50 Days of CoboTalks

Technology
Innovation Hub
of IIT Delhi

Content

About IHFC

In the past few years, the world and especially India has rapidly seen advancement in sensing, computing, algorithm research, and development. This has further ushered in the growth of robotics research and its adaptation in the real world. Today, it's very obvious that robots are being used and every sector, let it be in the life of a simple farmer planting and harvesting his crops, to the wholesaler who needs to manage his inventory in his vast warehouse of all agricultural produce. The usage of drones in agriculture, defense, and industry has taken a turn only for the better. The use of robots in collaboration with doctors is being used in long intensive surgeries. All over the world and this kind of collaborative work with robots will just increase with time.

It is evident that robots are going to play an essential role in society in the coming years in all sectors so Intelligent robotic teammates have the potential to expand human capabilities, reduce risk of harm, increase safety, productivity and ultimately the quality of life for our people. Therefore, the development of technology and products that enable the population to work alongside robots is the need of the hour.

With this aim, I-Hub Foundation for Cobotics (IHFC), Technology Innovation Hub of IIT Delhi, was established partnering with the Department of Science Technology (DST), Ministry of Science and Technology, Govt. of India under National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS). This brings together 3 major pillars of success from Academia, Government and Industry.

Established in June 2020 as a Section 8 company, IHFC has 4 mandates under its 4 Application Areas, Medical, Agriculture, Industry and Defence. The mandates being Research and Development, Entrepreneurship and Startups, Skills and Training and International Collaborations such as with Japan and NSF, USA.

Under Research and Development we are working on 10 Grand Projects, and a few are in International Collaboration with National Science Foundation (NSF). We are hand holding many start-ups and many young Entrepeneur's are already incubated and accelerated with IHFC under READY (Research Entrepreneurship and Development for You) program. Our first successful startup from READY is TOTO which is already in talks with many IHFC industry partners for commercialization and there are many more in the pipeline.

Preface

At the outset, we would like to congratulate the IHFC (I-Hub Foundation for Cobotics), the Technology Innovation Hub of IIT Delhi for compiling its monthly webinars called CoboTalks over the last four years.

It is an initiative with a collaborative effort by IHFC, CoE-BIRD (Center of Excellence on Biologically-Inspired Robotics and Drones) and M.Sc. program in Cognitive Science at IIT Delhi, run by the Department of Humanities and Social Sciences, HSS. The speakers from all over the world, drawn from academics, industries, and entrepreneurship domain shared their experiences online for the benefit of all to work in the domains of robotics, cobotics, AI/ML, IoT, and associated technologies. At the start of CoboTalks in 2020, we used to invite 2-3 speakers to highlight their domains of expertise, just to expose an area. After about a year, we thought only industrial sessions would also be a good addition in the name of iCoboTalks on the 3rd Wednesday (typically, 5-6 PM), while CoboTalks are on the 2nd Wednesdays (same time, i.e., 5-6 PM or 6-7 PM, if the time suits a speaker from abroad). Later, we realized that an in-depth exposition of an expert's contribution, either from academia or industry, would be more impactful. Hence, CoboTalks continued on every 2nd Wednesday, 5-6 PM IST with Springer's vouchers for the speakers and Amazon's vouchers for the quizzes conducted post each webinar. That way sessions have been more interesting.

Upon reaching the 50th CoboTalk, we decided to bring out this special publication of 50 Days of CoboTalks. We hope this publication will exemplify "Who's Who in Cobotics," which can be used as a resource material to reach out to an expert for a review of a research proposal, a Ph.D. thesis, piloting a study or conduct consultancy research projects, etc. Please share your valuable feedback and comments at `contact@ihfc.co.in` till we bring out our next edition.

February 2025
Team CoboTalks

Acknowledgements

The organizing team of CoboTalks webinar sincerely thanks IHFC (the Technology Innovation Hub of IIT Delhi), CoE-BIRD at IIT Delhi, and the M.Sc. in Cognitive Science by the HSS dept. of IIT Delhi for providing the opportunity to bring experts from around the world to share their experiences and best practices. Thanks to all speakers for sparing their valuable time irrespective of which country they are from. Springer Nature is thanked, who sponsors 150 Euros voucher coupons to the external speakers. In order to bring more interactions and interests, IHFC sponsors Amazon vouchers for those who ask the best questions post each CoboTalk. Thanks to IHFC, specially, Ms. Piya Basu and Mr. Udayan Banerjee (Ph.D. student at SIRE, IIT Delhi) who spearheaded the event regularly with the students of M.Sc. in Cognitive Science at IIT Delhi.

To contact any speaker featured, please reach us at:
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I-Hub Foundation for Cobotics (IHFC), IIT Delhi

Speaker: Subir Kumar Saha
Designation: Professor
Department: Mechanical Engineering
Affiliation: IIT Delhi

Speaker Bio: Subir Kumar Saha, a 1983 Mechanical Engineering graduate from RE College (Now NIT), Durgapur, India, completed his M. Tech from IIT Kharagpur, India, and Ph. D from McGill University, Canada. Upon completion of his Ph. D, he joined Toshiba Corporation's R&D Center in Japan. After 4-years of work experience in Japan, he has been with IIT Delhi since 1996. He is actively engaged in teaching, research, and technology transfer. He has completed sponsored projects and consultancies worth a bout Rs. 14 crores (USD 2.0 millions). Prof. Saha was awarded the Distinguished Alumnus Award for 2020 in Academic and Research by NIT Durgapur. He established the Mechatronics Laboratory at IIT Delhi in 2001, and contributed significantly in the development of the Programme for Autonomous Robotics during 2010-16 with the funding from BARC/BRNS, Mumbai. As a recognition of his international contributions, Prof. Saha was awarded the Humboldt Fellowship in 1999 by the AvH Foundation, Germany.

Talk Overview:
The I-Hub Foundation for Cobotics (IHFC) at IIT Delhi serves as a pioneering institution driving innovation and collaboration in the field of collaborative robotics (cobotics). This interdisciplinary research hub brings together experts from various domains, including robotics, artificial intelligence, engineering, and human-computer interaction, to develop cutting-edge solutions that enhance human-robot collaboration. IHFC's primary focus is on advancing the capabilities of cobotic systems, where robots and humans work together seamlessly to achieve shared goals. Through research, development, and industry partnerships, IHFC aims to address key challenges in cobotics, such as safety, efficiency, and adaptability. The foundation emphasizes the importance of designing cobotic systems that prioritize human well-being and productivity while ensuring reliable performance in diverse environments. At the core of IHFC's mission is fostering innovation and entrepreneurship in cobotics. The foundation provides a collaborative ecosystem for researchers, students, and industry partners to ideate, prototype, and commercialize cobotic solutions. By nurturing talent and facilitating technology transfer, IHFC contributes to the growth of India's robotics industry and its global competitiveness. IHFC also serves as a hub for knowledge dissemination and capacity building in cobotics. Through workshops, seminars, and training programs, the foundation shares insights and best practices with stakeholders, empowering them to leverage cobotic technologies effectively. In summary, IHFC plays a pivotal role in driving advancements in cobotics research, innovation, and entrepreneurship. By bridging the gap between academia and industry, the foundation catalyzes the development and adoption of cobotic solutions that have the potential to transform industries, enhance productivity, and improve quality of life.

Research Presentation

Speaker: Rohan Paul
Designation: Assistant Professor
Department: Computer Science and Engineering
Affiliation: IIT Delhi

Speaker Bio: Rohan is an Assistant Professor and Pankaj Gupta Faculty Fellow at IIT Delhi's Department of Computer Science and Engineering. Specializing in Robot Learning and AI, his research spans human-robot teaming, planning, and scene understanding, aiming to create service robots that integrate seamlessly with human life. His passion extends to develop innovations for persons with disabilities, enhancing mobility and education. Rohan's academic journey includes a D.Phil. from Oxford University, and B. Tech. and M.Tech. degrees from IIT Delhi, with a notable postdoctoral tenure at MIT's CSAIL. As the chief inventor of the SmartCane and a pivotal figure in establishing the Assistive Technologies Lab at IIT Delhi, his contributions have garnered international recognition, including multiple best paper awards and prestigious national awards. Rohan's innovative spirit and impactful research have earned him spots on lists like "35 Global Innovators Under 35" by MIT Technology Review, reflecting his contributions in the field of robotics and AI.

Talk Overview:
The concept of AI-driven human-robot collaboration represents a significant advancement in the field of robotics, emphasizing the integration of artificial intelligence (AI) technologies with robotic systems to facilitate seamless interaction and cooperation between humans and robots. This presentation delves into the principles, applications, and implications of AI-driven human-robot collaboration, highlighting its transformative potential across various industries and domains. At its core, AI-driven human-robot collaboration leverages AI algorithms and machine learning techniques to enable robots to perceive, interpret, and respond to human actions and intentions in real-time. This capability fosters a symbiotic relationship between humans and robots, where each complements the strengths and capabilities of the other, leading to enhanced efficiency, productivity, and safety in collaborative work environments. The presentation showcases examples of AI-driven human-robot collaboration in practice, ranging from manufacturing and logistics to healthcare and service industries. In manufacturing, robots equipped with AI capabilities can adapt to dynamic production environments, working alongside human workers to optimize production processes and improve overall throughput. In healthcare, AI-driven robots can assist medical professionals in patient care tasks, such as monitoring vital signs, administering medication, and providing rehabilitative therapy. However, the adoption of AI-driven human-robot collaboration also poses challenges, including ethical considerations, privacy concerns, and the potential impact on employment dynamics. The presentation discusses strategies for addressing these challenges while maximizing the benefits of AI-driven collaboration. In conclusion, AI-driven human-robot collaboration represents a paradigm shift in robotics, offering unprecedented opportunities to augment human capabilities, enhance productivity, and revolutionize various industries.

Research Presentations

Speaker: Ashwini Vaidya
Designation: Assistant Professor
Department: Humanities and Social Sciences
Affiliation: IIT Delhi

Speaker Bio: Ashwini Vaidya is an Assistant Professor in the Department of Humanities and Social Sciences and also associated with the Cognitive Science program, and Yardi School of AI at IIT Delhi. Her research areas are computational lexical semantics, argument structure, and lexical access. She is also interested in the design, collection, and evaluation of linguistic datasets for NLP, using both computational and experimental methods.

