Ege Altan, Ph.D.

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RESEARCH EXPERIENCE

Limb Lab, Neuromuscular Control Lab, Northwestern University   **Chicago, IL**
Ph.D. Student   **Sep 2017 – Sep 2023**
- [Dissertation](#) – **Deciphering the geometry of primary motor cortical manifolds: observations from naturalistic movements and implications for intracortical brain-computer interfaces**.
- Investigated the relationship between primary motor cortex (M1) and hand muscle activity during natural movements with the ultimate goal of translating intracortical brain-computer interfaces, novel technologies that aim to restore function to individuals with paralysis, to real-world settings.
- Performed neurosurgical procedures including craniotomy and implantation of multielectrode arrays into M1, trained monkeys to perform simple-to-complex hand gestures, and recorded behavioral data.
- Developed a simulation-based method to accurately identify low-dimensional neural and muscular features. Used linear (PCA) and nonlinear (autoencoder) dimension reduction techniques to extract denoised features.
- Revealed that movement-related information in the primary cortical manifolds exists in simple geometries even for naturalistic behaviors, suggesting that M1 employs a simple, generalized computational strategy for reliable movement control across various tasks and settings.
- Deployed an array of algorithms, spanning linear regression to recurrent neural networks, to improve brain-to-muscle predictions in brain-computer interfaces aimed at restoring natural movements.
- Pioneered a domain adaptation method based on canonical correlations and adversarial networks to address the infeasibility of brain-to-muscle predictions in humans with paralysis. Adapted monkey-trained algorithms, retaining ~80% of the monkey's operational performance.

Dewald Lab, Northwestern University   **Chicago, IL**
Rotating Ph.D. Student   **Aug 2017 – Nov 2017**
- Researched rotator cuff muscle activation patterns in individuals with stroke to develop therapeutic solutions.

Raman Lab, Washington University in St. Louis   **St. Louis, MO**
Research Fellow   **Jul 2016 – Jun 2017**
- Trained locusts to associate odors of explosives with food rewards, performed microneurosurgery on the locust antennal lobes and recorded their neural signals using tetrodes.
- Discovered that low-dimensional neural features of locusts encode both the presence and identity of trace amounts of explosive odors, introducing innovative counter-terrorism solutions based on biorobotics.

Conrad Lab, Washington University in St. Louis   **St. Louis, MO**
Undergraduate Researcher   **Aug 2015 – May 2016**
- Prototyped a polydimethylsiloxane-based sperm purification device that selected high-quality sperm cells based on morphology, hormone response, and motility for use in *in vitro* fertilization.
- Computationally modeled progesterone diffusion, drag force, velocity profiles, and hydrodynamic effects to simulate flow patterns and to improve device design.

IDEA Labs, Washington University in St. Louis   **St. Louis, MO**
Undergraduate Researcher   **Jan 2015 – Jun 2015**
- Implemented an image stitching algorithm that accurately mapped the inner surface of the bladder using the images obtained from a novel, wireless cystoscope.

Anastasio Lab, Washington University in St. Louis   **St. Louis, MO**
Undergraduate Researcher   **Jan 2015 – Jun 2015**
- Applied inverse problem-solving methods to a filtered back projection (FBP) model built for photoacoustic tomography.

Akduman Lab, Istanbul Technical University **Istanbul, Turkey**
Summer Researcher **May 2014 – Aug 2014**
- Streamlined a breast cancer detection device by automating sensor movements.

PUBLICATIONS

* indicates first or co-first authors.

