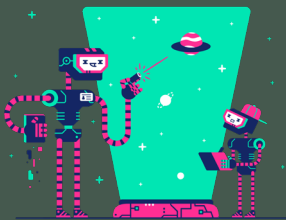## At a Glance

Activities:
- Robotics Activities at BRAIL, IIT Guwahati

Glimpses:
- TRS Workshops
- TRS Awareness Workshops
- TRS-SCALE Workshops

Upcoming Events:
- AIR 2025

Editor Speaks

Welcome to Volume 12, Issue 2 of The Robotic Society (TRS) of India's newsletter! We are honored to serve as the editors and extend our sincere gratitude to the Governing Council for their continued trust.

In this issue, we bring you a diverse range of activities happening under the TRS umbrella. We are particularly excited to feature the cutting-edge work in biomimetic and artificial intelligence being conducted at BRAIL, IIT Guwahati. This issue also highlights the TRS Student Chapter Activity for Learning and Enhancing (SCALE) initiatives, featuring details of two impactful workshops. Furthermore, we provide comprehensive reports on two TRS workshops recently conducted at IIT Gandhinagar and Tezpur University, along with details of two TRS awareness workshops. This edition also includes an important announcement and call for papers for the upcoming AIR 2025 conference.

The TRS Newsletter is published twice a year and primarily features activities under the TRS umbrella. We encourage our readers to inform us about the research activities in their laboratories and to contribute descriptions of their work for future newsletters. Your insights are invaluable to our community.

Lastly, we invite companies and institutions to become sponsors of our newsletter. This is a unique opportunity to showcase your brand to the expansive robotics fraternity. We also welcome articles related to robotics activities from your institutions for publication in our newsletter. Together, let's drive the future of robotics in India.

Dr. Vineet Vashista, IIT Gandhinagar (vineet.vashista@iitgn.ac.in)
Dr. Riby A. Boby, IIT Jodhpur (riby@iitj.ac.in)

Activities

### Biomimetic Robotics and Artificial Intelligence Lab @ IIT Guwahati

The Biomimetic Robotics and Artificial Intelligence Lab within the Department of Mechanical Engineering, IIT Guwahati (BRAIL@IITG) conducts research in the area of Rehabilitation Robotics with a focus on the development of neuroprostheses and intelligent assistive devices (IADs) for Robotic Neurorehabilitation. This translates into research in Artificial Intelligence and Machine Learning, merging the fields of robotics and neuroscience and evolving novel strategies for motor therapy aimed at improving the quality of life for individuals with neuromotor disabilities.

Five Fingered Bionic Prosthetic Hand

Starting with a DIT, Govt. of India funded project on Design and Development of a Cost-Effective Bio-signals Controlled Prosthetic Hand, we have arrived at Prototype 2.0 of an anthropomorphic bionic hand. The project on Five Fingered Bionic Prosthetic Hand is the second phase funded by BDTD, DST, Govt. of India. Optimization of the kinematic design of the under-actuated hand is achieved using synergies for grasp postures and Potential Grasp

Robustness. Control and actuation of the muscular system are replicated through a two-layered architecture. The figure shows Prototype 2.0 of our surface electromyogram (EMG) controlled prosthetic hand capable of executing six different grasp types based on user intention. The BRAIL Bionic hand is slated to undergo clinical trials.
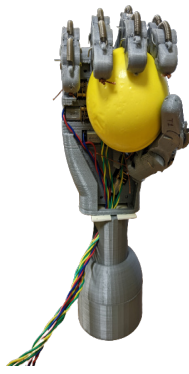
Reinforcement Learning based Adaptive Control

Maintaining a stable grasp on objects is a critical challenge in the realm of robotic hands. External disturbances often disrupt grasp stability, leading to slippage. We have exploited reinforcement learning (RL) for intelligent slippage control. However, RL-trained policies are susceptible to failure in perturbed environments due to dynamic variations. To address this limitation, we augment a pre-trained RL policy with an adaptive sliding mode controller, particularly suited for systems with continuous state and action spaces. Leveraging the invariance property of the sliding mode algorithm against uncertainties, our approach enhances the robustness of RL policies trained without accounting for diverse, dynamic variations in real-world settings.