Talk Overview:
In this comprehensive talk, the intricate interplay between computational lexical semantics, argument structure, and lexical access is explored, shedding light on their pivotal roles in understanding language comprehension and production processes. Computational lexical semantics serves as the cornerstone, providing frameworks and algorithms to computationally model the meanings of words and their relationships within linguistic contexts. By analyzing semantic properties, syntactic structures, and discourse patterns, computational lexical semantics enables machines to comprehend and generate natural language with increasing accuracy and sophistication. Argument structure, on the other hand, delves into the hierarchical organization of predicates and their arguments within sentences, elucidating how words interact syntactically and semantically to convey meaning. Understanding argument structure is crucial for tasks such as sentence parsing, semantic role labeling, and information extraction, facilitating deeper insights into the structure of language and its cognitive underpinnings. Furthermore, lexical access plays a vital role in bridging computational lexical semantics and argument structure, encompassing the processes by which words are retrieved from memory during language production and comprehension. Through intricate mechanisms of activation and inhibition, lexical access enables rapid and efficient retrieval of words based on contextual cues, syntactic constraints, and semantic associations. By integrating computational lexical semantics, argument structure, and lexical access, researchers aim to unravel the complexities of language processing, paving the way for advancements in natural language understanding, machine translation, and cognitive modeling. Through interdisciplinary collaboration and innovative methodologies, this holistic approach promises to deepen our understanding of human language and accelerate progress in artificial intelligence and computational linguistics.

Research Presentation

Speaker: Atanendu Sekhar Mandal
Designation: Chief Scientist(Retd.)
Department: CSIR-CEERI, Pilani (Retd.)
Affiliation: IHFC, IIT Delhi

Speaker Bio: Atanendu Sekhar Mandal has done his B. Tech in Electrical Engineering from IIT Kanpur, and M.Tech. in Integrated Electronics and Circuits (IEC) and PhD in Computational Neuro-Vision from the Electrical Engineering Department, IIT Delhi. Since 1989 he had been working in the VLSI Design Group, CSIR-Central Electronics Engineering Research Institute (CSIR-CEERI), Pilani, Rajasthan. He has participated in all the major Grant-in-Aid projects of the group funded by the Ministry of Electronics & Information Technology (MeitY),

Talk Overview:
The talk on cognitive computing delves into the nuanced interplay between strong and weak artificial intelligence (AI) within the realm of cognitive systems. Cognitive computing, a subset of AI, aims to mimic human thought processes by leveraging advanced algorithms and data analytics to process vast amounts of unstructured data. The presentation explores the distinction between strong AI, which enhances the development of machines with consciousness and self-awareness akin to humans, and weak AI, which focuses on specific tasks without achieving true human-like cognition. In the context of cognitive computing, weak AI systems are typically employed to perform narrowly defined tasks, such as natural language processing, image recognition, or predictive analytics, with proficiency in these specialized domains. These systems excel in processing structured data and executing predefined algorithms but lack the broader understanding and adaptability characteristic of human intelligence. Conversely, strong AI aspires to imbue machines with human-level intelligence, enabling them to reason, learn, and adapt to diverse contexts autonomously. While still largely theoretical, the pursuit of strong AI holds profound implications for revolutionizing industries and addressing complex societal challenges. The talk navigates through various applications of cognitive computing, spanning healthcare, finance, cybersecurity, and beyond, showcasing how both weak and strong AI contribute to enhancing decision-making, automating processes, and augmenting human capabilities. Additionally, the presentation delves into the ethical considerations and societal impacts of advancing cognitive computing technologies, emphasizing the importance of responsible AI development and deployment. Overall, the discussion illuminates the evolving landscape of cognitive computing, highlighting the complementary roles of weak and strong AI in driving innovation and shaping the future of intelligent systems.

Research Presentation

Speaker: Sumitava Mukherjee
Designation: Assistant Professor
Department: Humanities and Social Sciences
Affiliation: IIT Delhi

Speaker Bio: Sumitava Mukherjee is a behavioral and cognitive scientist who studies human judgment and decision making (JDM) situated at cross sections of cognitive & behavioral science and behavioral economics. He is passionate about behavioral insights and in possibilities of inputs from behavioral science towards national initiatives and UN sustainable development goals. Mukherjee is currently an associate faculty at the Yardi School of Artificial Intelligence at IIT Delhi, India.

Talk Overview:
In this enlightening talk, the fascinating intersection of judgment, decision-making, and behavioral science is explored, illuminating the intricate processes that govern human choices and behaviors. At the heart of this discussion lies the exploration of how individuals assess information, weigh options, and arrive at decisions in various contexts, ranging from everyday choices to high-stakes scenarios. Judgment serves as the foundation, encompassing the cognitive processes involved in evaluating evidence, forming opinions, and making subjective assessments. By examining the biases, heuristics, and mental shortcuts that influence judgment, researchers gain insights into the underlying mechanisms driving human decision-making. Decision-making, on the other hand, delves into the complex interplay between cognitive, emotional, and social factors that shape choices and outcomes. Through empirical research and theoretical frameworks, behavioral scientists uncover the principles governing decision processes, highlighting the role of risk perception, loss aversion, and social influence in shaping behavior. Behavioral science provides a holistic lens through which to understand judgment and decision-making, drawing upon insights from psychology, economics, and neuroscience to elucidate the underlying mechanisms of human behavior. By integrating empirical evidence with theoretical models, researchers aim to uncover the underlying principles governing human judgment and decision-making, informing strategies for improving decision outcomes and promoting better societal outcomes. Ultimately, this interdisciplinary approach to studying judgment, decision-making, and behavioral science holds promise for enhancing individual well-being, optimizing organizational performance, and addressing societal challenges. By leveraging insights from behavioral science, policymakers, practitioners, and individuals alike can make more informed decisions, leading to better outcomes and a deeper understanding of human behavior.

IITD AIA Foundation for Smart Manufacturing

Speaker: Sunil Jha
Designation: Professor
Department: Mechanical Engineering
Affiliation: IIT Delhi

Speaker Bio: Sunil Jha obtained his Ph.D. in Manufacturing Science from IIT Kanpur and has been engaged in teaching and research on manufacturing processes and related automation for the last 14 years. He has developed new unconventional super finishing processes and filed 10 patents on them. Some of his significant contributions include advancements in manufacturing sciences and the development of innovative techniques for surface finishing.

Talk Overview:
The IITD AIA Foundation for Smart Manufacturing spearheads advancements in manufacturing through AI-driven solutions and interdisciplinary cooperation. This discussion offers insights into the foundation's objectives, endeavors, and contributions to enhancing efficiency and sustainability in manufacturing. Central to its mission is leveraging AI and cutting-edge technologies to optimize manufacturing processes, foster sustainability, and improve operational efficiency. By forging partnerships with industry, academia, and government bodies, the foundation facilitates research, development, and implementation of intelligent manufacturing solutions. A core focus lies in utilizing AI and machine learning algorithms for predictive maintenance, quality assurance, and resource optimization. These technologies empower manufacturers to proactively identify issues, minimize downtime, and boost productivity by analyzing real-time data. Interdisciplinary collaboration is emphasized as a pivotal strategy, uniting experts from various fields such as engineering, computer science, and business management. Through joint research projects and training initiatives, the foundation fosters innovation and knowledge exchange, driving progress in smart manufacturing practices. Furthermore, the foundation prioritizes sustainability and ethical practices in manufacturing, promoting circular economy principles and environmental stewardship. By championing responsible manufacturing, the foundation strives to create a more sustainable and inclusive manufacturing ecosystem, poised to shape the future of industry.

Research Presentation

Speaker: Samar Husain
Designation: Assistant Professor
Department: Humanities and Social Sciences
Affiliation: IIT Delhi

Speaker Bio: Samar Husain is an Associate Professor in the Department of Humanities and Social Sciences at IIT Delhi. He teaches courses to undergraduates and postgraduates in the areas of linguistics, cognitive science, statistics, and psycholinguistics. His broad areas of research are human sentence processing, natural language modeling, natural language parsing, and dependency grammars. These topics lie at the intersection of psychology and computational/theoretical linguistics.

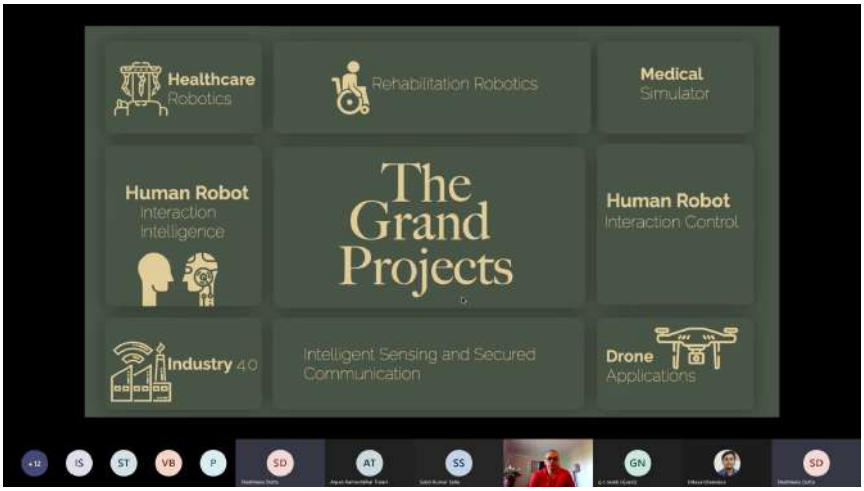
Talk Overview:
The intersection of human sentence processing, natural language modeling, natural language parsing, and dependency grammars represents a rich and multifaceted domain at the forefront of computational linguistics and cognitive science. This amalgamation of disciplines seeks to unravel the intricacies of language comprehension and production, both from a human cognitive perspective and through computational modeling. Human sentence processing delves into how individuals perceive, interpret, and generate language in real-time. By conducting psycholinguistic experiments and analyzing behavioral data, researchers aim to uncover the underlying mechanisms and constraints governing language comprehension in the human brain. Natural language modeling involves the development of computational algorithms and statistical models to simulate human-like text generation and understanding. Leveraging large-scale linguistic data, these models learn patterns and structures within language, enabling tasks such as machine translation, text summarization, and sentiment analysis. Natural language parsing focuses on the automatic analysis and representation of the syntactic structure of sentences. Parsing algorithms aim to identify the grammatical relationships between words and organize them into hierarchical structures, such as parse trees or dependency graphs. Dependency grammars provide a formal framework for representing syntactic dependencies between words in a sentence. Unlike traditional phrase structure grammars, dependency grammars model syntactic structure as a network of directed dependencies, capturing the relationships between words in terms of heads and dependents. By integrating insights from human cognition with computational techniques, this combined area drives advancements in natural language processing, artificial intelligence, and cognitive modeling. It not only facilitates the development of more accurate and efficient language technologies but also enhances our understanding of the complex interplay between language and cognition in both humans and machines.

