ARISH ALREJA

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RESEARCH INTERESTS

Computational Neuroscience, Biological and Computer Vision, Statistics, Machine Learning/AI, Dynamical Systems and Signal Processing.

EDUCATION

Joint Ph.D.	Machine Learning & Neural Computation	Carnegie Mellon University	*2023*
M.S.	Machine Learning	Carnegie Mellon University	2020
M.S.	Electrical Engineering	Georgia Institute of Technology	2016
B.S.	Electrical Engineering (Highest Honors)	Georgia Institute of Technology	2007

COURSEWORK AND SKILLS

Quantitative	Random Signals, Parametric & Non-Parametric Statistics, Convex Optimization, Deep Learning, Advanced ML, Statistical ML, Signal Processing, Linear & Optimal Control, Nonlinear Systems
Neuroscience	Cellular, Systems, Cognitive, Computational & Quantitative Neuroscience
Engineering	Digital Systems Design, Computer Architecture and Operating Systems, Microcontroller Design, Electromagnetics, DSP Chip Design, Computer, Mobile & Wireless Networks, Filter Design
Programming	Python, MATLAB, C++, Powershell, SQL, C#, Perl, Verilog, VHDL, Assembly, C

AWARDS AND HONORS

Carnegie Mellon University, R K Mellon Presidential Fellowship	2017 - 2020
Kavli Summer Institute in Cognitive Neuroscience, Fellowship	2019
Ripple Neuro LLC, Society for Neuroscience Travel Award	2018
Carnegie Mellon University, GSA and Provost Office Conference Funding Award	2016
Microsoft, Future Leadership Bench Program ($\approx$1% engineers nominated)	2013 - 2014
Georgia Institute of Technology, International Student Tuition Waiver Award	2006 - 2007
Georgia Institute of Technology, President's Undergraduate Research Award	2006
Georgia Institute of Technology, Faculty Honors	2006

PUBLICATIONS

REFEREED PAPERS

[1] **A. Alreja**, M. J. Ward, R. M. Richardson, J. González-Martínez, M. G'Sell, and A. S. Ghuman, "Temporal Dynamics of Face Viewpoint and Identity Representations in Human Ventral Temporal Cortex," *In Prep*,

[2] E. Schwartz, **A. Alreja**, R. M. Richardson, A. Ghuman, and S. Anzellotti, "Intracranial electroencephalography and deep neural networks reveal shared substrates for representations of face identity and expressions," *Journal of Neuroscience*, vol. 43, no. 23, pp. 4291–4303, May 2023.

[3] **A. Alreja**, M. J. Ward, Q. Ma, B. E. Russ, S. Bickel, N. C. V. Wouwe, J. A. González-Martínez, J. S. Neimat, T. J. Abel, A. Bagić, L. S. Parker, R. M. Richardson, C. E. Schroeder, L.-P. Morency, and A. S. Ghuman, "A New Paradigm for Investigating Real-World Social Behavior and its Neural Underpinnings," *Behavior Research Methods*, vol. 54, no. 4, pp. 1–20, Jul. 2022.

[4] **A. Alreja**, I. Nemenman, and C. Rozell, "Constrained brain volume in an efficient coding model explains the fraction of excitatory and inhibitory neurons in mammalian sensory cortices," *PLOS Computational Biology*, vol. 18, no. 1, pp. 1–19, Jan. 2022.

[5] M. N. Sahadat, **A. Alreja**, N. Mikail, and M. Ghovanloo, "Comparing the Use of Single vs. Multiple Combined Abilities in Conducting Complex Computer Tasks Hands-free," *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, vol. 26, no. 9, pp. 1868–1877, Aug. 2018.

[6] M. N. Sahadat, **A. Alreja**, and M. Ghovanloo, "Simultaneous Multimodal PC Access for People With Disabilities by Integrating Head Tracking, Speech Recognition, and Tongue Motion," *IEEE Transactions on Biomedical Circuits and Systems*, vol. 12, no. 1, pp. 192–201, Dec. 2017.

