with industrial applications through consulting, and collaborations with Bloomberg L.P., Microsoft Research, and the UK Met Office, and a strong commitment to open source software and FAIR data.

Experience

Eindhoven University of Technology **Eindhoven, NL**
Researcher 3 (Automated Machine Learning Group) *Mar 2025–Jan 2026*

- Consulted with numerous SMEs helping them to integrate AI into their workflow and business processes.
- Example projects developed include: order processing system for metal working company, AI chatbot for health app, label validation and generation for seafood importer, CAD search engine for engineering firm.

Utrecht University **Utrecht, NL**
Researcher (Human Geography & Spatial Planning) *Jan 2023–Jan 2025*

- Designed and implemented the full stack of the **Percept** mobile web app, collecting ~20,000 responses.
- Assembled a ML pipeline to analyze environmental and geographic data together with perception data, applying vision and spatial data tools to process and filter 700,000 Mapillary street view images.
- Co-authored papers on computer vision and street view perception surveys with research team.

Cambridge University **Cambridge, UK**
Research Associate (Digital Technology Group / Systems Research Group) *Sep 2015–Dec 2022*

- Created **DeepDish**, privacy-preserving 'intelligent sensor' software running lightweight object detection and tracking models for real-time monitoring of people and vehicle flows, using low-power (~7 W) edge computing devices to achieve MOTA scores within 18–25% of a full-strength workstation with GPU.
- Initiated and designed an intelligent sensor system reconstructing in real-time a model of room occupancy from indoor video feed, to be fused with other data streams for air quality monitoring.
- Developed many of the main modules of the **CamFort** lightweight verification, modernization and static analysis tools for research into automated software evolution of scientific Fortran programs.
- Worked on **Fortran-Src**, an industrial-strength open-source parser and analyzer for Fortran versions 66 though 2003, written in Haskell, now used internally by commercial partners such as Bloomberg, L.P.
- Consulted with the Met Office weather forecasting service and developed automated tools to analyze their very large Fortran code base to find hidden bugs and improve code quality.
- Led an academic/industrial (Microsoft Research, Bloomberg L.P.) team to write a paper and research proposal on using hybrid ML algorithms to analyze and generate specifications for scientific programs.
- Lectured in an international series of **Fortran Modernisation** workshops for scientists in the UK, Spain and Germany, which were hosted by representatives from the Numerical Algorithms Group, Ltd.
- Negotiated for a £99,000 research funding donation from a corporate partner, hired a research assistant.

Cambridge Cycling Campaign **Cambridge, UK**
Charity Trustee (volunteer role) *2016–2022*

- Advised a 1,600+ member charity, hiring and managing employees. Led multi-year campaigns using technical knowledge of urban design and policy while communicating effectively with many stakeholders.

Boston University **Boston, Massachusetts, USA**
PhD, Computer Science *Sep 2008–May 2015*

- Dissertation: *Terrier: An embedded operating system using advanced types for safety.*

Carnegie-Mellon University **Pittsburgh, Pennsylvania, USA**
Research Programmer, Robotics Institute *June 2004–June 2008*
BS, Logic and Computation *Aug 2000–May 2004*

Skills

Machine Learning: Hands-on experience with PyTorch-based ML model training and evaluation for computer vision and beyond, including fine-tuning LLMs and developing CLIP-based algorithms. Deployed TensorFlow with Google Edge TPUs. Used AutoML for human perception modeling.

Programming: Haskell, C, Python, PostgreSQL/PostGIS, R, Java, HTML/CSS/JS and more. Linux systems programming, HPC (e.g. Snellius), Parallel and Distributed programming.

Communication: Presented at numerous workshops, conferences and meetings. Experienced at policy discussions with elected officials from the level of city councillor up to MP. Authored several op-ed columns in local newspapers and frequent articles for the charity's regular magazine.

Leadership and Management: Led team of authors on several papers and proposals. Secured £99,000 donation from corporate partner for my research, and used it to hire a research assistant. Chaired the Computer Laboratory Research Staff Forum. Volunteered 6 years as a charity trustee, hiring employees, leading campaigns and managing relationships with many other stakeholders.