Mission IHFC, IIT Delhi

Speaker: Ashutosh Dutt Sharma
Designation: CEO
Affiliation: IHFC, IIT Delhi

Speaker Bio: Ashutosh Dutt Sharma is the Chief Executive Officer of IHFC [Technology Innovation Hub of IIT Delhi]. He comes with an experience of almost two decades in managing large business in Electronics/Telecom/Internet/IT industry. During his prolific career, he has worked with industry market leaders including Samsung Electronics, Bharti Airtel Limited and IndiaMart to name a few.

Talk Overview:
Mr. Sharma the CEO explained his vision of spearheading the establishment of a collaborative robotics ecosystem in India, aligned with the vision of the Department of Science and Technology (DST), Ministry of Science and Technology (Government of India), the task at hand encompasses a multifaceted approach. This initiative involves not only defining the framework and objectives but also orchestrating the creation of an integrated ecosystem that fosters innovation, research, and development in the field of collaborative robotics. Central to this endeavor is the cultivation of partnerships and collaborations between government entities, academic institutions, research organizations, and industry stakeholders. By leveraging the collective expertise and resources of these diverse stakeholders, the aim is to catalyze the growth of collaborative robotics in India and position the country as a hub for innovation and excellence in this transformative technology. Moreover, fostering a culture of entrepreneurship and technological innovation will be instrumental in driving the ecosystem forward, facilitating the translation of research outcomes into tangible solutions that address real-world challenges across various sectors. By nurturing talent, fostering interdisciplinary collaboration, and providing necessary support infrastructure, the goal is to create an environment conducive to the development, deployment, and adoption of collaborative robotics technologies that positively impact society and drive economic growth



Some Recent Results on Security of Cyber-Physical Systems

Speaker: Arpan Chattopadhyay
Designation: Assistant Professor
Department: Electrical Engineering
Affiliation: IIT Delhi

Speaker Bio: Arpan Chattopadhyay is an Assistant Professor in the Electrical Engineering department at IIT Delhi. He is also associated with the School of Artificial Intelligence, Bharti School of Telecommunication Technology and Management, and the Centre of Excellence in Cyber Systems and Information Assurance at IIT Delhi. His research interests include theoretical machine learning and operations research, communication, signal processing networks, and cyber-physical systems.

Talk Overview:
Recent research in the security of cyber-physical systems (CPS) has yielded noteworthy advancements in safeguarding these interconnected systems against cyber threats. This area of study encompasses various efforts aimed at protecting critical infrastructure, industrial control systems, and autonomous vehicles from malicious attacks. Researchers have focused on developing innovative intrusion detection and prevention systems tailored to the unique challenges posed by CPS environments. Leveraging advanced machine learning algorithms and real-time monitoring, these systems effectively identify and mitigate cyber threats. Moreover, cryptographic techniques and secure communication protocols are being integrated into CPS deployments to enhance data integrity, confidentiality, and authenticity. Encryption, digital signatures, and secure key management mechanisms are employed to fortify CPS against unauthorized access and cyber attacks. Additionally, efforts are directed towards devising resilient CPS architectures and control strategies capable of withstanding cyber-physical attacks while maintaining system functionality. Fault-tolerant designs, redundancy mechanisms, and adaptive control algorithms are being developed to mitigate the impact of cyber incidents on CPS operations. Overall, recent research endeavors are paving the way for enhanced cybersecurity measures to safeguard critical infrastructures and industrial processes in our increasingly digitized world. Collaboration between academia, industry, and government stakeholders remains essential to further advance the resilience and security of CPS against emerging cyber threats.

Polymer-Ceramic Nanocomposites for Flexible Dielectric Materials and its Application

Speaker: Sunil Kumar
Designation: Post-Doctoral Fellow
Department: SIRE
Affiliation: IIT Delhi

Speaker Bio: Sunil Kumar is currently working as an Assistant Professor at the University Department of Electronic Science, Babasaheb Bhimrao Ambedkar Bihar University, Muzaffarpur, Bihar. He was a postdoctoral Fellow at the School of Interdisciplinary Research, IIT Delhi. He received a Ph.D. Degree from Indian Institute of Technology Patna in 2019. He received a B.Sc. (Hons.) degree in electronics from Magadh University, Bodhgaya, Bihar, India, in 2007 and an M.Sc. in electronics science from DAVV, Indore, India, in 2009. His research interests are Polymer-Ceramic nanocomposites, Electro-thermal Modulated dielectric elastomer actuators for Soft Robotic Applications, and soft robotics. He has published 32 international journals and 16 conference proceedings.

Talk Overview:
The talk delves into the utilization of polymer-ceramic nanocomposites for flexible dielectric materials and their wide-ranging applications. These materials offer unique properties and versatility, making them suitable for various industries. The speaker emphasizes the importance of flexible dielectric materials in modern technologies, particularly in fields like electronics, telecommunications, and energy storage. The presentation outlines the fabrication process of polymer-ceramic nanocomposites, highlighting the integration of ceramic nanoparticles into polymer matrices to enhance dielectric properties while maintaining flexibility. These nanocomposites exhibit improved mechanical strength, thermal stability, and electrical insulation, making them ideal for flexible electronic devices and components. Furthermore, the talk explores the diverse applications of these materials, including flexible printed circuit boards, wearable electronics, sensors, and energy storage devices. The speaker discusses recent advancements in research and development, showcasing examples of innovative solutions enabled by polymer-ceramic nanocomposites. Overall, the presentation underscores the significant potential of polymer-ceramic nanocomposites in revolutionizing flexible dielectric materials and driving advancements in various technological domains. Through continued research and innovation, these materials hold promise for addressing current challenges and unlocking new opportunities in flexible electronics and beyond.

iHub-Anubhuti: TiH in "Cognitive Computing and Social Sensing" at IIIT-Delhi

Speaker: Pushpendra Singh
Designation: Professor
Department: Computer Science and Engineering
Affiliation: IIIT-Delhi

Speaker Bio: Pushpendra Singh, a faculty at IIIT-Delhi's Computer Science and Engineering and Human-Centered Design departments, is the Project Director of the Technology Innovation Hub in "Cognitive Computing and Social Sensing" and Dean of Academic Affairs. A PhD graduate from Inria-Rennes, France, his work, notably funded by organizations including the Bill and Melinda Gates Foundation, focuses on HCI, Mobile Systems, ICT for Development, and has led to impactful industry transfers and startups.

Talk Overview:
The talk on "iHub-Anubhuti: TiH in Cognitive Computing Social Sensing" at IIIT-Delhi highlighted groundbreaking research and innovation in the realm of cognitive computing and social sensing. The iHub-Anubhuti aims to harness the power of cutting-edge technologies to address societal challenges and enhance the quality of life. The session delved into the utilization of cognitive computing techniques, such as artificial intelligence and machine learning, to analyze vast amounts of social data in real-time. By leveraging these technologies, researchers can gain valuable insights into human behavior, sentiment analysis, and social trends, paving the way for informed decision-making and proactive interventions. Furthermore, the integration of social sensing methodologies enables the collection of data from various sources, including social media platforms and IoT devices, to create a comprehensive understanding of the social landscape. This holistic approach facilitates the identification of patterns, correlations, and anomalies, offering invaluable knowledge for policymakers, researchers, and community stakeholders. The talk emphasized the collaborative nature of the iHub-Anubhuti, promoting interdisciplinary partnerships and knowledge exchange to drive meaningful impact. By fostering innovation and knowledge dissemination, IIIT Delhi continues to push the boundaries of cognitive computing and social sensing, shaping a more informed and connected society.

Decentralised Control for A Group of Distributed Robots to Perform Collaborative Tasks

Speaker: Ou Ma
Designation: Professor
Department: Aerospace Engineering and Engineering Mechanics
Affiliation: University of Cincinnati, Ohio

Speaker Bio: Ou Ma is directing the Intelligent Robotics and Autonomous Systems (IRAS) Laboratory at UC. Ou does research in Aerospace Engineering, Mechanical Engineering and Biomechanics Engineering. His current research projects involve system dynamics and intelligent control of robotic systems for aerospace robotics, smart manufacturing, and healthcare.

Talk Overview:
The talk on "Decentralised Control for A Group of Distributed Robots to Perform Collaborative Tasks" explored the cutting-edge research and innovations in the field of robotics and decentralized control systems. The focal point of the discussion was the development of control mechanisms that enable a group of distributed robots to seamlessly collaborate in performing complex tasks. The session shed light on the significance of decentralization in robotic systems, emphasizing the ability of individual robots to make autonomous decisions while collectively achieving common objectives. By leveraging decentralized control strategies, these robots can navigate dynamic environments, adapt to changing conditions, and synchronize their actions without relying on a centralized command structure. Furthermore, the talk delved into the intricate algorithms and communication protocols essential for enabling seamless coordination among distributed robots. This involves the exchange of information, task allocation, and real-time decision-making, all while ensuring robustness, fault tolerance, and scalability in the face of uncertainties and adversities. The collaborative nature of the research underscores the interdisciplinary efforts aimed at bridging the gap between robotic systems, control theory, and distributed computing. Through this convergence, the potential applications span various domains, including search and rescue missions, environmental monitoring, autonomous manufacturing, and space exploration.