[7] M. N. Sahadat, **A. Alreja**, P. Srikrishnan, and M. Ghovanloo, *A Multimodal Human Computer Interface combining Head Movement, Speech and Tongue motion for people with severe disabilities*, IEEE Biomedical Circuits and Systems Conference (BioCAS), Atlanta, GA, USA, Aug. 2015.

ABSTRACTS

[1] **A. Alreja**, M. J. Ward, J. A. Colan, Q. Ma, R. M. Richardson, L. P. Morency, and A. Ghuman, "Reconstructing human brain dynamics during real-world social interactions - one face at a time," in *Society for Neuroscience, Annual Meeting*, Washington D.C., USA, Nov. 2023.

[2] D. Geng, **A. Alreja**, J. A. Colan, R. M. Richardson, T. Abel, and A. Ghuman, "What aspects of the electrophysiological signal contain stimulus information?" In *Society for Neuroscience, Annual Meeting*, Washington D.C., USA, Nov. 2023.

[3] **A. Alreja**, M. J. Ward, J. A. Colan, Q. Ma, R. M. Richardson, L. P. Morency, and A. Ghuman, "Decoding and Reconstructing the Neural Basis of Real World Social Perception," in *National Institutes of Health, 9th Annual Brain Initiative Meeting*, Washington D.C., USA, Jun. 2023.

[4] **A. Alreja**, M. J. Ward, J. A. Colan, R. M. Richardson, L. P. Morency, and A. Ghuman, "Reconstructing the neurodynamics of face perception during real world vision in humans using intracranial EEG recordings," in *Vision Sciences Society, Annual Meeting*, St. Pete Beach, FL, USA, May 2023.

[5] E. Schwartz, **A. Alreja**, R. M. Richardson, A. Ghuman, and S. Anzellotti, "Comparing iEEG responses and deep networks with Bayesian statistics challenges the view that lateral face-selective regions are specialized for facial expression recognition over identity recognition," in *Vision Sciences Society, Annual Meeting*, St. Pete Beach, FL, USA, May 2023.

[6] E. Schwartz, K. O'Nell, **A. Alreja**, A. Ghuman, and S. Anzellotti, "Deep networks trained to recognize facial expressions predict ventral face-selective ECoG responses as well as networks trained to recognize identity," Virtual, May 2021.

[7] **A. Alreja**, H. Chen, M. Leszczynski, M. J. Ward, R. M. Richardson, M. G'Sell, L. P. Morency, C. Schroeder, and A. Ghuman, "Intracranial Electroencephalography reveals Neurodynamics underlying Face Perception during Real-World Vision in Humans," in *Vision Sciences Society, Annual Meeting*, Virtual, May 2021.

[8] **A. Alreja**, V. Sharma, M. J. Ward, M. Richardson, M. G'Sell, L. P. Morency, and A. S. Ghuman, "Intracranial Electroencephalography reveals Real World Vision in Humans is a Contextually Modulated, Distributed, and Active Sensing Process," in *Vision Sciences Society, Annual Meeting*, Virtual, Jun. 2020.

[9] **A. Alreja**, M. J. Ward, M. Richardson, and A. S. Ghuman, "A Dynamic Representation of Orientation and Identity in Human Ventral Face Processing Areas as Revealed by Intracranial Electroencephalography," in *Vision Sciences Society, Annual Meeting*, St. Pete Beach, FL, USA, May 2019.

[10] **A. Alreja**, M. J. Ward, M. Richardson, and A. S. Ghuman, "The Representation of Orientation and Identity in Human ventral face processing areas as measured by Intracranial Electroencephalography," in *Society for Neuroscience, Annual Meeting*, San Diego, CA, USA, Nov. 2018.

[11] **A. Alreja**, I. Nemenman, and C. Rozell, "Optimal E:I cell ratios in efficient coding models of V1 under volume constraints," in *Society for Neuroscience, Annual Meeting*, Washington D.C., USA, Nov. 2017.

