Hemanth Manjunatha

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Google Scholar
LinkedIn
Github

Earned Degrees

Ph.D. Mechanical and Aerospace Engineering. 2016–2021
University at Buffalo, The State University of New York Buffalo, NY

M.S. in Mechanical and Aerospace Engineering. 2015–2017
University at Buffalo, The State University of New York Buffalo, NY

B.S. in Mechanical Engineering. 2010–2014
National Institute of Engineering Mysore, India

Research Interests

Safe Learning based Cyber Physical Human Systems | Brain Machine Interfaces | Human-Machine Interaction | Robotics | Haptics | Telerehabilitation | Deep Learning | Reinforcement Learning

Professional Experience

Assistant Professor August 2024-Present
Mechanical and Aerospace Engineering Stillwater OK
Oklahoma State University
Intelligent Human-Machine Nexus Lab (iHuman Lab)

I conduct interdisciplinary research at the intersection of robotics, neuroscience, and machine learning, developing intelligent systems that interpret brain activity, muscle signals, and eye movements to enable safe, adaptive human-robot collaboration. By combining physiological sensing, deep learning, and brain-machine interfaces, I create robotic technologies that respond to and learn from human partners. My work addresses real-world challenges in areas such as rehabilitation, industrial automation, and human-swarm teaming.

Postdoctoral Fellow @ Dynamics and Control Systems Laboratory April 2021 - July 2024
Georgia Institute of Technology Atlanta, GA

Research Experience

University at Buffalo, The State University of New York Buffalo, NY
Research Assistant @ Human in the Loop Systems Lab 2016-2021
Advisors: Dr. Ehsan T Esfahani, Dr. Souma Chowdhury, Dr. Karthik Dantu

Human in the Loop Learning for Human Swarm Interaction. Funded by DARPA OFFSET

- Designed and collaboratively developed an advanced Brain-Machine Interface (BMI) framework dedicated to the study of Human-Swarm Interaction (HSI).
- Spearheaded the creation of an innovative user interface within the framework, enabling the provision of real-time tactical decision support in complex scenarios, particularly in search and rescue missions, and simultaneously collecting time-synchronized neuro-physiological measurements such as eye-tracking and brain activity.
- Conducted comprehensive data collection efforts, overseeing the participation of 20 human subjects, resulting in the acquisition of a diverse and extensive dataset encompassing various swarm tactics.

– Achieved the milestone demonstrating the feasibility of predicting tactical decisions based on the analyzed eye-tracking and brain activity data.

Cognitive-Engagement in Haptic Interaction. Funded by NSF

– Orchestrated and conducted a comprehensive experiment to quantify subjects' cognitive engagement during interactions with a haptic device while engaged in a virtual writing task.

– Employed cutting-edge electroencephalogram (EEG) and electromyogram (EMG) biosensors to collect high-fidelity data, enabling the precise measurement of cognitive and biomechanical engagement among users while they engaged in the visually intensive writing task using the haptic device.

– Employed advanced statistical modeling techniques to unveil the influence of various haptic controller parameters on subjects' cognitive engagement levels. The findings contributed to an internationally recognized peer-reviewed journal publication, adding to the body of knowledge in the field.

Human-Robot Interaction. Funded by NSF

– Implemented a cutting-edge deep learning model utilizing brain activity as input to assess the motor control difficulty experienced by individuals during physical interactions with robots. Achieved a remarkable performance boost, increasing accuracy from 64% to 92% when compared to conventional methodologies.

Multi-Robot Tele-Operation. Funded by NSF

– Collaborated in developing an advanced analysis framework for classifying operator's reaction time through integrating eye-tracking and brain activity monitoring.

– Implemented an integrated approach, considering cognitive indicators such as mental workload, engagement levels, and distraction, enabling real-time prediction of task complexity. This approach facilitated adaptive task difficulty adjustments to reduce mental workload, ultimately enhancing operational efficiency.

Publications

Book Chapters

1. **H. Manjunatha** and E. T. Esfahani, "Application of reinforcement and deep learning techniques in brain–machine interfaces", *Advances in Motor Neuroprostheses*, pp. 1–14, 2020.