Technology Innovation Hub at IISc Bangalore

Speaker: Amrutur Bharadwaj
Designation: Professor
Department: Electronics and Communication Engineering
Affiliation: IISc Bangalore

Speaker Bio: Bharadwaj Amrutur is a Professor in the Electronics and Communication Engineering Department at IISc Bangalore. He is also the Chairman of the Robert Bosch Center for Cyber Physical Systems. He completed his BTech in Computer Science and Engineering from IIT Bombay in 1990, MS and PhD in Electrical Engineering from Stanford University in 1994 and 1999. His research theme is Large Scale IoT Enabled Systems, Collaborative Robotics

Talk Overview:
The talk on the Technology Innovation Hub at the Indian Institute of Science (IISc) Bangalore provided a comprehensive overview of the institution's pioneering endeavors in fostering technological innovation, interdisciplinary research, and industry collaboration. The hub serves as a catalyst for driving cutting-edge research and translating knowledge into impactful solutions. The discussion highlighted the multidisciplinary nature of the Technology Innovation Hub, emphasizing its role in bridging the gap between academia and industry. By fostering a collaborative ecosystem, the hub facilitates seamless knowledge transfer, technology commercialization, and the incubation of startups, thereby propelling the translation of research outcomes into real-world applications. Moreover, the talk underscored the hub's emphasis on addressing grand societal challenges through technological advancements. This includes leveraging emerging technologies such as artificial intelligence, machine learning, and advanced materials science to devise sustainable solutions in critical areas like healthcare, energy, environment, and urban development. The collaborative ethos of the hub was a focal point, emphasizing partnerships with industry, government agencies, and international institutions to drive innovation and entrepreneurship. This collaborative framework not only accelerates the pace of technological advancement but also nurtures a vibrant ecosystem for nurturing talent and fostering a culture of innovation.

Some Numerical Techniques for Solving Polynomial Equations and Their Applications in Robot Kinematics

Speaker: Anirban Nag
Designation: Post-Doctoral Fellow
Department: SIRE
Affiliation: IIT Delhi

Speaker Bio: Anirban Nag is currently Assistant Professor at IIEST Shibpur, specializing in Parallel Robotic Manipulators and mechanism design. He earned his Ph.D. from IIT Madras' Department of Engineering Design in 2020, an M.Tech in Mechatronics from IIEST Shibpur in 2013, and a B.Tech in Instrumentation and Control Engineering from the Calcutta Institute of Engineering and Management in 2011. He has authored published and co-authored several journals and conferences.

Talk Overview:
The presentation on numerical techniques for solving polynomial equations and their applications in robot kinematics explored the intersection of mathematics and robotics, focusing on innovative methods to address complex problems in robot motion planning and control. The talk delved into various numerical methods, such as Newton's method, bisection method, and polynomial interpolation, highlighting their efficacy in solving polynomial equations typically encountered in robot kinematics. These techniques enable engineers and researchers to calculate joint angles, position vectors, and trajectory planning with precision and efficiency. Moreover, the discussion emphasized the practical applications of these numerical techniques in robot kinematics, showcasing how they streamline the design and operation of robotic systems. By leveraging accurate polynomial solutions, robots can navigate intricate tasks, optimize movement sequences, and enhance overall efficiency in various industrial and research settings. The presentation underscored the significance of numerical methods in overcoming the inherent complexities of robot kinematics, including inverse kinematics and path planning. By employing these techniques, researchers can model robotic movements, optimize manipulator configurations, and ensure seamless interactions between robots and their environments.

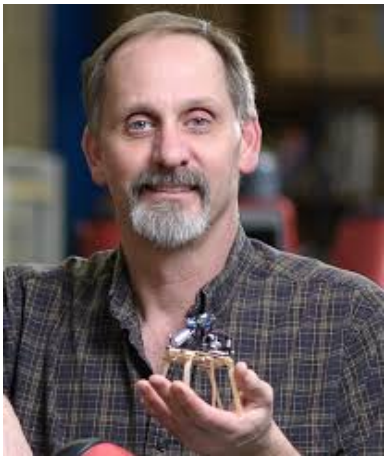
On Surgical Robotics

Speaker: Sunita Chauhan
Designation: Professor
Department: Mechanical and Aerospace Engineering
Affiliation: Monash University, Australia

Speaker Bio: Sunita Chauhan held the positions of Professor and Director of Robotics and Mechatronics Engineering at Monash University, Australia for almost a decade. She is also a member of several prestigious professional organizations, such as senior member-IEEE and its Robotics Automation Society, life member-IACAS, member of UIA and ISTU and SPIE (past). Her current research interests include: Medical/Surgical Robotics (comprising state of the art surgical assist technologies such as Computer Assisted and Integrated Surgery (CAS/CIS) systems including safety driven design, development (using both subtractive and additive manufacturing) and intelligent control of novel medical/surgical robotic systems for minimally invasive and non-invasive surgery, Robotic exoskeletons, Intern-replacement, system safety, etc.); Surgical training and automated assessment using AI based deep-learning methodologies; Intelligent Diagnostics and Robotics in Infrastructural Healthcare for inspection and proactive maintenance (Railways, Aerospace, Defence, Agriculture, Buildings, Solar farms, etc.)

Talk Overview:
The presentation on surgical robotics offered a comprehensive overview of the transformative role of robotics in the field of surgery, highlighting technological advancements, applications, and the impact on patient care and surgical outcomes. The talk delved into the evolution of surgical robotics, underscoring the convergence of engineering, computer science, and medicine in developing highly sophisticated robotic systems. These systems enable surgeons to perform minimally invasive procedures with enhanced precision, dexterity, and visualization, thereby minimizing trauma to patients and accelerating recovery. The discussion emphasized the diverse applications of surgical robotics across multiple surgical specialties, including general surgery, urology, gynecology, and neurosurgery. From complex tumor resections to intricate microsurgery, robotic systems have expanded the scope of what is achievable in the operating room, paving the way for innovations in surgical techniques and patient care. Furthermore, the presentation highlighted the potential for enhancing surgical education and training through simulation-based learning using robotic platforms. Surgeons can hone their skills in a controlled environment, leading to improved proficiency and patient safety in clinical practice. The talk also addressed the ongoing research and development in the field, exploring concepts such as haptic feedback, autonomous navigation, and integration with advanced imaging modalities to further augment the capabilities of surgical robotics.

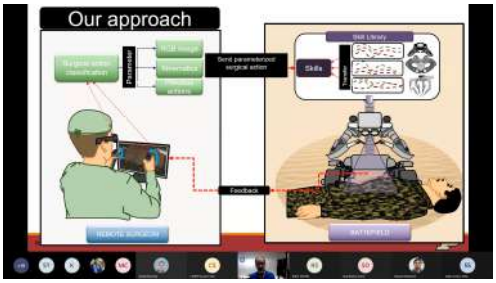
Semi-Autonomous Robotics Surgery



Speaker: Richard Voyles
Designation: Professor
Department: Engineering Technology
Affiliation: Purdue University

Speaker Bio: Head of the Collaborative Robotics Lab at Purdue and Director of the Robotics Accelerator, Prof. Voyles knows robots! With expertise in electrical engineering, mechanical engineering, and computer science, Dr.Voyles' research interest include novel robotic mechanisms, sensors, self-adaptive software, real-time control, and gesture-based human/robot interaction. His professional experience includes IBM, Avanti Optics, Integrated Systems and Dart Controls, tenured academic positions at the University of Minnesota, University of Denver, and Purdue University, positions with the federal government including leading the National Robotics Initiative at the National Science Foundation, and Assistant Director for Robotics and Cyber-Physical Systems at the Office of Science and Technology Policy at the White House, and Board of Director positions on The Works, Easton Family Foundation, Minnesota Virtual Simulations, and Mark V Automation. His formal training includes the PhD in Robotics from Carnegie Mellon University, MS in Manufacturing Systems Engineering from Stanford University, and BS in Electrical Engineering from Purdue.

Talk Overview:
The talk delves into semi-autonomous robotic surgery, focusing on teleoperation with delays. It highlights the benefits of minimally invasive surgery and the rise of robotic surgery, exemplified by the da Vinci surgical robot. The main challenge addressed is the cost and network constraints of direct teleoperation. The proposed solution involves simulation and machine learning to create a semi-autonomous system. The remote surgeon operates through a virtual reality interface, with the robot learning from the surgeon's actions to perform tasks autonomously, especially with network delays. Surgical training using simulated robots and skill transfer between platforms are demonstrated for tasks like debridement and crike. The presentation emphasizes improving healthcare accessibility, particularly in austere environments. Advanced robots, like the "super Baxter," equipped with tactile sensors, are used for tasks requiring tactile sensing. Results indicate the simulator-based approach's usability even with delays, tolerating delays up to 7.5 seconds before becoming unworkable. Future work includes developing and testing surgical tasks and extracting surgical style. During the QA session, security in remote operations and handling individual variations in surgeries are discussed. The goal is to achieve full autonomy in surgical tasks while maintaining human oversight. The session concludes with audience appreciation.



Simulation Assisted Product Lifecycle

Speaker: Xavier Cyril
Designation: Co-Founder
Department: Controls, Simulation and Training
Affiliation: TesFlo Inc.