Intelligent Wearable Hand Exoskeleton

Our work on an Intelligent Wearable Hand Exoskeleton is funded through INAE Abdul Kalam Technology Innovation National Fellowship to Prof. Shyamanta M Hazarika.
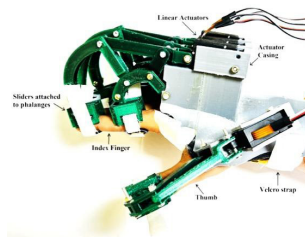
Prototype 1.0 of an underactuated hand exoskeleton has been completed. Kinematic synthesis of the linkage-based wearable hand exoskeleton has been accomplished using Burmester Theory. The figure shows the BRAIL Hand Exoskeleton 1.0, Planar 8-link mechanism with phalanges and articulations as part of the kinematic chain for each finger; a planar 6-link mechanism for the thumb is under two principal considerations: a) to obtain link lengths that ensured no mechanical interference and b) each finger followed the natural trajectory of the human digits.

Synergy-based Adaptive Control for Assistance-as-needed

Grasp synergy analysis is carried out to identify underlying patterns for different postures. We observe how the grasp postures and grasp forces cluster together, revealing patterns and similarities among the different grasp types using a custom-built data glove. The figure shows the BRAIL Data Glove. These findings serve as a comprehensive guide in controller design, enabling the replication of natural hand movements and forces for assistance-as-needed (AAN). We have worked out EMG processing and analysis for control and coordination based on muscle synergy. The process involves using a non-negative matrix factorization (NNMF) to decompose the EMG signal into muscle synergies and their corresponding activation coefficients. The synergy obtained from this process reveals the underlying patterns in the EMG data that help classify finger movements.

Neural Correlates of Motor Imagery and Affordance-driven Action

Action observation (AO) and motor imagery (MI) are two forms of motor simulation that can influence motor responses. EEG-based motor imagery, together with the impact of observing affordance-driven action during motor imagery, was studied. We examined combined AO + MI, where participants simultaneously engaged in AO and MI. Participants imagined and observed the same affordance-driven action during congruent AO + MI, whereas in incongruent AO + MI, participants imagined the actual affordance-driven action while observing a distracting affordance involving the same object. The maximum source current density (0.00611 μA/mm2) using Low-Resolution Electromagnetic Tomography (LORETA) was observed during congruent AO + MI in brain areas responsible for planning motoric actions. The results of our analysis highlight the importance of prioritizing congruent AO + MI tasks in rehabilitation protocols to maximize neural engagement and motor learning.
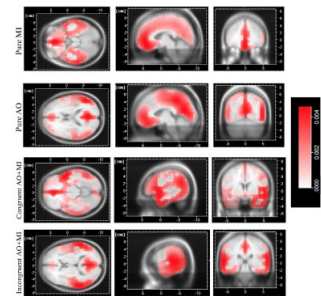
Glimpses:

TRS Workshop cum Investor and MSME meet on Robotics, Artificial Intelligence and Entrepreneurship

The DST-Technology Enabling Centre (TEC), Tezpur University in collaboration with The Robotics Society, and Innovation Hub for Cobotics – IIT Delhi and BITS BioCyTiH Foundation - Goa as knowledge partners held its three-day workshop cum Investor and MSME meet on Robotics, Artificial Intelligence and Entrepreneurship during December 16-18, 2024 at Tezpur

University. Ten technologies have been demonstrated in an exhibition in parallel to the event.

The first session was led by Dr. Kukil Khanikar, Assistant Professor, Department of Electronics and Communication Engineering, IIIT Guwahati where he introduced AI concepts, particularly focusing on AI-driven innovations and their potential in various industrial applications.