Additional Roles & Awards

EdgeSys workshop (co-hosted with EuroSys): Publicity Chair (2021), Presenter (2020, 2022)

New Wiseman Award 2019: Received for outstanding contributions to the Computer Laboratory.

Campaigner of the year 2018: Received for volunteer work with Cambridge Cycling Campaign.

Debian: Software package maintainer for the ATS language and several small Lisp packages.

Projects

Percept: Toolkit for preparing and deploying street view perception survey (mobile) web apps.

DeepDish: 'Intelligent sensor' edge computing software for object detection and tracking.

CamFort: Static analysis and verification tool for scientific Fortran programs.

Fortran-Src: Haskell library for parsing and generation of historical & modern Fortran programs.

Terrier: Embedded ARM OS incorporating the ATS language for advanced type safety features.

ATS: Functional programming language with linear and dependent types (former group member).

Quest: Real-time OS with virtualisation-based sandbox features (former group member).

Adaptive City: Real-time urban & indoor sensor data processing platform (former group member).

Appendix: Selected Publications

[1] M. Danish, S. Labib, B. Ricker, and M. Helbich, "A citizen science toolkit to collect human perceptions of urban environments using open street view images," *Computers, Environment and Urban Systems*, vol. 116, p. 102207, 2025.

[2] M. Helbich, M. Danish, S. Labib, and B. Ricker, "To use or not to use proprietary street view images in (health and place) research? that is the question," *Health & Place*, vol. 87, p. 103244, 2024.

[3] J. Brazauskas, C. Jensen, M. Danish, I. Lewis, and R. Mortier, "Cerberus: Privacy-preserving crowd counting and localisation using face detection in edge devices," in *Proceedings of the 7th International Workshop on Edge Systems, Analytics and Networking*, pp. 25–30, 2024.

[4] M. Danish, R. Verma, J. Brazauskas, I. Lewis, and R. Mortier, "DeepDish on a Diet: Low-Latency, Energy-Efficient Object-Detection and Tracking at the Edge," in *Proceedings of the 5th International Workshop on Edge Systems, Analytics and Networking*, 2022.

[5] M. Danish, J. Brazauskas, R. Bricheno, I. Lewis, and R. Mortier, "DeepDish: multi-object tracking with an off-the-shelf Raspberry Pi," in *Proceedings of the Third ACM International Workshop on Edge Systems, Analytics and Networking*, 2020.

[6] M. Danish, M. Allamanis, M. Brockschmidt, A. Rice, and D. Orchard, "Learning units-of-measure from scientific code," in *2019 IEEE/ACM 14th International Workshop on Software Engineering for Science (SE4Science)*, 2019.

[7] M. Danish, D. Orchard, and A. Rice, "Incremental units-of-measure verification," *arXiv preprint arXiv:2406.02174*, 2018.

[8] D. Orchard, M. Contrastin, M. Danish, and A. Rice, "Verifying spatial properties of array computations," *Proceedings of the ACM on Programming Languages*, 2017.

[9] M. Contrastin, A. Rice, M. Danish, and D. A. Orchard, "Units-of-measure correctness in Fortran programs," *Computing in Science & Engineering*, vol. 18, no. 1, pp. 102–107, 2015.

[10] M. Danish and H. Xi, "Using lightweight theorem proving in an asynchronous systems context," in *NASA Formal Methods Symposium*, pp. 158–172, Springer, 2014.

[11] M. Danish, H. Xi, and R. West, "Applying language-based static verification in an ARM operating system," *ACM SIGBED Review*, vol. 10, no. 2, pp. 16–16, 2013.

[12] M. Danish, Y. Li, and R. West, "Virtual-CPU scheduling in the Quest operating system," in *17th IEEE Real-Time and Embedded Technology and Applications Symposium*, 2011.

[13] M. Danish and H. Xi, "Operating System Development with ATS," in *Proceedings of the International Workshop on Programming Languages Meets Program Verification, PLPV*, 2010.