Speaker Bio: Currently, Xavier is a Senior Director (Operations) at L3 MAPPS Inc. He is responsible for managing several Engineering, Program Management and Operations departments at L3 MAPPS Inc. He has managed projects and products for Nuclear Power Plant Controls and amp; Simulation; Space and Medical Simulation; Submarine Controls and Simulation; VR and Simulation Software Technologies. He completed his Ph.D. (with Deans Honor) and M.Eng. from McGill University and BE from Bangalore University. Xavier has 30+ years of experience in the industry and has published 50+ technical articles including 10 in journals

Talk Overview:
The seminar on "Simulation Assisted Product Lifecycle" provides a comprehensive overview of simulation's pivotal role in various stages of product development, from conceptualization to maintenance. The speaker emphasizes the importance of considering simulation early in the product lifecycle to facilitate rapid development, collaboration, and cost analysis. Orchid, a graphical-based simulation environment, is introduced as a tool to empower engineers to develop simulations without coding, thus enabling them to focus on system engineering and leverage their expertise effectively.Throughout the presentation, the speaker illustrates the versatility of simulation across domains such as engineering, space, medical, and training. Simulation aids in conceptualization, performance analysis, and iterative design improvements. Examples of simulators developed by the speaker, including those for the International Space Station and endoscopic surgery, demonstrate the diverse applications of simulation technology. Furthermore, the seminar delves into the benefits of open-source tools, immersive technologies, and the importance of well-defined requirements in simulation development. The QA session addresses concerns about project delays due to simulation integration and underscores the need for flexible integration without impeding product development.The speaker highlights the role of simulation in building confidence in engineering projects through validation processes involving analytical, experimental, and real data validation. Moreover, the challenges in simulation, such as real-time effects and accurate modeling, are discussed, along with various simulation technologies like Unity, Cry Engine, and OpenGL.Overall, the seminar elucidates simulation's significance in optimizing designs, understanding complex systems, and driving innovation across diverse fields, underscoring its indispensable role in modern product development processes.

Healthcare Simulation Science, a Research Agenda for the next 10 years

Speaker: David Marko Hananel
Designation: Director Department: Department of Surgery
Affiliation: University of Washington

Speaker Bio: David is Director at Center for Research in Education and Simulation Technologies, Department of Surgery, University of Washington School of Medicine. Along with it he is an Executive V.P., Chief Technology Officer at Simagine Health, Inc. and also the Assistant Teaching Professor, Division of Healthcare Simulation Science at University of Washington School of Medicine. He completed his Bachelor of Science in Electrical Engineering from Technische Universität Berlin in Germany and Bachelor of Arts in Computer Science from Southern Illinois University at Carbondale, Illinois. David has 30+ years of experience not only in the education sector but also in the industry. David has 25+ publications in journals, books, posters, etc.

Talk Overview:
Dr. David Hannanel from the University of Washington underscores the pivotal role of healthcare simulation in training medical professionals, enhancing patient safety, and addressing workforce shortages. He outlines the development process, stressing the need for identifying learning gaps, designing educational methods, and validating outcomes. Highlighting simulation's evolution from technology demonstration to comprehensive educational tool, he emphasizes interdisciplinary collaboration and common language among fields. Open-source initiatives like Sofa VR and Moses software contribute to advancements. During QA, he discusses simulation's potential in disease study and medicine's future, focusing on tissue interaction and haptic feedback. The growth of simulation is evident through increased research publications. Challenges include eliciting desired behaviors from learners and improving accuracy. He introduces initiatives like Sofa VR and Moses software, emphasizing modularity and interoperability. The QA session explores simulation's potential in disease study, challenges in physical and VR simulations, and future opportunities. Dr. Hannanel clarifies the focus on in silico trials and physiological modeling. He discusses advantages and limitations of physical and VR simulations, ongoing research in diseases like sepsis, and future challenges like improving tissue properties and collaboration with industry. The ultimate goal remains accurately replicating the human body in simulation, regardless of medicine's future evolution.

Man-machine Collaboration in Computational Creativity

Speaker: Roy de Kleijn
Designation: Assistant Professor
Department: Computer Science and Engineering
Affiliation: Leiden University, Netherlands

Speaker Bio: Roy de Kleijn is a computer scientist and cognitive psychologist interested in both how interaction with artificial agents affects human behavior, as well as how the human brain can inspire the design of artificial agents. His current research interests are evolutionary robotics, deep reinforcement learning, and human-robot interaction. He is an assistant professor at Leiden University where he lectures in both the BSc Artificial Intelligence and the BSc Psychology programs.

Talk Overview:
Creating agents that generate creative artifacts requires the use of a reward or fitness function that quantifies the quality of the created artifacts in terms of creativity, originality, visual pleasantness, etc. In this talk, he will discuss some recent experiments that he has done using Neatures, an evolutionary robotics implementation that produces visual artifacts in the form of a canvas. Manipulating the sensory input of the agent's own generated canvas results in different types of art produced. Further, he will explore the implications of these findings for both the field of artificial intelligence and the broader domain of art. By analyzing the aesthetics of the generated images and the underlying decision-making processes of the agents, the talk aims to shed light on how AI can enhance artistic creativity and possibly redefine the boundaries of art. The potential for AI to not only replicate but also to innovate and inspire new art forms is at the heart of this research. In addition to the technical discussion, he will address the ethical considerations and the future of human-AI collaboration in creative domains. As AI systems become more capable of producing complex and appealing art, questions about authorship, creativity, and the value of art created by non-humans become increasingly pertinent. He will propose frameworks for understanding and integrating AI-driven creativity in traditional art contexts and discuss potential guidelines for crediting AI contributions in artistic works. This comprehensive examination not only highlights the capabilities of evolutionary robotics in art but also prompts a reevaluation of the role of artificial intelligence in creative industries. By the end of this talk, attendees will got a richer understanding of how AI is transforming the art world and the complex interactions between technology, creativity, and aesthetics.

Modelling and Control of Self-Reconfigurable Mobile Robots

Speaker: Madan Mohan Rayguru
Designation: Assistant Professor
Department: Electrical Engineering
Affiliation: Delhi Technological University, DTU

Speaker Bio: Madan Mohan Rayguru is working as an Assistant Professor in the Electrical Engineering department of Delhi Technological University. Prior to that, he was a Research Fellow in the Engineering Product Development Pillar at Singapore University of Technology and Design (SUTD). He received his Ph.D. degree in Control Systems from the Indian Institute of Technology, Delhi, India. He received his master's degree in Control and Automation from the National Institute of Technology Rourkela, and a B.Tech in Electrical Engineering from the Biju Patnaik University of Technology, Rourkela, India. His research interests include Control of Modular Reconfigurable Robots, Convergent Systems, Nonlinear Systems with Timescales, and Saturated Controller Design.

Talk Overview:
The talk on "Modelling and Control of Self-Reconfigurable Mobile Robots" explores the latest advancements in robots that autonomously change their structures to adapt to different tasks and environments. These robots are invaluable in dynamic settings like space exploration, search and rescue operations, and complex industrial processes. The speaker begins by outlining the mathematical and computational frameworks used to simulate the physical dynamics of self-reconfigurable robots. This includes discussing kinematic and dynamic models that predict robot movements and interactions with their environments, which are essential for developing effective control systems. Control strategies form a significant part of the presentation, highlighting various mechanisms that enable the robots to autonomously reconfigure and adapt their functionalities in real time. This includes distributed control systems that allow robot modules to communicate and coordinate actions independently, thus enhancing local decision-making capabilities. The talk also addresses challenges such as scalability, energy efficiency, and the robustness of inter-module connections. Solutions presented involve the use of novel materials and advanced algorithms to improve performance and reliability. In conclusion, the speaker emphasizes the transformative potential of self-reconfigurable mobile robots across multiple industries and discusses the future implications of integrating further innovations in AI and machine learning. The presentation wraps up with a call for interdisciplinary collaboration to push the boundaries of robotics research further, highlighting the ongoing need for innovation in this rapidly evolving field.

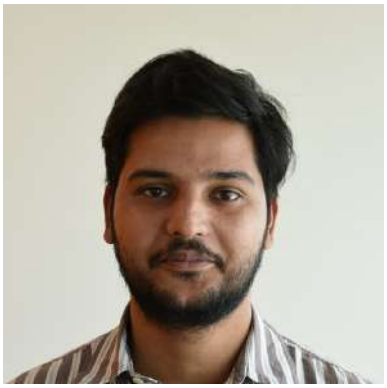
Product Innovation: Idea to Impact (Stories and Lessons from Med-Tech Sector)

Speaker: B. Ravi
Designation: Professor
Department: Mechanical Engineering
Affiliation: IIT Bombay, India

Speaker Bio: B. Ravi is an Institute Chair Professor of Mechanical Engineering at IIT Bombay. He is well known for his work in metal casting through AutoCAST, E-Foundry and SMART Foundry projects. In 2014 he set up BETIC – Biomedical Engineering & Technology Innovation Centre, whose team members developed and patented 50+ medical devices, incubated 16 startup companies, licensed several products to industry, and won many prestigious awards. In 2019, he took over as the head of DS School of Entrepreneurship, which has trained over 2000 students in entrepreneurship and led to over 30 start-ups during the last five years. As a member of governing or advisory councils of several institutes and expert committees of various government agencies, Prof. Ravi also contributes to project reviews, policies and practices related to translational research, product innovation and entrepreneurship.

Talk Overview:
There is immense potential to develop novel and affordable products for unmet needs in various sectors by leveraging new technologies such as smart sensors, robotics, machine learning and the Internet of Things. This requires team members with complementary backgrounds, along with a systematic process to navigate the 'valleys of death' between idea, invention, innovation and impact. In particular, translation of research prototypes into marketable products that meet the target quality and cost requires the attention of all stakeholders. In this talk, we narrate real-life stories of novel medical devices such as smart stethoscope developed at BETIC and offered to the end-users by incubating startup companies. The process involves four stages: unmet need identification with users, product development by engineers, testing by entrepreneurs and commercialization supported by investors. The best practices for creating success stories of 'Made in India' by building a supportive eco-system will also be highlighted based on the experience gained at IIT Bombay and partner institutes.

Bin Picking in Mobile Robotics (iCoboTalk)



Speaker: Sarthak Upadhyay
Designation: Senior Engineer
Affiliation: Addverb Technologies

Speaker Bio: Senior Manager working on Vision and perception and formerly worked as Research Assistant at IIT Hyderabad with Robotics research Lab

Talk Overview:
Sarthak Upadhyay from Addverb Technologies' Mobile Robotics team discussed the complexities of 3D bin picking, a field propelled by Amazon's challenge and involving object recognition, picking, and placement in varied shapes and cluttered environments. Their approach integrates computer vision and robotics using an overhead sensor and a collaborative robot (cobot). Key processes include calibration, spatial alignment, and bin detection, starting with simple box shapes and using cost-effective sensors like RGBT or Kinect. The system utilizes point cloud and image processing to enhance object detection, segmentation, and pose estimation, specifically overcoming challenges with similar-colored objects through neural network-based edge detection and object masking. Upadhyay's presentation detailed their use of neural networks, incorporating techniques like fusion of algorithm outputs, and integration of Fuse Net for better object boundary recognition. Features such as squeeze and excitation layers improve feature scaling and information weighting. Their intelligent system, designed with a modular architecture, allows for rapid prototyping, integration with different robotic systems, and customization. Future goals include creating a generalized detection module, employing lifelong learning, and moving towards cloud deployments. Challenges such as handling transparent or fragile objects and optimizing for real-world applications were also discussed, along with potential enhancements using event cameras and cost-effective hardware adaptations.