- **Altan, E*.**, Ma, X., Miller, L. E., Perreault, E. J., & Solla, S. A. (2023). Low-dimensional neural manifolds for the control of constrained and unconstrained movements. *bioRxiv (manuscript under review).* https://doi.org/10.1101/2023.05.25.542264
- Rizzoglio, F*., **Altan, E*.**, Ma, X., Bodkin, K. L., Dekleva, B. M., Solla, S. A., Kennedy, A., & Miller, L. E. (2022). From monkeys to humans: observation-based EMG brain-computer interface decoders for humans with paralysis. *bioRxiv (manuscript under review).* https://doi.org/10.1101/2022.11.12.515040
- **Altan, E*.**, Solla, S. A., Miller, L. E., & Perreault, E. J. (2021). Estimating the dimensionality of the manifold underlying multi-electrode neural recordings. *PLoS Computational Biology.* https://doi.org/10.1371/journal.pcbi.1008591
- Saha, D*., Mehta, D*., **Altan, E*.**, Chandak, R., & Traner, M. (2020). Explosive sensing with insect-based biorobots. *Biosensors and Bioelectronics: X.* https://doi.org/10.1016/j.biosx.2020.100050
- Mehta, D*., **Altan, E.**, Chandak, R., & Raman, B. (2017). Behaving cyborg locusts for standoff chemical sensing. *IEEE International Symposium on Circuits and Systems (ISCAS).* https://doi.org/10.1109/ISCAS.2017.8050610
- Saha, D*., Sun, W., Li, C., Nizampatnam, S., Padovano, W., Chen, Z., Chen, A., **Altan, E.**, Lo, R., Barbour, D. L., & Raman, B. (2017). Engaging and disengaging recurrent inhibition coincides with sensing and unsensing of a sensory stimulus. *Nature Communications.* https://doi.org/10.1038/ncomms15413

CONFERENCES AND INVITED TALKS

- Feb 2023 **Talk** Monkey to human transfer of brain-computer interface decoders. *Manifold Meetings*
- Nov 2022 **Poster** Transferring intracortical brain-computer interface decoders across users. *Neuroscience 2022*
- Sep 2022 **Talk** Transferring brain-computer interface decoders across users. *Pitt-UChicago BCI Meeting*
- May 2022 **Talk** Transferring brain-computer interface decoders across users. *Chicago Sensorimotor Consortium*
- Jan 2022 **Talk** Comparing neural network representations. *Manifold Meetings*
- Jan 2022 **Talk** Low-dimensional neural manifolds for the control of natural movements. *Banff International Research Station: Dynamical Principles of Biological and Artificial Neural Networks*
- Oct 2021 **Talk** Transferring BCI decoders across monkeys. *Manifold Meetings*
- Sep 2021 **Talk** Definitions and interpretations of dimensionality of neural signals. *Manifold Meetings*
- Jun 2021 **Talk** Neural dimensionality during natural behaviors. *Manifold Meetings*
- Apr 2021 **Poster** Low-dimensional neural manifolds describing natural behaviors. *Neural Control of Movement*
- Jun 2020 **Talk** Estimating dimensionality. *Chicago Sensorimotor Consortium*
- Feb 2020 **Talk** Making sense of big data: Estimating the intrinsic dimensionality of multi-electrode neural recordings. *Biomedical Data Science Day*
- Oct 2019 **Poster** Dimensionality of neural subspaces for the control of natural and stereotyped movements. *Neuroscience 2019*
- Aug 2019 **Poster** Improving brain-machine interfaces using machine learning. *Movement and Rehabilitation Sciences Training Day*
- Aug 2018 **Poster** Decoding cortical signals using artificial neural networks to restore hand function. *Movement and Rehabilitation Sciences Training Day 2018*

PROFESSIONAL EXPERIENCE

Meta (formerly Facebook) **New York, NY**
Research Scientist Intern, CTRL Team **Aug 2022 – Feb 2023**
- Published four peer-reviewed internal studies focused on transforming electromyogram (EMG) signals from

muscles into control commands for augmented/virtual reality (AR/VR) platforms using a wrist-based wearable.
- Developed EMG-based simulations to troubleshoot failure modes of in-house feature engineering algorithms.
- Condensed EMG features 200-fold using recurrent networks for a large user base while retaining gesture information.

