Denisa Qori McDonald, PhD

Machine Learning Researcher | Applied ML, Temporal Modeling & Robust Learning

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Summary

Research Scientist specializing in temporal and representation learning for sequential data. My work focuses on building robust, sample–efficient models for continuous multi–channel signals—from capacitive touch sensors to physiological time–series and video data—with relevance to user–facing, perception–driven ML systems. These problems are unified by studying how representations remain stable under noise, sparsity, and distribution shift, enabling generalization, interpretability, and real–time inference in real–world systems. I have led end–to–end research—from problem formulation and data collection to model design, evaluation, and deployment—with publications in top–tier venues.

Research Interests

Temporal representation learning for real–world sequential data | Learning under noise, sparsity, and distribution shift | Sample–efficient modeling in low–data regimes | Inductive biases for human–generated signals | Robust evaluation beyond in–distribution benchmarks | End–to–end applied ML systems for real–world deployment

Education

Drexel University, Philadelphia, PA

Ph.D. Computer Science, December 2021
Dissertation: *"On the Real–World Interactivity Potential of Minimalistic Knitted Sensors at the Intersection of Artificial Intelligence and User Experience"*

M.S. Computer Science, September 2017

B.S. Computer Science, Magna Cum Laude June 2015
Concentrations: Computing Systems & Computer Network Security
Minor: Psychology

Honors, Awards, & Fellowships

Best Paper Award, EICS/PACM, *Top 1% of submissions* September 2020

Best Presentation Award, ICMHI May 2023

Snap Creative Challenge Award, Snap Inc. August 2021

Jay Modi Memorial Award for Best PhD Research, Drexel University CS Department May 2019

International Research Experiences for Students, NSF–funded program December 2017

Dean's List & AJ Drexel Scholarship, Drexel University

Applied Research & ML Systems Experience

Center for Autism Research – Children's Hospital of Philadelphia, PA

Computer Vision Postdoctoral Fellow April 2022 – April 2023

Highlights: Built computational models to automatically extract social–behavioral information from conversational video for neurotypical and neurodivergent populations.

- Created computational models to distinguish between autistic and neurotypical individuals using their conversational head movement patterns and combined head movement angles.
- Built supervised and unsupervised models to study how head movement patterns during naturalistic conversations vary with age at two levels of analysis: monadic (i.e. relating to participant alone) and dyadic (i.e., relating to both participant and confederate).
- Investigated the localization of meaningful head movement patterns during a face–to–face conversation using manifold learning, clustering, and template matching.
- Investigated and quantified eye gaze timing and patterns between two conversation partners.
- Collaborated with clinicians to ensure interpretability and domain relevance; co–authored peer–reviewed publications.

Principal Investigator: Birkan Tunç

Research Collaborations (During Parental Leave)

Maintained active research collaborations, resulting in publications on:

- Advanced manufacturing of touch–sensitive textiles 2024
- Automatic Measurement of Social Gaze During Naturalistic Conversations in Autism 2024

Department of Computer Science & Center for Functional Fabrics – Drexel University, PA

Research Assistant November 2018 – January 2022

Highlights: Built high–accuracy models to recognize complex touch input on knitted sensors with minimal hardware, enabling real–world interactive use.

- Established a general modeling framework for recognizing complex gestures from minimal, low–power, noisy sensor inputs, addressing constraints relevant to real–world and on–device systems.
- Built the foundations for an interactive gesture recognition system using knitted sensors as input, and a CNN–LSTM model deployed on an NVIDIA® Jetson Xavier™ NX system–on–module.
- Created two PyTorch recognition models, one achieving *90% accuracy in classifying 12 complex gestures on a minimally–designed knitted sensor*, and the other achieving 66% touch location identification accuracy on a 36–button sensor, while chance accuracy is 3%.
- Designed an algorithm to represent a multi–channel signal in terms of its most salient aspects, detected as scale–space invariances (SIFT–based).
- Created a distance metric algorithm to measure the similarity between two multi–dimensional signals of varying lengths.