Under Review

1. E. Oveisi and **H. Manjunatha**, "Human factor analysis of helicopter accidents using large language models", in *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, American Society of Mechanical Engineers, 2025.
2. **H. Manjunatha** and P. Tsiotras, "Beyond one model fits all: Evaluating the ensemble deep learning for autonomous vehicles", 2023.
3. **H. Manjunatha**, A. Pak, D. Filev, and P. Tsiotras, "Karnet: Kalman filter augmented recurrent neural network for learning world models in autonomous driving tasks", *arXiv preprint arXiv:2305.14644*, 2023.
4. A. Pak, **H. Manjunatha**, D. Filev, and P. Tsiotras, "Carnet: A dynamic autoencoder for learning latent dynamics in autonomous driving tasks", *arXiv preprint arXiv:2205.08712*, 2022.
5. **H. Manjunatha**, P. KrisshnaKumar, J. P. Distefano, A. Jani, A. Behjat, P. Ghassemi, S. Chowdhury, K. Dantu, and E. T. Esfahani, "Shasta: An open-source simulator for human and swarm team applications", 2024.

Journal Articles

1. **H. Manjunatha**, A. H. Memar, and E. T. Esfahani, "Estimating motor control difficulty in humanrobot fine co-manipulation tasks using brain activities", *Journal of Computing and Information Science in Engineering*, vol. 25, no. 5, p. 051 004, Mar. 2025, ISSN: 1530-9827. DOI: 10.1115/1.4068083. [Online]. Available: https://doi.org/10.1115/1.4068083.
2. S. S. Jujjavarapu, **H. Manjunatha**, and E. T. Esfahani, "A variable stiffness end-of-arm tooling mechanism to enhance dynamic task capabilities of robotic manipulators", *Journal of Mechanisms and Robotics*, vol. 15, no. 6, p. 061 003, 2023.
3. **H. Manjunatha**, S. S. Jujjavarapu, and E. T. Esfahani, "Transfer learning of motor difficulty classification in physical human-robot interaction using electromyography", *Journal of Computing and Information Science in Engineering*, pp. 1–32,
4. C. Thammineni, **H. Manjunatha**, and E. T. Esfahani, "Selective eye-gaze augmentation to enhance imitation learning in atari games", *Neural Computing and Applications*, pp. 1–10, 2021.
5. **H. Manjunatha**, S. Pareek, S. S. Jujjavarapu, M. Ghobadi, T. Kesavadas, and E. T. Esfahani, "Upper limb home-based robotic rehabilitation during covid-19 outbreak", *Frontiers in Robotics and AI*, vol. 8, 2021.
6. **H. Manjunatha**, P. Shrey, M. Amir, E. Ehsan, and K. Thenkurussi., "Effect of haptic assistance strategy on mental engagement in fine motor tasks", *Journal of Medical Robotics Research*, 2020.
7. S. Pareek, **H. Manjunatha**, E. T. Esfahani, and T. Kesavadas, "Myotrack: Realtime estimation of subject participation in robotic rehabilitation using semg and imu", *IEEE Access*, vol. 7, pp. 76 030–76 041, 2019.
8. B. Zhang, J. Huang, R. Rai, and **H. Manjunatha**, "A sequential sampling algorithm for multistage static coverage problems", *Journal of Computing and Information Science in Engineering*, vol. 18, no. 2, 2018.