The programme went ahead with the auspicious ceremony of ribbon cutting and digital lighting of lamps. Dr. Ekta Singla, Secretary of the Robotics Society, delivered the welcome address, highlighting the importance of collaboration in driving innovation in robotics and AI. A warm welcome by The Vice Chancellor, Tezpur University Professor Shambhu Nath Singh was extended to all attendees and emphasized the role of educational institutions in fostering innovation and entrepreneurship. The Chief Guest of the event, Mr. Rajkumar More, Chairman Emeritus of Torsa Machines Limited, introduced the importance of industries to promote automation and improve operational processes. Following this was the session by Dr. Ashish Singla, Associate Professor, Thapar Institute of Engineering and Technology, Punjab, focused on research advancements in robotics and AI.

The second day was initiated by Dr. Susha Lekshmi S.U., Senior Program Manager-R&D, I-Hub Foundation for Cobotics-IIT Delhi on the role of robotics in industry, particularly in emerging technologies and their applications in various sectors. It was followed by Dr. Ekta Singla, Associate Professor, Mechanical Engineering Department, IIT Ropar, where she discussed the role of robotics in enhancing productivity and creating new opportunities for entrepreneurship. The workshop continued with the online Session I-2 by BITS BioCyTIH Foundation-Goa, where the discussions were made about the transfer of technology for fostering innovation,

economic development, and the commercialization of new technologies. The day was concluded by Dr. Vivek Kumar Mehta, Assistant Professor, Department of Mechanical Engineering Tezpur University, where he highlighted the growing role of AI in various fields and how data forms the backbone of intelligent systems that make our daily activities more efficient.

The third day started with Mr. Abhijit Pegu, Officer (Corporate Planning) of Numaligarh Refinery Limited. In this session, the speaker emphasized the critical role of industry in the growth and development of technology and innovation. The discussion centered around understanding the challenges and strategies for taking technology or innovation from the research and development phase into practical use within industries.

Brainstorming Session

Led by Dr. Rupam Goswami, it was a collaborative brainstorming event that brought together representatives from Micro, Small, and Medium Enterprises (MSMEs), investors, and academic leaders. The session aimed to provide a comprehensive understanding of how to effectively commercialize innovations, with a particular emphasis on robotics and AI technologies. Dr. Goswami facilitated the discussion, guiding the participants through various stages of the commercialization process, from the initial idea to bringing the technology to the market. The discussions were on the importance of overcoming any hesitations or fears about sharing ideas, the importance of seeking mentorship during the development phase of the innovation, engaging with experienced professionals and advisors to help in shaping the technology, securing financial support from various government schemes, increasing the Technology Readiness Level (TRL) of innovations for a technology to be commercially viable which involves rigorous testing, prototyping, and refining the technology to ensure it is ready for industrial deployment and mass production. Finally, the discussion touched on the essential aspects of marketing and scaling the innovation for industrial commercialization. The interactive discussions and shared experiences helped participants understand the various opportunities and resources available to support their innovation journey.

Parallel to the workshop, the exhibition was carried out, and it included students, industries, researchers, and companies presenting their cutting-edge work in robotics, AI, and related fields.

TRS Workshop on Wearable Robotics: Enhancing Mobility and Autonomy for All Ages

The increasing prevalence of mobility impairments due to age or health conditions underscores the urgency for innovative solutions that can restore autonomy and movement. Wearable robotic technologies, such as motion sensors, soft exoskeletons, and non-active aids, are emerging as practical tools to enhance physical abilities, support rehabilitative efforts, and aid in everyday tasks. These systems provide a tailored and adaptable form of support that reduces discomfort and promotes active participation and self-reliance.

A TRS workshop on Wearable Robotics: Enhancing Mobility and Autonomy for All Ages was conducted on 10, 11 December

2024 at IIT Gandhinagar. This workshop served as a specialized forum for those engaged in the wearable robotics domain, offering a unique opportunity for scholars, researchers, industry experts, and school kids to convene. It featured dedicated sessions on state-of-the-art research, successful industry ventures, lab tours, and hands-on demonstrations for participants and kids.