Robot Design Concepts for Intuitive Physical human-robot interaction: Leveraging the Basic Principles of Mechanics

Speaker: Clément Gosselin
Designation: Professor
Department: Mechanical Engineering
Affiliation: Laval University, Canada

Speaker Bio: Clément Gosselin received the B. Eng. degree in Mechanical Engineering from the Université de Sherbrooke, Canada, and the Ph.D. degree from McGill University, Canada. He was then a post-doctoral fellow at INRIA in Sophia-Antipolis, France. he was then appointed by the Department of Mechanical Engineering at Université Laval, Québec where he has been a Full Professor since 1997. His research interests are kinematics, dynamics and control of robotic mechanical systems with a particular emphasis on the mechanics of grasping, the kinematics and dynamics of parallel manipulators and design and development of human-friendly robots.

Talk Overview:
Robots have been used in industrial manufacturing for decades. Working in highly structured environments, they perform a wide variety of tasks such as assembly, painting, machine tending, logistics and many others. More recently, robots have been introduced in more complex environments and, in particular, in applications that involve physical interactions with human beings such as collaborative manufacturing, rehabilitation, assistance and others. Physical human-robot interaction (pHRI) aims at taking advantage of the complementary capabilities of robots and humans. One of the key challenges in pHRI is to provide a high-bandwidth human-robot interaction that is safe and intuitive for the human user. To this end, it is proposed in this work to focus on the basic principles of mechanics and revisit the design of robots in order to provide a low-impedance mechanical interaction. The concept of macro-mini robotic system is used and applied to interactive robotic devices. Also, the design of backdrivable redundant parallel robots is considered. In this concept, parallel robots are used to provide backdrivability while kinematic redundancy is introduced to increase the rotational workspace of parallel mechanisms, by alleviating the singularities. Solutions based on passive or active human-robot interfaces are proposed and examples of implementations are described. Prototypes of robotic systems developed at Université Laval based on the above concepts are demonstrated.

Mobile Robots - The upcoming rovers in the mobility space (iCoboTalk)

Speaker: Varun Jain
Chief Manager,
Mobile Robotics,
Addverb Technologies

Speaker Bio: Varun Jain is one of the pillars and impactful members of the Mobile Robotics team at Addverb Technologies. He is a maestro in mobile robotics, with expertise in the field of vehicle dynamics control and driver assistance systems. He pursued his research journey from Fraunhofer ITWM and the University of Kaiserslautern, Germany where he worked in the field of system modeling optimization and model predictive control. Varun has done his Mechanical Automation Engineering from Maharaja Agrasen Institute of Technology and completed his MS in Commercial Vehicle Technology from the University of Kaiserslautern, Germany. He worked for 2 years with ZF Group, an automotive company in Germany. In Jan 2018, he started working for Elektronische Fahrwerksysteme GmbH, Audi AG. Here he contributed to the development of path planning and control algorithms for highway piloted driving. He joined Addverb in March 2020 as a Chief Manager in the Mobile Robotics Team. As an automation enthusiast, he is developing mobile robots for warehouse automation to solve diverse problems in intralogistics operations and leading one of the largest teams at Addverb. Varun is continuously raising the bar by frequently proposing the latest developments in the field for the products in the Mobile Robots portfolio.

Talk Overview:
Mobile robotics is a complex, interdisciplinary field that intersects several branches of engineering and science, including electrical engineering, mechanical engineering, computer science, cognitive science, and social science. This domain focuses on the design and creation of autonomous robots that have the capability of movement, which is integrated with advanced technologies in artificial intelligence, vision, and various sensing modalities. The utility of mobile robots is expansive, spanning across several industries and applications such as surveillance, guidance systems, transportation, entertainment, and even critical medical applications, signaling a rapidly growing market with significant potential. The current discussion is centered on the latest advancements in the development and experimental validation of intelligent control techniques specifically tailored for autonomous mobile robots. These robots are engineered to independently plan and execute a wide range of tasks within controlled environments. The session also aims to address recent developments in mobile robotics research, delving into innovative solutions and technologies that have emerged in the field. Additionally, it seeks to enhance academic and practical understanding of the core challenges typically encountered in mobile robotics, such as navigation, obstacle avoidance, task allocation, and interaction with humans and other robots in dynamic environments. This comprehensive focus not only highlights the technological innovations but also underscores the multidisciplinary approach necessary for advancing the capabilities of mobile robots in complex real-world scenarios.

Magnetoelectric Nanorobot - A Revolutionary Device for Targeted Treatment

Speaker: Soutik Betal
Designation: Assistant Professor
Department: Electrical Engineering
Affiliation: IIT Delhi

Speaker Bio: Soutik Betal is currently working as an assistant professor in the department of Electrical Engineering, IIT Delhi, India. He received his PhD in Electrical Engineering from University of Texas at San Antonio, Texas, USA and further completed his postdoctoral research from Alfred University, New York,USA, University of Maryland-Baltimore County, USA and Czech Academy of Science, Prague, Czech Republic.

Talk Overview:
The presentation revolves around the development of nanorobots with the capacity for targeted drug delivery and precise cellular manipulation. These nanorobots exploit magnetoelectric principles, capitalizing on their ability to generate electric fields through the application of magnetic fields. The innovative technology enables several functions, including the creation of nanopores in cell membranes for therapeutic purposes. The core focus of this technology is its potential for targeted cancer treatment, among other medical applications. The nanorobots possess a unique architecture comprising a core-shell structure, utilizing materials like cobalt ferrite and barium titanate. By leveraging AC magnetic fields, the nanorobots can generate localized AC electric fields that facilitate actions such as opening nanopores on cancer cell membranes. One of the key advantages highlighted is the potential for highly specific cancer treatment, which could minimize cytotoxicity and adverse effects associated with traditional chemotherapy. The ability of the nanorobots to differentiate between cancer cells and healthy cells, based on their distinct relaxation and excitation times, is particularly emphasized. This differentiation allows the nanorobots to selectively target cancer cells while avoiding healthy ones. The presentation also addresses safety concerns, noting that the nanorobots operate within a safe range of magnetic and electric fields that do not cause harm to the body's biological components. Additionally, the nanorobots are designed to exit the body after their intended tasks, primarily through sweat and the skin's natural mechanisms. Future applications are discussed, such as potential usage for regenerating neuronal pathways in conditions like Alzheimer's and Parkinson's diseases. The speaker envisions a scenario where freshly flowing cells through compromised neuronal pathways could aid in the regeneration of neural connections. While cognitive enhancement is raised as a query, it is suggested that the current technology may not be particularly influential in that specific area.

Warehouse Automation: A Human-Robot Collaboration (iCoboTalk)

Speaker: Satish Shukla
Designation: Cofounder and Head, Marketing
Affiliation: Addverb Technologies

Speaker Bio: Mr. Satish Shukla is the Cofounder and Head of Marketing HR at Addverb. He is responsible for establishing unique people practices at one of the largest and most automated paint factory in the world. He also did a cross-functional stint in Supply Chain and looked after Emulsion Processing as Manager, Production. He co-founded Addverb Technologies in June 2016 and has extensive experience in Order Picking Technologies, Industrial IoT Solutions, Robotic Solutions and Industry 4.0 technologies.

Talk Overview:
Warehouse automation is revolutionizing the logistics industry by enhancing efficiency, accuracy, and overall operations. The symbiotic relationship between humans and robots in warehouses is reshaping traditional practices. Collaborative robots, or cobots, are designed to work alongside human employees, optimizing productivity and safety. Through this partnership, tasks such as order picking, packaging, and inventory management are streamlined and accelerated. One key aspect of human-robot collaboration in warehouses is the division of labor based on strengths and capabilities. While robots excel in repetitive, precise tasks, humans contribute their problem-solving skills and adaptability. Together, they form a cohesive team that maximizes output and minimizes errors. Moreover, the implementation of advanced technologies like artificial intelligence (AI) and machine learning enables robots to learn from human interactions and improve their performance over time. This continuous learning loop enhances the overall efficiency of warehouse operations and contributes to a dynamic, responsive environment. As warehouse automation continues to evolve, the focus shifts towards creating a seamless integration between humans and robots, fostering a harmonious working environment that capitalizes on the strengths of both entities. This collaborative approach not only enhances productivity but also opens up new opportunities for innovation and growth in the logistics industry.

Practical DeepTech Use Cases in Airline and Public Safety Sectors (iCoboTalk)

Speaker: Sanjeev Thukral
Designation: CEO, neurIOT Technologies LLP

Speaker Bio: Sanjeev is the CEO of neurIOT, a leading provider of Artificial Intelligence and Internet of Things solutions. Sanjeev is a Bachelor of Technology in Electrical Engineering from IIT Delhi with an MBA and has close to 3 decades of experience in providing technology, business development, operational and strategic growth leadership within the ICT industry. For the last 8 years, Sanjeev and the neurIOT team have been focused on building AI solutions across healthcare pharmaceuticals, manufacturing, transportation logistics and policing industries with many successful assignments to his credit. neurIOT's recent projects include computer vision solutions for making airline operations more efficient, profiling of healthcare professionals for pharmaceutical companies using NLP, computer vision and graph theory and extraction of Modus Operandi from FIR data followed by clustering to identify criminals for National Crime Records Bureau (NCRB).