SELECTED HONORS AND AWARDS

Northwestern University	**Chicago, IL**
- Biomedical Engineering Graduate Research Funding	2017 – 2023
- Travel grants	2019 – 2023
- Rank 1 in Biomedical Engineering	2020

Washington University in St. Louis	**St. Louis, MO**
- Rank 1 in Biomedical Engineering	2016
- Salutatorian, School of Engineering and Applied Science	2016
- *Summa Cum Laude*	2016
- Outstanding Senior Academic Achievement Award	2016
- Second Place in Washington University Discovery Competition	2016
- Second Place in Biomedical Engineering Senior Design Competition	2015
- Outstanding Junior Academic Achievement Award	2015
- Ralph S. and Lee Anne Quatrano Scholarship	2014 – 2016
- The Antoinette Frances Dames Award	2014
- Alpha Eta Mu Beta - National Biomedical Engineering Honor Society Member	2014 – 2016
- Mesmer Scholarship in Engineering (full tuition and living expenses)	2012 – 2016
- Dean's List	2012 – 2016

INTELLECTUAL PROPERTY

- Bio-robotic "artificial nose" system for detecting explosives and other chemicals ([T-019136](#))
- Sperm purification system ([WO 2016176563 A1](#))

ACADEMIC SERVICE

- Reviewer, IEEE Engineering in Medicine & Biology Society (EMBC)	2021

TEACHING

Department of Biomedical Engineering, Northwestern University	**Chicago, IL**
Teaching Assistant – Experimental Design and Measurement Laboratory	**Mar 2020 – Jun 2020**

- Led discussion sections on designing experiments and statistical models.

Teaching Assistant – Soft Robotics	**Mar 2019 – Jun 2019**

- Gave lectures on neural control of movement and Wiener filters used to process neural data.
- Enabled students to operate the robots they built for their final project using neural signals from a monkey.

Department of Biomedical Engineering, Washington University in St. Louis	**St. Louis, MO**
Teaching Assistant – Quantitative Physiology I and II	**Aug 2015 – May 2016**

- Improved course structure by incorporating lecture material with the laboratory section of the class by helping design new computational experiments for the renal and pulmonary modules.

Teaching Assistant and Curriculum Planner – Biomechanics Laboratory	**Dec 2015 – May 2016**

- Helped create a new course that subsequently became a mandatory course for Biomedical Engineering majors.
- Designed experiments that helped students explore bone structure, stress-strain relationships, three-point bending, computer-aided design, and 3D printing.

Problem Solving Team Leader – Introduction to Biomedical Engineering **Aug 2013 – Dec 2014**
- Guided several teams of junior students in solving challenging Biomedical Engineering homework problems.

EDUCATION

Northwestern University **Chicago, IL**
- ***Ph.D.*** *in Biomedical Engineering, Neural Engineering Track* **Sep 2023**
- ***MS*** *in Biomedical Engineering* **Dec 2020**
- **GPA: 4.00/4.00**

Washington University in St. Louis **St. Louis, MO**
- ***BS*** *in Biomedical Engineering* **Jun 2016**
- **GPA: 3.98/4.00**

Hisar High School **Istanbul, Turkey**
- *Science and Mathematics Track* **Jun 2012**
- **GPA: A+**

SKILLS

Areas of Expertise
Experimental design; data collection; biosignals; wearables; data analysis, probabilistic modeling, parallel computing; machine learning; deep learning; statistics; natural language processing; statistical pattern recognition; time series analysis; frequency domain analysis; linear algebra; system identification; scientific communication; technical writing

Programming languages and computational tools
Python (scikit-learn, pandas, Pytorch, Tensorflow, Keras); Git; Docker; SQL; Linux; bash/zsh; MATLAB; CUDA; DAGs

Languages
English and Turkish

HOBBIES

Traveling, cooking, playing electric guitar, hiking, bouldering, European football