Eleven researchers from different institutes delivered talks on the following topics. Prof. Francesco Travascio, University of Miami, spoke on image-based techniques integrated with AI tools for injury prevention strategies across occupational and sports environments. Prof. Deepak Joshi from the Indian Institute of Technology (IIT) Delhi discussed muscle synergy-based functional electrical stimulation delivery in post-stroke patients. Prof. Ashish Singla from Thapar Institute of Engineering & Technology presented an analysis of the biomechanics of human movement and its importance in the design of

control strategies for exoskeletons. Prof. Andrej Olenšek from the University Rehabilitation Institute Soča reiterated the importance of device transparency and proposed a cable-driven actuation unit to provide passive transparency. Prof. Siddharth Bhardwaj from Amrita Vishwa Vidyapeetham, Coimbatore, emphasized the role of ergonomics in designing a passive back exosuit for preventing occupational injuries. Prof. Sanjeevi Surya Satya Nakka and Prof. Deep Seth from Mahindra University Hyderabad presented the promotion of a particular joint strategy during gait rehabilitation using a lower-limb cable-driven exoskeleton and the development of an anthropomorphic upper-limb exoskeleton, respectively. Prof. Saikat Sahoo from the IIT Bhilai presented human-in-the-loop optimization techniques to tailor interventions for better outcomes, such as reduced metabolic cost. Dr. Matjaž Zadravec from the University Rehabilitation Institute Soča explained a real-time gait event detection algorithm using the center of pressure from treadmills, specifically to include cross-stepping during perturbation-based balance training for fall prevention. Dr. Teja Krishna Mamidi from the IIT Gandhinagar presented the thought process behind developing adaptive frequency oscillators for gait phase detection. Prof. Vineet Vashista from the IIT Gandhinagar shared the importance of considering human-robot interactions in developing intervention paradigms and how this has been the central idea behind the developments at the human-centered robotics lab.

Additionally, the details of three industrialists in the domain of wearable robotics who shared their journey and demonstrated their products in the market are as follows.

Shri. Chirag Shah from Rymo Technologies Mumbai emphasized how immersion through games, virtual reality, and home environment makes a difference in product acceptance and effective rehabilitation. Dr. Chandan Kumar Jha from Galanto Innovations Pvt Ltd Gandhinagar demonstrated rehabilitation devices that integrate sensors to track precise movements and games to motivate patient engagement for stroke recovery and motor skill improvement. Shri. Gunjan Patel from SynerSense Ahmedabad presented wearable motion analysis systems with generative artificial intelligence for healthcare diagnosis and sport biomechanics applications. The lab tour involved demonstrations of virtual reality-

based diagnosis and rehabilitation paradigms, wearable sensors to measure joint kinematics and ground reaction forces, an active exoskeleton for multi-modal walking assistance, an ankle-foot orthotic device to prevent foot drop, a passive back exoskeleton for lifting activities, and other cable-driven experimental testbeds. A live demonstration of the motion capture system synced with the electromyography sensor system, beginning from participant preparation to exporting the measurements for further processing, was conducted as part of the hands-on session.

The hands-on session for kids involved demonstrations of real-time feedback on the posture assessment during squatting using IMUs, muscle-driven actuator using EMG signals from forearm flexors, and 3D sketching using a virtual reality set-up.

A total of thirty-five participants, including faculty, students, researchers from educational institutes, and research organizations nationwide, attended the event. Among these, eight participants presented their work in the form of posters. Additionally, ten kids from the local communities attended the hands-on session.

TRS Awareness Workshop

TRS Awareness Workshops had been organized at two leading events – DD Robocon 2025 at New Delhi and at Pune International Exhibition and Convention Center, Moshi, Pune. The platforms had been selected to enhance the awareness of society among undergraduate students and industry leaders. Where the former event at DD Robocon bound together the enthusiasm and energy of young students, the latter event at Factory Automation Exposition was a go-to event for the manufacturing sector.

The first TRS Awareness event included a TRS stall at the prestigious DD Robocon 2024, a national robotics competition hosted by IIT Delhi, during June 13-14, 2024. DD Robocon is a part of the Asian-Oceanian college robot competition, which is fostered internationally by the Asia-Pacific Broadcasting Union (ABU). At this prime event, TRS volunteers, including Mr Shreyas Patel, GC member, introduced the participants to TRS and its significance in the evolving robotics landscape. The participants mainly consisted of college students involved in robotics, with a high interest in advancing

their knowledge through TRS connects and activities. At the stall, networking opportunities were also provided to foster connections between attendees. TRS awards were announced for the first eight qualifiers of the prestigious event. Follow-up actions include planning similar workshops at future events, including the Factory Automation Expo 2025 in Pune on November 25, 2024. The venue of the event was the Pune International Exhibition and Convention Center, Moshi, Pune, with a Co-located Show on Factory Automation and Process Automation.