Talk Overview:
In the airline and public safety sectors, Practical DeepTech, including technologies like artificial intelligence, machine learning, and advanced data analytics, is driving significant advancements and innovations. Specifically tailored to these industries, DeepTech is being leveraged in diverse use cases to enhance safety, efficiency, and decision-making processes. In the airline sector, DeepTech applications are streamlining operations, from predictive maintenance to route optimization. Using AI and machine learning, airlines can predict equipment failures before they occur, ensuring aircraft are in optimal condition. Additionally, DeepTech is utilized in optimizing flight routes by analyzing vast amounts of data to minimize fuel consumption and reduce environmental impact. In public safety, practical DeepTech use cases include predictive crime analytics, emergency response optimization, and intelligent surveillance systems. Deep learning algorithms enable law enforcement agencies to anticipate crime hotspots and allocate resources accordingly. Furthermore, advanced analytics and real-time data processing enhance emergency response systems, improving efficiency and ultimately saving lives. Intelligent surveillance systems equipped with DeepTech capabilities enhance security measures, augmenting threat detection and accelerating response times. Overall, practical DeepTech use cases in the airline and public safety sectors are driving transformative changes, improving safety, operational efficiency, and resource allocation. As technology continues to evolve, these sectors will experience continued advancements, ultimately enhancing the safety and well-being of individuals and communities.

Frequency Modulated Continuous Waves (FMCW) - A new paradigm for radar-sensors

Speaker: Chinmoy Bhattacharya
Designation: Retired Scientist
Department: Sensor Data Analysis Lab
Affiliation: DRDO, Pune

Speaker Bio: Chinmoy Bhattacharya received Master's degree in Electronics and Telecommunication Engineering and PhD degree in Computer Sciences and Engineering in 1994 and 2004, respectively, all from Jadavpur University, Kolkata. He joined Defense Electronics Applications Lab (DEAL), Dehradun as a scientist 'D' in December 1996. Prior to that, he was a faculty in Birla Institute of Technology and Sciences (BITS), Pilani from 1994 to 1996. From March 2009 – February 2015 he was heading the Department of Electronics Engineering, Defence Institute of Advance Technology (DIAT), Pune as scientist 'F' and later as scientist 'G'. From March 2015 –January 2020, he was the group director,initiation technology (INIT) group in Armament Research and Development Establishment (ARDE), Pune. He is currently active in designing compact 3-D ground based microstrip antennas readily usable with miniaturized FMCW radar sensors. His research interests include synthetic aperture radar (SAR), digital telemetry, radar clutter modelling, etc. He is a senior member (SM) of IEEE signal processing society, USA from 2010 and the first recipient of the best researcher award of DIAT in 2014.

Talk Overview:
This talk provides an overview of the significant advancements in FMCW-based radar technology, particularly focusing on their miniaturization and enhanced capabilities at Ka-band and nearing W-band frequencies. Traditionally used in military and automotive applications, these radars have evolved to include diverse waveform and advanced signal processing technologies, paving the way for new applications in high-resolution imaging. FMCW radars are now utilized for generating detailed aerial synthetic aperture radar (SAR) images with lower RF power than pulsed-radar systems, making them more efficient and cost-effective. Recent adaptations have extended their use to ground-based SAR (GB-SAR), Arc-SAR, and ground penetrating radars (GPR) for environmental monitoring tasks such as slope monitoring, landslide detection in coal mines, and avalanche prediction. The integration of these radars with drone and ground-based systems highlights their increased accessibility and flexibility in data collection, essential for real-time analysis and rapid response in emergent situations. The presentation underscores the role of FMCW radars in civil engineering, urban planning, and emergency management, emphasizing their potential to improve infrastructure resilience and safety. The talk aims to showcase the ongoing innovations in radar technology and their growing impact across various sectors.

Healthcare As Homecare

Speaker: Jayanta Mukhopadhyay
Designation: Professor
Department: Computer Science and Engineering
Affiliation: IIT Kharagpur

Speaker Bio: Jayanta Mukhopadhyay is presently a professor in the Department of Computer Science and Engineering at Indian Institute of Technology Kharagpur, India. He is also holding the office of Dean Outreach in the Institute. His research interests are in image processing, computer vision, robotics, and pattern recognition. Dr. Mukhopadhyay worked extensively in telemedicine, neonatal health care, and cancer radiomics. He has also worked on medical instrumentation and assistive technology. For more than two decades, he has been engaged in research and development of telemedicine systems, which were deployed several Government hospitals in West Bengal and Tripura. Presently the system has been upgraded to provide direct consultation to patients at their residences, and its customized versions are being used by IIT, Kharagpur, RKMHOS, Varanasi, and Department of Health and Family Welfare, Govt. of West Bengal. A base version of the system, named iMediXcare has been released as an open source software. Dr. Mukhopadhyay received the Young Scientist Award from the Indian National Science Academy in 1992. He is a Senior Member of the IEEE, and a fellow of the Indian National Academy of Engineering (INAE).

Talk Overview:
Dr. Mukhopadhyay's presentation highlighted the transformative potential of technology in redefining healthcare delivery. He detailed how innovations in image processing and computer vision are enhancing home-based healthcare solutions, enabling continuous monitoring and diagnosis without the need for patients to leave their homes. This shift not only increases the accessibility of healthcare services but also significantly improves the efficiency of care delivery. Further, he discussed the integration of artificial intelligence (AI) with these technologies to predict and prevent potential health issues before they become critical, illustrating this with examples where AI has successfully anticipated episodes from chronic conditions. Dr. Mukhopadhyay also touched on the importance of data security and privacy in the development and deployment of these technologies, acknowledging the concerns around patient data and the need for robust protective measures. The session concluded with a look towards the future, speculating on upcoming innovations in sensor technology and machine learning algorithms that could offer even more precise and personalized care options. Dr. Mukhopadhyay emphasized the role of interdisciplinary collaboration in advancing home-based healthcare technologies, calling for a united effort from engineers, healthcare professionals, and policy makers to create a seamless, integrated healthcare system that is both patient-centric and sustainable. His talk provided a comprehensive overview of the current state and exciting future of home healthcare, driven by technological advancement.

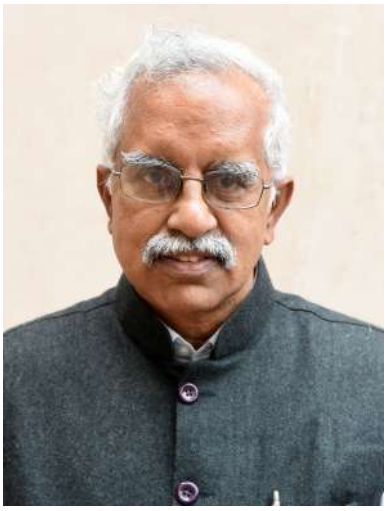
Natural Language Task Understanding For an Embedded agent (iCoboTalk)

Speaker: Chayan Sarkar
Designation: Research Scientist
Affiliation: TCS

Speaker Bio: Dr. Chayan Sarkar is a Scientist at TCS Research. He received his bachelor's and master's degree in Computer Science from Jadavpur University in 2009 and IIT Bombay in 2011, respectively. He completed his doctoral studies at the Delft University of Technology, the Netherlands in 2016. He briefly worked as a researcher at SICS Swedish ICT in Sweden. Currently, he is part of the Robotics Autonomous Systems research area of TCS Research. His research interest includes human-robot interaction, multi-robot systems, and networked embedded systems

Talk Overview:
The speaker introduced the integration of natural language interaction with robots, specifically focusing on task understanding, using Sophia, an expressive robot, as a visual aid. The presentation covered ongoing efforts at TCS Research Labs' Robotics and Autonomous Systems group, drawing from their experience in the Amazon Robotics Challenge where they developed a robot specialized in warehouse item picking. The speaker elaborated on multi-robot coordination, simultaneous localization and mapping, drone navigation, and cloud robotics, highlighting their picker robot and telepresence robots designed for specific tasks like teleoperation. A significant part of the talk was dedicated to the Task Conversational Agent for Robots (T-CAR), which handles dialogue with users to predict tasks and clarify ambiguities through natural language processing. T-CAR utilizes tagging and classification models for task prediction and can ask clarifying questions, employing strategies such as rephrasing and implicit clarification to improve understanding. The speaker illustrated this with a demo involving a telepresence robot that navigated to a dining table to retrieve an item, showcasing the robot's ability to adapt to available information and ask relevant questions when confronted with unexpected scenarios. The system's natural language interaction was compared favorably to traditional methods like using WordNet for synonym matching, and plans were discussed for enhancing real-time interaction capabilities, adhering to social norms in communication, and handling commands from multiple users simultaneously.

Mobility Challenges of Visually Impaired in Unstructured Public Spaces



Speaker: M. Balakrishnan
Designation: Professor
Department: Computer Science and Engineering
Affiliation: IIT Delhi

Speaker Bio: M. Balakrishnan is a Professor of Computer Science & Engineering at IIT Delhi. He is actively engaged in addressing the challenges mainly related to mobility and education of the visually impaired. He has founded ASSISTECH along with Prof. PVM Rao, which has been successful in scaling some of the assistive technologies developed for the visually impaired.

Talk Overview:
This talk explores the significant mobility challenges faced by visually impaired individuals in unstructured public spaces. The speaker discusses the various barriers that visually impaired people encounter daily, such as navigating through crowded city streets, dealing with unpredictable pedestrian traffic, and interacting with poorly designed infrastructure. These challenges are compounded by the lack of standardized tactile and auditory signals in many environments, making independent travel difficult and often unsafe. The presentation highlights the critical need for inclusive urban planning that integrates the needs of visually impaired citizens into the design of city landscapes. This includes the implementation of tactile paving, audible traffic signals, and clear, unobstructed pathways that can be easily navigated with a white cane or through the guidance of service animals. Additionally, the speaker introduces innovative technological solutions aimed at improving the autonomy of visually impaired people in these settings. Examples include the development of GPS-based navigation aids, smartphone apps that provide audio descriptions of surroundings, and wearable technology that detects obstacles using echolocation or similar methods. The talk emphasizes the importance of collaboration between urban planners, technology developers, and the visually impaired community to create environments that are accessible to all. By addressing these mobility challenges through proactive design and technology, we can significantly enhance the independence and quality of life for visually impaired individuals navigating unstructured public spaces.