INDUSTRY TALKS AND WHITEPAPERS

[1] **A. Alreja**. (May 2011). "Talk: Microsoft Lync 2010 and the Enterprise Network," [Online]. Available: `https://channel9.msdn.com/Events/TechEd/NorthAmerica/2011/EXL314` (visited on 12/01/2016).

[2] **A. Alreja** and J. Reed. (May 2011). "Talk: Monitoring Microsoft Lync 2010 Deployments," [Online]. Available: `https://channel9.msdn.com/Events/TechEd/NorthAmerica/2011/EXL318` (visited on 12/01/2016).

[3] **A. Alreja**. (May 2011). "Whitepaper: Understanding Quality of Experience Alerting," [Online]. Available: `http://download.microsoft.com/download/0/7/0/07052A51-709B-4AF5-8726-BD28F6FEA2BD/4_Understanding_QoE_Alerting.doc` (visited on 12/01/2016).

[4] J. Zhang and **A. Alreja**. (Jun. 2010). "Talk: Microsoft Communications Server 14: Monitoring and Reporting," [Online]. Available: `https://channel9.msdn.com/Events/TechEd/NorthAmerica/2010/UNC316` (visited on 12/01/2016).

RESEARCH EXPERIENCE

GRADUATE

Neurodynamics of Face Perception in the Human Brain | 2017 - *Present*
Lab for Cognitive Neurodynamics, University of Pittsburgh | *Avniel S. Ghuman*

Developed novel engineering, statistical, and analytical approaches to gain new neuroscientific knowledge about information processing in the human brain during unrestricted natural behavior in the real world using intracranial EEG recordings.

Connecting Models of Biological and Computer Vision | 2016 - 2017
Center for Neural Basis of Cognition, Carnegie Mellon University | *Tai Sing Lee*

Developed computational models of biological vision motivated by novel experimental neuroscience findings, with the objective of improving the performance of computer vision models, as part of IARPA's MICrONS project.

Real Time Closed Loop Optogenetic Control | 2016
Neural Coding Lab, Georgia Institute of Technology | *Garrett B. Stanley*

Developed hard real-time implementations of control algorithms for closed loop optogenetic control of neural activity in mouse somatosensory cortex.

Sparse Coding Models and "Optimal" E:I ratios in Mammalian Sensory Cortex | 2015 - 2016
Sensory Information Processing Lab, Georgia Institute of Technology | *Christopher J. Rozell*

Identified computational principles underlying physiologically observed Excitatory to Inhibitory neuron ratios of 6:1 - 7:1 in sensory cortex using dynamical systems implementation of sparse coding models of early visual cortex.

Multimodal Tongue Drive System (mTDS): Interfaces for individuals with loss of motor function | 2015
Bionics Lab, Georgia Institute of Technology | *Maysam Ghovanloo*

Developed real-time algorithms for an assistive human computer interface (mTDS headset) that enables individuals with loss of motor function to control computers and wheelchairs.

UNDERGRADUATE

Energy Efficiency of Ultra-Wideband Radio for Wireless Multimedia Sensor Networks | Fall 2006
Broadband Wireless Networking Lab, Georgia Institute of Technology | *Ian F. Akyildiz*

Developed channel and power usage models for physical layer radio technology candidates for the standardization of Ultra-Wideband Radio (802.15.3b) to evaluate their suitability for Wireless Multimedia Sensor Networks.

Low Power Orthogonal Frequency Division Multiplexing (OFDM) engine for WiFi chipsets | Spring 2006
School of Electrical and Computer Engineering, Georgia Institute of Technology | *Vijay K. Madisetti*

Developed a low power multiplierless 64 point Fast Fourier Transform (FFT) processor that reduced memory access to $1/3^{\text{rd}}$ of typical designs for use in OFDM engines for WiFi (802.11a) chipsets.

Computational Models of Pond Snail Behavior 2005
Neuroengineering Lab, Georgia Institute of Technology *Robert J. Butera*

Conducted experiments to collect video recordings of pond snail behavior, developed custom computer vision tools to analyze experimental data, and trained computational models of pond snail behavior.