- Designed rigorous evaluation and validation pipelines, including cross–validation and held–out testing under distribution shift, ensuring robustness in noisy and sparse data environments.
- Explored generative models (VAEs & GANs) for data augmentation of physiological user data.
- Investigated user perceptions of knitted sensors through an 8–focus–group study, based on which, formulated application design guidelines.
- Explored the integration of knitted sensors and AR to enhance parent–child communication.
- Co–authored multi–disciplinary peer–reviewed publications related to the above results, also presenting them to different audiences: researchers, sponsors, and collaborators.

Advisors: Ali Shokoufandeh and Genevieve Dion

Advanced Interaction Research Lab – Drexel University, PA

Research Assistant October 2015 – August 2018

Highlights: Investigated the development of efficient human–centric systems that adapt based on implicit fNIRS brain–signal input.

- Developed an open–source 10,000–line Python framework to streamline physiological signal processing and ML experimentation with PyTorch and scikit–learn, using a modular, scalable design.
- Built a deep learning model to identify the subject of origin from fNIRS brain signal segments across 30 participants, with 63% accuracy, while random chance is 3.3%.
- Investigated privacy implications of brain data.
- Processed multi–channel fNIRS brain signals to extract neural activity patterns, including noise reduction, motion artifact removal, and hemodynamic response modeling.
- Ran user study to collect fNIRS data while subjects were performing creative tasks, to build machine learning models of creative process states.
- Developed Java software tools and databases to parse and process data collected from user studies.

Advisor: Erin Solovey

Human–Centered Ubiquitous Media – Ludwig Maximilian University, Germany

Visiting Research Assistant June 2018 – July 2018

- Experimented with machine learning techniques to detect brain states based on EEG data for building adaptive workload–detecting systems.
- Defined user studies to move from machine learning models based on controlled lab tasks to real–world environments.

Advisor: Albrecht Schmidt

Privacy, Security & Automation Lab – Drexel University, PA

Undergraduate Research Assistant April 2014 – September 2014

- Improved the user interface and document parsing functionality of Anonymouth, an open–source, Java–based authorship anonymization tool relying on SVMs.
- Participated in designing and running a user study using Anonymouth.

Advisor: Rachel Greenstadt

Selected Publications

Selected peer–reviewed publications in representation learning, temporal modeling, and foundational learning systems for real–world data.

1. **Denisa Qori McDonald**, Richard James Vallet, Erin Solovey, Genevieve Dion, and Ali Shokoufandeh. Knitted Sensors: Designs and Novel Approaches for Real–Time, Real–World Sensing. *IMWUT 2019/UbiComp 2021.*
2. **Denisa Qori McDonald**, Richard James Vallet, Lev Saunders, Genevieve Dion, and Ali Shokoufandeh. Recognizing Complex Gestures on Minimalistic Knitted Sensors: Toward Real–World Interactive Systems. arXiv manuscript.
3. Richard James Vallet, **Denisa Qori McDonald**, Genevieve Dion, Youngmoo Kim, and Ali Shokoufandeh. Toward Accurate Sensing with Knitted Fabric: Applications and Technical Considerations. *ACM EICS 2020/2021. Best Paper Award (Top 1% of submissions).*
4. **Denisa Qori McDonald**, Evangelos Sariyanidi, Casey J. Zampella, Ellis DeJardin, John D. Herrington, Robert T. Schultz, and Birkan Tunç. Predicting Autism from Head Movement Patterns during Naturalistic Social Interactions. *ICMHI 2023. Best Presentation Award.*
5. **Denisa Qori McDonald**, Shruti Mahajan, Richard James Vallet, Erin Solovey, Genevieve Dion, and Ali Shokoufandeh. Interaction with Touch–Sensitive Knitted Fabrics: User Perceptions and Everyday Use Experiments. *ACM CHI 2022. Acceptance rate: 24.6%.*
6. **Denisa Qori McDonald**, Casey J. Zampella, Evangelos Sariyanidi, Aashvi Manakiwala, Ellis DeJardin, John D. Herrington, Robert T. Schultz, and Birkan Tunç. Head Movement Patterns during Face–to–Face Conversations Vary with Age. *ICMI Companion 2022.* Workshop paper, peer–reviewed.
7. Joel Chan, Kanya "Pao" Siangliulue, **Denisa Qori**, Ruixue Liu, Reza Moradinezhad, Safa Aman, Erin Solovey, Krzysztof Gajos, and Steven Dow. Semantically Far Inspirations Considered Harmful: Accounting for Cognitive States in Collaborative Ideation. *ACM Creativity and Cognition 2017. Acceptance Rate: 25%.*
8. Yankowitz, L., Pargi, M.K., Dejardin, E., Zampella, C.J., Guthrie, W., Pandey, J., Bartley Jr, G.K., Chen, D., **McDonald, D.Q.**, Manakiwala, A. Khanna, M., Keen, K., Buboltz, G., Yang, A., Herrington, J., Sariyanidi, E., Schultz, R.T., and Tunc, B. February 14, 2025. Automatic Measurement of Social Gaze During Naturalistic Conversations in Autism. Pre–print.
9. Richard Vallett, **Denisa Qori McDonald**, Dario Salvucci, Geneviève Dion, and Ali Shokoufandeh, "Advanced Manufacturing of Touch–Sensitive Textile", in *Artificial Intelligence in Manufacturing 2024.* Invited book chapter, peer–reviewed.