The TRS Awareness Workshop was held as part of the Factory Automation Expo 2025, a premier event showcasing advancements in industrial automation. The workshop focused on the theme "Robotics in Industries: National Viewpoint," highlighting the role of robotics in transforming the industrial landscape and fostering innovation in India. The call for participation had been advertised to all the members and a larger audience through the exposition partners.

The event began with a warm welcome and an introduction to The Robotics Society by Prof. Ekta Singla, Secretary, TRS, and a faculty member at IIT Ropar. Her address set the tone for the workshop, emphasizing the importance of TRS in the rapidly evolving field of robotics and industrial automation. The opening address was delivered by Sh. Alok Mukherjee, President, TRS, who spoke on 'The Start-up Revolution and Robotics Technology Innovation'. His speech underscored the critical role of robotics in enabling start-ups to drive innovation and accelerate growth in India's industrial sector. He highlighted the synergies between technological advancement and entrepreneurial spirit, urging attendees to seize emerging opportunities. Discussions included the topic of robots for sustainable development in the emerging national economy – the topic was planned to be talked about by Prof Santanu Chaudhary, former Director of IIT Jodhpur. He could

not join the workshop in person. This was followed by an insightful talk by Dr. Ranjan Dasgupta, Principal Scientist, TCS Robotics and Autonomous Systems. Dr. Dasgupta's presentation titled "TCS Robologistics - Robotics for Industries" delved into TCS's cutting-edge initiatives in integrating robotics into logistics and manufacturing. His talk provided a glimpse into real-world applications of robotics in streamlining industrial operations and enhancing efficiency. The workshop concluded with a Q&A session where participants engaged in discussions with the speakers, exploring the future trends in industrial robotics sectors and its implications for India's economy. The workshop resulted in an increased understanding of TRS structure and activities, and valuable feedback emphasizing the importance of such initiatives. Participants expressed enthusiasm for future workshops and collaborations with industry partners.

TRS-SCALE (Student Chapter Activity for Learning and Enriching) 2023-24: Phase 1

Faculty Development Program on AI & ML Applications in Robotics, Rajalakshmi Engineering College (REC)

May 28 to June 1, 2024 (5 days)

Topics Covered:

- Kinematics and Dynamics of Industrial Robots, Underwater Robotics
- Design, Motion Planning and Control of Mobile Robots
- Introduction and Hands-on Session on ANN (Artificial Neural Network)
- Introduction to Machine Learning
- Convolutional Neural Network Architecture and Applications, Deep Learning
- Introduction and Hands-on Session on Tensor Flow

Coordinators: Mr. Eswaran A, Dr. Saravanan and Mr.

Ramkumar S., Dept. of Robotics and Automation, Rajalakshmi Engineering College

ROS (Robot Operating System) Workshop, Amrutvahini College of Engineering

April 3-4, 2024 (2 days)

Topics Covered:

- Introduction to Robotics
- Introduction to ROS
- Gazebo Simulator, Turtlesim and Robot Arm modelling
- Self-driving robots (Autonomous)

Coordinators: Prof. Vilas B. Shinde and Prof. Manoj M., Dept. of Automation & Robotics Engineering
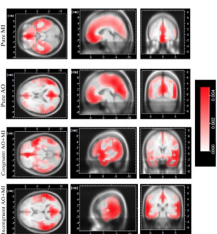

Workshop on Mastering ROS2: Robot Perception and Navigation Techniques, SAINTGITS College of Engineering

July 17-19 (3 days)

Topics Covered:

- Introduction to ROS2
- Turtlesim and URDF
- Hands-on session on ESP32, Nav2 and Micro-ROS
- Robotic vision using OpenCV
- Self-driving robots (Autonomous)

