Parthan Olikkal

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RESEARCH SUMMARY

My research lies at the intersection of artificial intelligence and robotics, with a particular focus on developing intelligent, human-centric systems that integrate perception, control, and cognition. I contribute across three main areas: (1) Perception and Understanding: enabling robust scene interpretation through computer vision, object recognition, and signal processing methods (e.g., image segmentation, feature extraction, dimensionality reduction, and Transformer-based deep learning); (2) Human-AI Interaction: designing intuitive interfaces that bridge human intent and machine action, leveraging Multimodal signals such as EMG and EEG for Brain-Computer Interfaces, Prosthetic Control, and Assistive Exoskeletons; (3) Learning and Control: applying Reinforcement Learning and neural network-based optimization for Dexterous Robot Manipulation, adaptive behavior, and Human-in-the-Loop collaboration.

EDUCATION

University of Maryland Baltimore County — Baltimore, MD
Ph.D., Computer Science — In-Progress
Thesis: Synergy-based Learning in Human-Robot Interaction

M.S., Computer Science — 2019 - 2021
Thesis: Kinematic and Muscle Synergies in Grasping Hand

Cochin University of Science and Technology — Kochi, India
B.Tech., Computer Science — 2013 - 2017

INDUSTRY EXPERIENCE

MathWorks — Natick, MA
Engineering Development Group Intern — Summer 2023
Team: Parallel Code Generation

- Composed machine learning models in MATLAB and Simulink and translated these scripts into Embedded C/C++ code using Code Generation to 100% production ready code.
- Succeeded in implementing 5 use cases that reinforces the advantages of the current implementation in multi-dimensional complex matrix arithmetic.
- Consolidated and implemented 3 use cases that highlights the weakness of the current algorithm while showcasing the advantages of Look-ahead Superword Level Parallelism.
- Investigated and developed a general template for Look-ahead Superword Level Parallelism algorithm that improves the current algorithm by 15%.
- Actively engaged in sprint planning, daily scrums and MATLAB 2023b "bashing".

Engineering Development Group Intern — Summer 2022
Team: Embedded Coder and Domain Specific Code Generation

- Developed a 5-layer CNN that surpassed a custom 4-layer CNN and VGGNet16 in brain tumor classification, achieving 82% accuracy (compared to 71% and 66% without preprocessing). Implemented these DL models in MATLAB using adam and sgdm optimizers and Simulink with a Neighborhood Processing Subsystem building block.
- Programmed a custom script that automated the translation of MATLAB layers to Simulink subsystems with 90% reusable code.

- Generated 100% reusable filter for edge detection for preprocessing of images using Neighborhood Processing Subsystem in Simulink for Image classification.
- Laid foundations to the structuring of "convolution block" in Simulink that mainly abstracts the number of filters/convolutions in deep learning models.
- Collaborated and participated in Scrum meetings, Sprints, MATLAB 2022b "bash" party with other team members and interns.
- Analyzed, refined and amended an inconspicuous bug in MATLAB & Simulink published documentation.

IBM India
Application Developer Nov 2017 – Jul 2019
Team: Specialized and Distributed ML

- Developed an API for word vectorization on word2vec library (NLP), improving the module to allow for user friendly inputs.
- Collaborated to organize, plan, manage, migrate, and execute new releases of 50 applications along with documenting, troubleshooting, and providing problem resolution steps for users.
- Investigated and assisted in post-implementation and continuous improvement to enhance the performance of over 10 applications.
- Monitored over 25 servers and resources on database servers at Calgary, Aberdeen, Stavanger, Newfoundland.
- Promoted within 12 months for outstanding performance, organizational contribution.

AWARDS

- **National I-Corps NSF Grant**, NSF 2025
- **COEIT Research Award**, UMBC 2025
- **GSA Professional Development Grant**, IEEE ROBIO Travel 2024
- **UMBC Financial Aid Scholarship**, UMBC 2022

PUBLICATIONS

Preprints

[18] **Parthan Olikkal**, Chris Dollo, Akshara Ajendla, and Ramana Vinjamuri. "*Reconstructing Hand Gestures with Synergies Extracted from Dance Movements.*" In *Nature, Scientific Reports*, 2025. (under review)

[17] **Parthan Olikkal**, Habib Ali, Ramana Vinjamuri. "*Hybrid EEG-EMG Transformer Model for Humanoid Robot Control in Center-Out Reaching Task.*" In *IEEE Transactions on Medical Robotics and Bionics*, 2024. (under review)

Journals and Conferences

[16] **Parthan Olikkal**, Dingyi Pei, Bharat Kashyap Karri, Ashwin Satyanarayana, Nayan M Kakoty, Ramana Vinjamuri. "*Biomimetic Learning of Hand Gestures in a Humanoid Robot.*" In *Frontiers in Human Neuroscience*, 2024.