Technical Expertise

Machine Learning, Representation Learning & Modeling

Temporal deep learning for sparse multi–channel physiological signals (CNN–LSTM, LSTM)

Representation learning for sparse, noisy, real–world time–series

Latent variable and generative modeling (VAEs, GANs) for data augmentation and robustness

Supervised, weakly supervised, and unsupervised learning

Cross–subject generalization, low–data regimes, and cross–distribution evaluation

Classical ML: SVMs, clustering, template matching, feature–based time–series modeling

Cross–validation pipelines, hyperparameter optimization, controlled evaluation design

Exploratory data analysis and visualization for model diagnostics, interpretability, and communication

Systems, Deployment & Scientific Computing

Core ML & Scientific Computing: Python, PyTorch, scikit–learn, SQL, NumPy, pandas, SciPy, OpenCV

Programming Languages: Java, C++, C, C#, MATLAB

Systems, Deployment & Dev Tools: Linux/Ubuntu, CUDA, ONNX, embedded GPU deployment (Jetson), real–time inference pipelines, PyCharm, Git, Jupyter, TensorBoard, matplotlib, seaborn

Computer Vision & Signal Processing

Video–based behavior analysis (head movement, gaze)

Multi–variate physiological signal processing (capacitive touch, fNIRS, EEG)

Spatiotemporal features extraction, wavelets and FFT, spectrograms, manifold learning, Bode analysis

Research Methods

Real–world multi–modal data collection (touch, gaze, motion, physiology)

Quantitative & qualitative human–sensing design and evaluation

Multi–disciplinary collaboration with clinicians, designers, and domain experts

Service & Mentorship

Research Community Involvement

1. *Reviewer*: CHI – 09/2020, 09/2016; IJHCS – 07/2017, 01/2017, 05/2016
2. *Conference Participation (selected)*: CHI 2017, CHI 2022, UbiComp 2021

Mentorship & Teaching

1. *Research Mentorship*: Mentored graduate and undergraduate researchers across ML and HCI.
2. *REThink CS@Drexel Graduate Assistant*: Organizer/contributor to a program providing CS research experience for local STEM teachers and 2–year college faculty, meeting weekly to discuss research projects, ML applications, and strategies to broaden participation in STEM.
3. *Teaching Assistantships*: Data Structures and Algorithms (graduate–level), Database Systems, Software Design, Fundamentals of Computer Science, Operating Systems, Concurrent Programming, Web and Mobile App Development

Entrepreneurship & Industry

1. Co–founder of *Frankly, I think* – mobile app for collecting and summarizing user sentiments on social and political topics.
2. *Industry Internships*:
    - Comcast Corporation: Technology and Product Development
      Engineering Intern (April 2013 – September 2013)
    - PECO, An Exelon Company: Smart Grid/Smart Meter
      Engineering Intern (April 2012 – September 2012)