Conference Proceedings

1. P. Krisshnakumar, S. Paul, **H. Manjunatha**, M. Corra, E. Esfahani, and S. Chowdhury, "Towards physically talented aerial robots with intelligent swarm behavior thereof: An efficient co-design approach", 2024.
2. **H. Manjunatha**, A. Pak, and P. Tsiotras, "Improving autonomous driving policy generalization via auxiliary tasks and latent modeling", in *5th Multi-disciplinary Conference on Reinforcement Learning and Decision Making*, 2022.
3. J. P. Distefano, **H. Manjunatha**, S. Chowdhury, K. Dantu, D. Doermann, and E. T. Esfahani, "Using physiological information to classify task difficulty in human-swarm interaction", *IEEE/SMC International Conference on System of Systems Engineering*, 2021.
4. **H. Manjunatha**, J. P. Distefano, A. Jani, P. Ghassemi, S. Chowdhury, K. Dantu, D. Doermann, and E. T. Esfahani, "Using physiological measurements to analyze the tactical decisions in human swarm teams", in *2020 IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, IEEE, 2020, pp. 256–261.
5. B. Amir, **H. Manjunatha**, A. J. Kumar, L. Collins, P. Ghassemi, S. Chowdhury, K. Dantu, D. Doermann, and E. T. Esfahani, "Learning swarm tactics overs complex uncertain environments", in *2021 International Symposium on Multi-Robot and Multi-Agent Systems (MRS)*, 2021. **[Acceptance rate was 30%, Received best paper award]**.
6. **H. Manjunatha** and E. T. Esfahani, "Extracting interpretable eeg features from a deep learning model to assess the quality of human-robot co-manipulation", in *2021 10th International IEEE/EMBS Conference on Neural Engineering (NER)*, 2021, pp. 339–342.

7. **H. Manjunatha**, S. S. Jujjavarapu, and E. T. Esfahani, "Classification of motor control difficulty using emg in physical human-robot interaction", *IEEE/SMC International Conference on System of Systems Engineering*, 2020.
8. S. Pareek, **H. Manjunatha**, E. T. Esfahani, and T. Kesavadas, "Myotrack: Realtime estimation of subject participation in robotic rehabilitation using semg and imu", *IEEE Access*, vol. 7, pp. 76 030–76 041, 2019.
9. **H. Manjunatha**, A. Memar, and E. Esfahani, "Classification of task type and reaction time of operator in simulated multiple robot tele-exploration", *Frontiers in Human Neuroscience*, vol. 12, 2018.
10. **H. Manjunatha**, J. Huang, B. Zhang, and R. Rai, "A sequential sampling algorithm for multi-stage static coverage problems", in *International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*, American Society of Mechanical Engineers, vol. 50114, 2016.

Professional Services

Session Organizer, ASME IDETC 2025

- CIE Graduate Student Poster Session
- DAC-16: Human-AI Collaboration in Engineering System Design
- CIE-12 CAPPD: Design and Integration of Large Language Models (LLMs) for Smart Manufacturing
- CIE-08 CAPPD: Human-In-the Loop and Digital Human Modeling for Product Design and Manufacturing

Session Chair

- DAC-20: Human-Artificial Intelligence Collaboration in Engineering System Design session, ASME IDETC 2025.
- DAC-19: Human-Artificial Intelligence Collaboration in Engineering System Design session, ASME IDETC 2024.
- Human Performance and Workload Estimation session, IEEE SMC 2020.

Reviewer

Journals

- IEEE Transactions on Robotics
- IEEE Transactions on Systems, Man, and Cybernetics: Systems
- IEEE Robotics and Automation Letters
- IEEE Transactions on Intelligent Vehicles
- IEEE Transactions on Human-Machine Systems
- Human-Centric Intelligent Systems
- Journal of Intelligent & Robotic Systems
- International Journal of Intelligent Robotics and Applications
- Frontiers in Neurorobotics
- Journal of Computing and Information Science in Engineering
- Journal of Mechanisms and Robotics

Conferences

- International Conference on Systems, Man, and Cybernetics (SMC)
- IEEE International Conference on Robotics and Automation (ICRA)
- International Conference on Intelligent Robots and Systems (IROS)
- International Design Engineering Technical Conferences & Computers and Information in Engineering Conference (IDETC)
- IEEE Conference on Decision and Control (CDC)
- American Control Conference (ACC

Research Supervision

PhD Students

- **Elahe Oveisi** 2024-Present
  - Dissertation Title: Neuro-physiological Computing for Team Situational Awareness

Undergraduate Students

- **Corbin Adam Roy, Cody Schlather, Olivia Fulkerson** Spring 2025-Present
  - Capstone Project: Human and Swarm Simulation Platform in ROS.