Coordinators: Mr. Harinarayanan Nampoothiri M G, Dept. of Electronics Engineering

Workshop on The Internet of Robotic Things, Sri Krishna College of Engineering and Technology

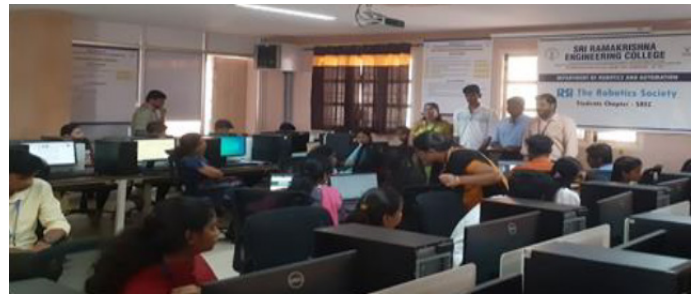Aug 28-29, 2024 (2 days)

Topics Covered:
- Introduction to IOT and Embedded System
- WOKWI Simulation
- Introduction to Sensor Interface
- App Development using Flutter

Coordinators: Dr. D. Pritima and Ms. S. Nithya Priya, Dept. of Mechatronics Engineering

Hands-on Workshop on LabVIEW-Driven Automation in Robotics, Sri Ramakrishna Engineering College

Sept 9, 2024 (1 day)

Topics Covered:
- Overview of LabVIEW environment & Graphical programming fundamentals
- Sensor interfacing and data collection in robotics
- Simulating robotic systems in LabVIEW
- Integrating LabVIEW with different robotic platforms
- Hands-on: Creating simple VIs for automation

Coordinators: Dr. A. Kishore Kumar, Mrs.G.Hemalatha and Mrs.N.Dheerthi, Dept. of Robotics and Automation, Sri Ramakrishna Engineering College

Upcoming Events:

Advances In Robotics (AIR) 2025

Dates:

July 2nd - 5th, 2025

Venue:

IIT Jodhpur

Important Deadlines:

Paper Submission Deadline:

Feb 15, 2024

Acceptance notification for papers:

April 15, 2025

How to become a TRS member?

To become a TRS member, kindly follow the instructions given in the website

NEW SUBMISSION ROUND 2 OPEN !

7th International Conference of The Robotics Society

ADVANCES IN ROBOTICS (AIR) 2025

IIT JODHPUR , RAJASTHAN , INDIA

Advances in Robotics (AIR) is a series of biennial international conferences organized by The Robotics Society. The conference aims to create a forum to present and exchange new ideas by researchers and developers from India and abroad working in the fields of robotics and its applications. The conference will feature keynote speeches, paper presentations, workshops, startup exposition, panel discussions and plenary sessions.

DATE
2 - 5 July 2025

CALL FOR PAPERS !

for more detail SCAN ME !

❗ IMPORTANT DATES

📅 **Submission Deadline:** February 15, 2025
📢 **Acceptance Notification:** April 15, 2025

THEMES INCLUDE

- Kinematics, Dynamics and Design of Robots
- Computer vision and AR/VR for robotics
- Multi-robot system and distributed control
- Robotics and Control Systems
- Grasping and Human-Robot Interaction
- Medical, Rehabilitation and Assistive Robotics
- Soft Robotics and Bio-Inspired Robotic Systems
- Field Robots: Legged, Flying and Underwater
- Collaborative Robots for Industry Automation
- Planning and navigation in unstructured environments
- Robot learning and GenAI & LLMs for robotics
- Telerobotics and Haptics

📌 IMPORTANT POINTS TO REMEMBER !

1. New authors can directly submit in Round 2.
2. Authors from Round 1 can revise and resubmit.
3. Ensure your paper follows the submission guidelines:
   a. Single-column format for the initial submission.
   b. Double-blind review process (no author details in the paper).

WHY SUBMIT?

- Publish in ACM Proceedings (for more details refer to AIR 2025 website)
- Network with leading experts and industry professionals
- Gain recognition for your cutting-edge research

The Robotics Society

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