

Max Ehrlich

Statement of Research

“A First Principles Approach to Media and Deep Learning”

My current research combines machine learning and computational imaging to solve real problems. My focus is on breaking down and understanding the first principles of the problem and then building these principles back up into a machine learning solution rather than treating the model as a black box.

In the past I have successfully applied this idea to image enhancement. The broader impact of this is to improve participation from underrepresented groups. For example, by creating better multimedia compression algorithms which incorporate simple deep learning based techniques, people operating in underinvested locations (e.g., rural areas, Native American reservations, 3rd world countries) are able to participate in an increasingly media-focused internet. I am grateful to have had recognition of the importance of this work by many funding partners over the years including government agencies: DARPA and IARPA, and private companies: Facebook AI, Adobe DIL, and NVIDIA ADLR.

Education

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| Aug. 2017 – May 2022 | Doctor of Philosophy
Computer Science
<i>University of Maryland</i>
Advisors Larry Davis, Abhinav Shrivastava |
| Feb. 2014 – Aug. 2015 | Master of Science
Computer Science
<i>Stevens Institute of Technology</i>
Advisor Philippos Mordohai |
| Sep. 2007 – May 2011 | Bachelor of Science
Computer Science
<i>Rutgers University</i> |

Awards

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| 2022 | Outstanding Research Assistant
(Top 2% of all graduate assistants)
<i>University of Maryland</i> |
| 2021 | Future Faculty Fellowship
<i>University of Maryland</i> |
| 2018 | Research Grant: Computational Imaging
<i>Facebook AI</i> |
| 2017, 2018 | Dean’s Fellowship
<i>University of Maryland</i> |
| 2009 | Dean’s List
<i>Rutgers University</i> |



Student Member of AAAI
<https://maxehr.umiacs.io>
<https://scholar.google.com/citations?user=q-WSy3AAAAAJ>
English, 한국어

Experience

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| Research Scientist
<i>NVIDIA</i> | Aug. 2022 |
| Research in Computer Vision, Machine Learning, and Computational Media. | |
| Research Assistant
<i>University of Maryland Institute for Advanced Computer Studies</i> | Aug. 2017 – May 2022 |
| Developed an independent research program and successfully won funding through DARPA and IARPA (Core3D, GARD, SemaFor) programs and a three year grant from Facebook AI. Served on the Graduate Admissions Committee, CS Department Education Committee, and the CMNS Diversity and Inclusion Council. | |
| Research Intern
<i>NVIDIA</i> | June 2021 – Nov. 2021 |
| Research in video restoration and enhancement. | |
| Research Mentor
<i>Summer STEM Institute</i> | June 2021 – Aug. 2021 |
| Mentored two students to produce successful research papers. | |
| Visiting Research Engineer
<i>Facebook AI</i> | July 2020 – Mar. 2021 |
| Research in compression robustness and its applications to adversarial defense. | |
| Machine Learning Intern
<i>Adobe Research</i> | June 2019 – Aug. 2019 |
| Research in scanned document image restoration and denoising using deep CNN regression. | |
| Computer Scientist
<i>SRI International Center for Vision Technologies</i> | July 2011 – July 2017 |
| Produced original research and publications in computer vision and machine learning domains. Designed and implemented algorithms to solve real-world computer vision problems. | |
| Service | |
| Conference Reviewer | AAAI 2020, ICLR 2020, ECCV 2020, IJCAI 2021, CVPR {2021, 2022}, ICML 2021, ICCV 2021 |
| Journal Reviewer | Transactions on Image Processing, International Journal of Artificial Intelligence |

Publications & Patents

- [1] **Max Ehrlich**. “The First Principles of Deep Learning and Compression”. In: *arXiv preprint arXiv:2204.01782* (2022). Doctoral Dissertation.
- [2] **Max Ehrlich**, Jon Barker, Namitha Padmanabhan, Larry Davis, Andrew Tao, Bryan Catanzaro, and Abhinav Shrivastava. “Leveraging Bitstream Metadata for Fast and Accurate Video Compression Correction”. In: *arXiv preprint arXiv:2202.00011* (2022). Under Submission.
- [3] **Max Ehrlich**, Larry Davis, Ser-Nam Lim, and Abhinav Shrivastava. “Analysing and Mitigating JPEG Compression Defects in Deep Learning”. In: *Proceedings of the IEEE International Conference on Computer Vision Workshops*. 2021.
- [4] Shishira R Maiya, **Max Ehrlich**, Vatsal Agarwal, Ser-Nam Lim, Tom Goldstein, and Abhinav Shrivastava. “A Frequency Perspective of Adversarial Robustness”. In: *arXiv preprint arXiv:2111.00861* (2021). Under Submission.
- [5] Evan Wen and **Max Ehrlich**. “Interpretable Automated Diagnosis of Retinal Disease using Deep OCT Analysis”. In: *arXiv preprint arXiv:2109.02436* (2021). Under Submission.
- [6] **Max Ehrlich**, Larry Davis, Ser-Nam Lim, and Abhinav Shrivastava. “Quantization Guided JPEG Artifact Correction”. In: *Proceedings of the European Conference on Computer Vision*. 2020.
- [7] Mohamed R Amer, Timothy J Shields, Amir Tamrakar, **Max Ehrlich**, and Timur Almaev. *Deep multi-task representation learning*. US Patent App. 16/085,859. Jan. 2019.
- [8] **Max Ehrlich** and Larry S Davis. “Deep residual learning in the jpeg transform domain”. In: *Proceedings of the IEEE International Conference on Computer Vision*. 2019, pp. 3484–3493.
- [9] Arthita Ghosh, **Max Ehrlich**, Larry Davis, and Rama Chellappa. “Unsupervised Super-Resolution of Satellite Imagery for High Fidelity Material Label Transfer”. In: *IEEE International Geoscience and Remote Sensing Symposium*. IEEE. 2019, pp. 5144–5147.
- [10] Arthita Ghosh, **Max Ehrlich**, Sohil Shah, Larry S Davis, and Rama Chellappa. “Stacked u-nets for ground material segmentation in remote sensing imagery”. In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops*. 2018, pp. 257–261.
- [11] Timothy J Shields, Mohamed R Amer, **Max Ehrlich**, and Amir Tamrakar. “Action-affect-gender classification using multi-task representation learning”. In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops*. 2017, pp. 1–10.
- [12] **Max Ehrlich** and Philippos Mordohai. “Discriminative hand localization in depth images”. In: *2016 IEEE Symposium on 3D User Interfaces (3DUI)*. IEEE. 2016, pp. 239–240.
- [13] **Max Ehrlich**, Timothy J Shields, Timur Almaev, and Mohamed R Amer. “Facial attributes classification using multi-task representation learning”. In: *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops*. 2016, pp. 47–55.
- [14] **Max Ehrlich**. “Discriminative Hand Tracking from Depth Images”. In: *Master’s Thesis, Stevens Institute of Technology* (2015).