[15] Farshad Safavi, **Parthan Olikkal**, Dingyi Pei, Sadia Kamal, Helen Meyerson, Varsha Penumalee, Ramana Vinjamuri. "*Emerging Frontiers in Human-Robot Interaction.*" In *Journal of Intelligent and Robotics System*, 2024.

[14] Pooya Chanu Maibam, Dingyi Pei, **Parthan Olikkal**, Ramana Kumar Vinjamuri, Nayan M Kakoty. "*Enhancing prosthetic hand control: A synergistic multi-channel electroencephalogram.*" In *Wearable Technologies*, 2022.

[13] Dingyi Pei, **Parthan Olikkal**, Tülay Adali, Ramana Vinjamuri. "*Reconstructing Synergy-Based Hand Grasp Kinematics from EEG Signals.*" In *Sensors*, 2022.

[12] **Parthan Olikkal**, Dingyi Pei, Tülay Adali, Nilanjan Banerjee, Ramana Vinjamuri. "*Data fusion-based musculoskeletal synergies in the grasping hand.*" In *Sensors*, 2022.

[11] Dingyi Pei, **Parthan Olikkal**, Tülay Adali, Ramana Vinjamuri. "*Dynamical synergies of multidigit hand prehension.*" In *Sensors*, 2022.

[10] **Parthan Olikkal**, Branesh M Pillai, Jackrit Suthakorn, Habib Ali, Ramana Vinjamuri. "*A hybrid EEG-EMG framework for humanoid control using deep learning transformers.*" In *IEEE Robotics and Biomimetics*, 2024.

[9] Sai Praveen Kadiyala, Ke Chen, Ziyang Guo, **Parthan Olikkal**, Andrew Catlin, Ashwin Satyanarayana, Ramana Vinjamuri. "*Novel Hand Gesture Classification based on Empirical Fourier Decomposition of sEMG Signals.*" In *IEEE Engineering in Medicine and Biology Society*, 2023.

[8] **Parthan Olikkal**, Dingyi Pei, Bharat Kashyap Karri, Ashwin Satyanarayana, Nayan M Kakoty, Ramana Vinjamuri. "*Learning hand gestures using synergies in a humanoid robot.*" In *IEEE Robotics and Biomimetics*, 2023.

[7] Maibam Pooya Chanu, Dingyi Pei, **Parthan Olikkal**, Ramana Vinjamuri, Nayan M Kakoty. "*Electroencephalogram based Control of Prosthetic Hand using Optimizable Support Vector Machine.*" In *Advances in Robotics*, 2023.

[6] Dingyi Pei, **Parthan Olikkal**, Tulay Adali, Ramana Vinjamuri. "*Dynamical Synergies in Multidigit Hand Prehension.*" In *IEEE Engineering in Medicine and Biology Society*, 2023.

[5] Poomipat Boonyakitanont, Ben Gabrielson, Irina Belyaeva, **Parthan Olikkal**, Jitkomut Songsiri, Yu-Ping Wang, Tony W Wilson, Vince D Calhoun, Julia M Stephen, Tulayi Adalı. "*An ICA-based framework for joint analysis of cognitive scores and MEG event-related fields.*" In *IEEE Engineering in Medicine and Biology Society*, 2023.

[4] **Parthan Olikkal**, Dingyi Pei, Tulay Adali, Nilanjan Banerjee, Ramana Vinjamuri. "*Musculoskeletal synergies in the grasping hand.*" In *IEEE Engineering in Medicine and Biology Society*, 2023.

[3] Akshara Ajendla, Mahi Patel, **Parthan Olikkal**, Ramana Vinjamuri. "*Mental Health Management Through Wearables and AI Innovation.*" In *Smart Healthcare, Clinical Diagnostics, and Bioprinting Solutions for Modern Medicine*, 2025.

[2] Farshad Safavi, Dingyi Pei, **Parthan Olikkal**, Ramana Vinjamuri. "*New Horizons in Human–Robot Interaction: Synergy, Cognition, and Emotion.*" In *Discovering the Frontiers of Human-Robot Interaction: Insights and Innovations in Collaboration, Communication, and Control*, 2024.

[1] Helen Meyerson, **Parthan Olikkal**, Dingyi Pei, Ramana Vinjamuri. "*Human-Robot Interaction–Advances and Applications.*" In *Human-Robot Interaction-Perspectives and Applications*, 2023.