Mentoring and Leadership Experience

- **Graduate Assistant** at Sustainable Manufacturing and Advanced Robotic Technologies (SMART) @ UB 2017-2019
  - Led the establishment of a state-of-the-art Robotics Lab, overseeing the assembly of two robots (UR3 and Baxter), six Pneumatic Systems, conveyor belts, and object recognition camera systems.
  - Developed comprehensive teaching modules for Programmable Logic Controllers (PLC), Pneumatic Systems, and Vision Systems, benefiting a class of 56 students.
  - Initiated, designed, and delivered a Robotics Operating System (ROS) course, covering both basic and intermediate levels, catering to undergraduate students.
  - Conducted hands-on demonstrations showcasing software building skills and the execution of pick-up and place routines on Baxter and UR3 robots.
  - Designed the ROS course as part of the Tinkering program, an experiential learning initiative aimed at fostering self-led, hands-on practice and laying the groundwork for future engineering pursuits.
  - Provided open access to the ROS course, benefiting approximately 5000 students and promoting robotics education.
  - Mentored and supervised a group of twelve students in a SMART-hosted project, wherein students successfully programmed a Baxter robot to emulate brush strokes, creating art in the style of a renowned painter.
- **Outreach Activities**
  - Facilitated the 33rd Annual Science Exploration day for a group of 180 students. Guided students in immersive, hands-on activities, fostering interactive and experiential learning.
  - Organized and executed robotics demonstrations for students ranging from elementary to high school levels during UB Robotics Day (2019). Developed a tailored curriculum accommodating diverse age groups, ensuring an engaging and educational experience.

Teaching

- Optimization for Machine Learning (MAE 5020) Spring 2025
  Mechanical and Aerospace Engineering, Oklahoma State University
  - Taught algorithms of optimization techniques essential for machine learning, online learning, large-scale machine learning, and real-world applications
- Dynamic Systems Analysis and Introduction to Control (MAE 3724) Fall 2024
  Mechanical and Aerospace Engineering, Oklahoma State University
  - Taught Frequency-domain analysis; Bode diagrams. Introduction to system identification and control. Analysis of linear and nonlinear dynamic systems using MATLAB. Laboratory investigation of dynamic systems.
- **Teaching Assistant** at University at Buffalo, Mechanical and Aerospace Engineering Dept. Spring 2017
  Manufacturing Automation (MAE 464)
  - Facilitated student comprehension of advanced topics in automation, manufacturing, and design integration, including hardware, software (robotics simulator CoppeliaSim), and algorithmic concepts crucial to rapid and adaptable product development lifecycles.
  - Assisted in the instruction and evaluation of strategies encompassing automated manufacturing systems, CAD-CAM techniques, and integration processes, fostering students' practical skills in programming and simulation for real-world applications.
- **Teaching Assistant** at University at Buffalo, Mechanical and Aerospace Engineering Dept. Fall 2016
  CAD Applications (MAE 477)
  - Mentored and guided students through comprehensive projects involving integrated CAD/CAE tools.

Awards

- 2024 JCISE **Reviewer of the Year Award** 2024
- **Best Paper Award**, International Symposium on Multi-Robot and Multi-Agent Systems (MRS) 2021
- ISMR Student Travel Award. 2019
- 3rd Place in Mechanical and Aerospace poster competition held at UB. 2018
- CIE Student Travel Award in IDETC. 2017

Oral Presentations

- Classification of Motor Control Difficulty using EMG in Physical Human-Robot Interaction @ IEEE International Conference on Systems, Man, and Cybernetics. 2020
- Classification of Task Type and Reaction Time of Operator in Simulated Multiple Robot Tele-Exploration @ Network in Aging of Western New York Conference. 2018
- Effect of Haptic Assistance Strategy on Mental Engagement in Fine Motor Tasks @ Neuroergonomics Conference. 2018
- Human-robot interaction using physiological signals poster presentation, IDETC. 2017