TEACHING EXPERIENCE

Graduate Teaching Assistant, Carnegie Mellon University 2017 - 2020
Machine Learning Department and Neuroscience Institute *Robert E. Kass*

Developed computational neuroscience lecture videos and guidelines for lecture video development. Designed a web based learning tool for intuitive exploration of connected concepts for CMU's Open Learning Initiative.

Graduate Teaching Assistant, Georgia Institute of Technology 2015 - 2016
School of Electrical and Computer Engineering *Sudhakar Yalamanchili*

Developed and graded homeworks and labs for ≈70 undergraduates in ECE 3056: Computer Architecture and Operating Systems (3 semesters).

Tutor, Georgia Institute of Technology 2006 - 2007
Student Success Center

Tutored undergraduates in Physics, Calculus, Statistics, Thermodynamics and Compressible Fluid Flow, Circuits, and Signal Processing.

INDUSTRY EXPERIENCE

Senior Program Manager, Skype Division, Microsoft Corporation 2007 - 2014
Real Time Media and Devices Group

Audio-Video and Screen Sharing Conferencing
- Drove customer scenarios, cross-team planning and end to end design for real-time cloud services delivering Audio, Video and Screen Sharing in conferencing for Skype's consumer and enterprise (Office 365) clouds.

Voice Quality and Call Reliability
- Developed scalable tools to detect of call reliability and audio quality issues in real-time via high frequency probing of Skype's worldwide media edge server network using proprietary media connectivity protocols.
- Developed data analysis approaches used by multiple teams to diagnose call reliability, media (audio, video, screen sharing) quality and network issues in real-time at multiple scales spanning individual calls, individual servers, regional data centers and the global Skype/Office 365 networks.
- Led cross-organization program with a team of 25 engineers to achieve 99.9% call success rate before the Skype for Business (formerly Lync) 2013 release which resolved over 200 product bugs prior to release.

Bridging Skype's Consumer & Business Clouds
- Drove planning and design for the first production deployment of an Office 365 bridging service to connect Skype's Consumer and Business clouds, enabling Skype users and Skype for Business (formerly Lync) users world wide to communicate with each other.
- Developed monitoring tools to track usage and service quality metrics for new bridging service.

Talks
- Delivered talks on designing, deploying and monitoring Skype for Business (formerly Lync) on Enterprise Networks at Microsoft's TechEd Conferences. Consistently rated among top 25% of all speakers.

Hardware Developer (Intern), Ivivity Inc. Jul. 2006 - Aug. 2006
ASIC Design Group

Developed modules in Verilog HDL for Storage Network Processor ASIC product line.

Lead Test Engineer (Co-op), E. G. Technology Inc.   Dec. 2004 - Jan. 2006
Design Verification and Quality Assurance Group

Recruited and led team of 3 co-ops to develop and execute QA strategy for multiple MPEG2 encoding products. Developed an operator certification program for MPEG 2 products that was productized and sold to customers.

SERVICE AND AFFILIATIONS

Reviewer, Nature Neuroscience, Cell, IEEE Access, PLOS One	2019 - Present
Reviewer, PhD Admissions Committee (ML Department), Carnegie Mellon University	2019 - 2020
Mentor, AI Mentoring Program for underrepresented groups, Carnegie Mellon University	2019 - 2020
Judge, Career Research & Innovation Development Conference Poster Competition, Georgia Tech	2020
Member, Vision Sciences Society (VSS), Society for Neuroscience, IEEE	2015 - Present
Organizing Committee, Brain Bag talk series, Carnegie Mellon University	2017 - 2018
Volunteer (Awarded funding), Jagriti Yatra - Traveling social entrepreneurship program in India	2008
Steering Committee/Co-founder, The Tower - Georgia Tech's undergraduate research journal	2007
Vice President, Eta Kappa Nu (ECE Honor Society), Georgia Institute of Technology	2006