ACADEMIC EXPERIENCE

University of Maryland Baltimore County

Guest Lecturer — Spring 2025
CMSC 691 Intro to Brain Computer Interaction
Supervisor: Dr. Ramana Vinjamuri

Graduate Teaching Assistant — Spring 2022
CMSC 461 Database Management and Systems
Supervisor: Dr. Konstantinos Kalpakis

Graduate Teaching Assistant — Fall 2021
CMSC 641 Design Analysis and Algorithms
Supervisor: Dr. David Chapman

Graduate Assistant — Fall 2020, Spring 2021
CMSC 313 Assembly Language and Computer Organization
Supervisor: Ivan Sekyonda

Reviewer: Artificial Intelligence Review, IEEE EMBC, Human Movement Science, Journal of Biomechanics, Heliyon, IEEE Access, Medical & Biological Engineering and Computing

Invited Talks:

- 17/05/2024: "Learning Hand Gestures using Synergies in a Humanoid Robot" The 2nd Workshop on NeuroDesign in Human-Robot Interaction. IEEE ICRA (Virtual)
- 18/03/2022: "Kinematic and Muscle Synergies in Grasping Hand." At BCI & Neurotech Masterclass US Captial Region 1.0 (Virtual). Host: Dr. Christoph Guger

Leadership

- Lab Manager, Sensorimotor Control Lab, UMBC — 2023-Present
- Organizer, Movement, Music, and Brain Health NSF AccelNet, UMBC — June 2025
- Student Representative, India-US Collaboration supported by NSF, Tezpur — Jan 2023
- Organizer, NSF BRAIN IUCRC Planning Meeting, UMBC — Sept 2022
- Secretary, Placement Cell, CUSAT — 2016-2017

PROGRAMMING SKILLS

Languages/Tools: Python, MATLAB, SIMULINK, C++, SQL, AWS (Practitioner), Git, RESTful API, Perforce
Libraries/Frameworks: PyTorch, ROS2, NumPy, Pandas, Matplotlib, Scikit-learn, SciPy, MediaPipe, OpenCV, Gym, Isaac Lab, Unity,
Robotic Platforms: Kinova Gen3 (7 DoFs), Mitra Humanoid (22 DoFs), ArmAble (2 DoFs), g.tec 64-channel EEG HIAMP system, Delsys EMG Avanti Sensors, Wearable Sensing DSI-24 16-channel EEG Headset, g.tec 8-channel EEG UniCorn Hybrid, Inspire-Robots Dexterous Hand

ACADEMIC MENTORING

Ph.D. Students

- Sruthi Sundharam, UMBC — Fall 2024-Present
- Siddharth Savadia, Manipal Institute of Technology — 2024-Present

Masters Students

- Dev Parikh, UMBC — Spring 2025
- Saksham Sharma, UMBC — Fall 2024
- Nidhi Misalankar, Manipal Institute of Technology — Fall 2024
- Satvik Reddy, UMBC — Fall 2024
- Hariom Vyas, UMBC — Spring 2023
- Aditi Shrivastava, UMBC — Fall 2023
- Shravika Tirumala, Google — Fall 2023

Undergraduate Students

- Leann Alhashishi, MS at Oxford University — Spring, Fall 2024, Spring 2025
- Oritsejolomisan Mebaghanje, UMBC — Fall 2024, Spring 2025
- Viraj Janeja, UMBC — Fall 2024, Spring 2025
- Oluwatobiloba Abidoye, Intern at Goldman Sachs — Spring 2024
- Rusham Bhatt, UMBC — Spring, Fall 2024
- Zainab Idowu, Intern at Mayo Clinic — Spring, Fall 2024
- Chris Dollo, UMBC — Spring, Fall 2024
- Nathan Dayie, Intern at MIT — Fall 2024
- Caly Ferguson, Intern at John Hopkins — Spring,Fall 2024
- Xavier Smith, Ph.D at MIT — Spring and Fall 2023
- Gaurang Pendyala, University of Texas at Dallas — Spring 2023
- Kyaw T Tun, Freddie Mac — Spring 2023

MEDIA COVERAGE

- 17/07/2025: *"Leading brain researchers and engineers converge on UMBC campus to advance innovative neurotechnologies"*, UMBC News
- 11/07/2025: *"Could a robot dance partner help us de-stress? UMBC researchers explore the 'algo-rhythmic' possibilities"*, UMBC News
- 09/05/2025: *"Three UMBC juniors receive prestigious Goldwater Scholarships."* UMBC News