Precision flying with 1000 drones (iCoboTalk)

Speaker: Tanmay Bunkar
Designation: Co-founder Botlab Dynamics

Speaker Bio: Tanmay Bunkar is an Engineer Physics Graduate from IIT Delhi and co-founder of BotLab Dynamics. He has been working on drones since his first year at IIT Delhi. His primary focus was always to make drones more capable as a system and then networking them for greater effectiveness in numerous use cases. Keeping that in mind BotLab Dynamics was founded. The team at BotLab has worked on indigenizing the technology that is involved in making a drone, along with solutions to enable flight of numerous drones together.

Talk Overview:
Precision flying with 1000 drones represents a remarkable integration of technology and artistry, showcasing the potential of coordinated aerial displays on a grand scale. This endeavor involves orchestrating a large swarm of drones to move in synchronized patterns and formations, creating captivating visual spectacles in the sky. The precision achieved in flying 1000 drones simultaneously is a testament to advanced software algorithms and meticulous planning. Each drone is programmed to communicate with others in the swarm, maintaining precise positioning and timing to execute complex maneuvers flawlessly. This level of coordination requires sophisticated control systems that enable real-time adjustments to ensure smooth and accurate movements. The visual impact of 1000 drones flying in harmony is awe-inspiring, captivating audiences with intricate patterns, dynamic shapes, and dazzling light displays. Beyond the entertainment value, precision flying with drones can also have practical applications, such as light shows for events, aerial advertising, or even assisting in search and rescue operations. As technology continues to advance, the possibilities for precision flying with drones are limitless, offering new opportunities for creativity, entertainment, and technological innovation. This blend of artistry and technical precision exemplifies the potential of drone technology to push the boundaries of what is possible in aerial displays and performances.

Robot Operations in Uncontrolled Environments: Recent Work and Challenges

Speaker: Dinesh Manocha
Designation: Professor
Department: Computer Science and Engineering
Affiliation: University of Maryland, USA

Speaker Bio: Dinesh Manocha is Paul Chrisman-Iribe Chair in Computer Science and ECE and Distinguished University Professor at University of Maryland College Park. His research interests include virtual environments, physically-based modeling, and robotics. His group has developed a number of software packages that are standard and licensed to 60+ commercial vendors. He has published more than 600 papers and supervised 40 PhD dissertations. He is a Fellow of AAAI, AAAS, ACM, and IEEE, member of ACM SIGGRAPH Academy, and Bézier Award from Solid Modeling Association. He received the Distinguished Alumni Award from IIT Delhi the Distinguished Career in Computer Science Award from Washington Academy of Sciences. He was a co-founder of Impulsonic, a developer of physics-based audio simulation technologies, which was acquired by Valve Inc in November 2016.

Talk Overview:
In the last few decades, most robotics success stories have been limited to structured or controlled environments. These include manufacturing, industrial applications, fulfillment and warehouses, autonomous driving on roads with low traffic, etc. A major challenge is to develop robot systems that can operate in complex or unstructured environments corresponding to construction, city streets, delivery scenarios, etc. Recent developments in machine learning, computer vision, planning, manipulation and control technologies are resulting in development of next generation robotics systems that can operate in uncontrolled environments. In this talk, we will give a brief overview of our recent work on combining these techniques for complex applications: robot navigation in crowded indoor environments or outdoor scenes, autonomous driving in dense, heterogeneous traffic scenarios, and an autonomous excavation that can continuously operate for 24 hours without any human assistance. In this talk, Prof. Manocha discussed the latest developments and challenges in operating robots in uncontrolled environments. He explored the complexities involved in navigating unpredictable and dynamic spaces, sharing insights into the methodologies, technologies, and algorithms being developed to improve the autonomy, efficiency, and safety of robots outside controlled settings.

Using Delays For Control

Speaker: Emillia Fridman
Designation: Professor
Department: Electrical Engineering and Systems
Affiliation: Tel-Aviv University, Israel

Speaker Bio: Emilia Fridman received the M.Sc. degree from Kuibyshev State University, USSR, and the Ph.D. degree from Voronezh State University, USSR, all in mathematics. She is a professor in the Department of Electrical Engineering and Systems at Tel-Aviv University. Her research interests include time-delay systems, sample-data control systems, robust control, and their applications in various fields.

Talk Overview:
This talk delves into the intriguing concept of leveraging artificial delays for control in various systems. The speaker introduces the notion of intentionally introducing delays into control systems, contrary to conventional wisdom, to achieve specific objectives. This approach challenges traditional control theory paradigms and opens up new avenues for enhancing system performance and stability. The presentation explores different scenarios where artificial delays can be beneficial, such as in networked control systems, cyber-physical systems, and robotics. By strategically incorporating delays into the control loop, engineers can mitigate issues like instability, oscillations, and overshoot, thereby improving overall system robustness and resilience. The speaker discusses the theoretical underpinnings of using artificial delays, drawing upon concepts from control theory, signal processing, and network science. Practical implementation strategies and case studies are presented to illustrate the effectiveness of this approach in real-world applications. Furthermore, the talk addresses challenges and considerations when implementing artificial delays, including the trade-off between responsiveness and stability, as well as the impact on system dynamics and performance metrics. The speaker emphasizes the need for careful design and tuning to optimize the benefits of artificial delays while minimizing potential drawbacks. Overall, the presentation highlights the innovative potential of using artificial delays for control and encourages researchers and practitioners to explore this unconventional approach further. By embracing delays as a design tool rather than a hindrance, engineers can unlock new possibilities for enhancing the performance and efficiency of control systems across diverse domains.

Reachy, Open Source Humanoid Robot

Speaker: Gaëlle Lannuzel
Designation: R&D Engineer
Department: Robotics
Affiliation: Pollen Robotics, France

Speaker Bio: Gaëlle Lannuzel is an R&D engineer at Pollen Robotics. After a brief experience in the industry 4.0 for aircraft manufacturing, she now mainly works on software development for Pollen Robotics with a focus on human-robot interactions. A key element of her actual work deals with robot teleoperation and enhancing the capabilities of robots to interact more naturally and effectively with humans.

Talk Overview:
This presentation introduces Reachy, an innovative open-source humanoid platform designed to facilitate research and development in robotics. The speaker outlines the key features and capabilities of Reachy, emphasizing its versatility, accessibility, and potential for advancing the field of robotics. Reachy is equipped with a range of sensors, actuators, and computational resources that enable it to interact with its environment and perform a variety of tasks. Its humanoid design, with articulated arms, head, and torso, allows for natural and intuitive interactions with humans and objects. The platform is also modular, allowing researchers to customize and expand its functionalities to suit their specific needs and applications. The open-source nature of Reachy makes it accessible to a wide range of users, from hobbyists and students to researchers and developers. The availability of comprehensive documentation, software libraries, and community support fosters collaboration and innovation within the robotics community. The speaker showcases examples of projects and applications built on the Reachy platform, demonstrating its versatility and potential impact in various domains such as healthcare, education, and entertainment. From assisting with household chores to serving as a research platform for human-robot interaction studies, Reachy offers endless possibilities for exploration and development. In conclusion, the presentation highlights Reachy as not just a robotic platform but as a catalyst for innovation and advancement in robotics research and development. Its open-source nature, coupled with its sophisticated capabilities, positions Reachy as a valuable tool for pushing the boundaries of what is possible in the field of robotics.

DD Robocon, 2022

Speaker: Sunil Jha
Designation: Professor
Department: Mechanical Engineering
Affiliation: IIT Delhi

Speaker Bio: Sunil Jha obtained his Ph.D. in Manufacturing Science from IIT Kanpur and has been engaged in teaching and research on manufacturing processes and related automation for the last 14 years. He has developed new unconventional super finishing processes and filed 10 patents on them. Some of his significant contributions include advancements in manufacturing sciences and the development of innovative techniques for surface finishing.

Talk Overview:
his talk provides a comprehensive overview of "DD Robocon," a prominent robotics competition held annually in India. The event is a platform for engineering students across the nation to showcase their skills in robotics design and automation. It aims to foster creativity, problem-solving, and innovation among participants, emphasizing the practical applications of theoretical knowledge acquired in academia. The presentation delves into the format of the competition, which typically involves teams designing, building, and programming autonomous robots to complete specific tasks. These tasks are designed to mimic real-world challenges, often revolving around themes such as sustainability, disaster management, or healthcare automation. The competition not only tests technical skills and engineering principles but also encourages teamwork, strategy, and time management.The speaker highlights the significant impact of DD Robocon on education and industry in India. By participating in such competitions, students gain invaluable hands-on experience that prepares them for careers in the burgeoning fields of robotics and artificial intelligence. Furthermore, the event has catalyzed partnerships between academia and industry, leading to internships, job placements, and collaborative projects that address real-world problems. Success stories from past participants are shared, illustrating how experiences at DD Robocon have propelled their professional and academic pursuits. The talk concludes by emphasizing the importance of such competitions in driving the innovation ecosystem in India, inspiring more institutions to participate and support the next generation of engineers and innovators.

Human-Robot-AI Teams for Improving Quality of Life

Speaker: Satyandra K Gupta
Designation: Professor
Department: Mechanical Engineering
Affiliation: Viterbi School of Engineering, USC

Speaker Bio: Satyandra K. Gupta holds Smith International Professorship in the Viterbi School of Engineering at the University of Southern California. He serves as the Director of the Center for Advanced Manufacturing. He is also Co-founder and Chief Scientist of GrayMatter Robotics. Dr. Gupta's research interests include virtual environments, physically-based modeling, and robotics. He has developed a number of software packages and received several best paper awards at international conferences.

Talk Overview:
This talk explores the dynamic field of collaborative human-robot-AI teams and their potential to significantly improve quality of life across various sectors. The speaker discusses how integrating humans, robots, and artificial intelligence creates synergistic teams capable of accomplishing tasks with greater efficiency and precision than any of these entities could achieve alone. The presentation begins with an overview of current technologies in robotics and AI, illustrating how these tools are being used in healthcare for surgery and patient care, in disaster response scenarios for search and rescue, and in everyday environments like homes and workplaces to enhance accessibility and functionality. Examples include robots that assist in complex surgical operations, AI systems that manage logistics in emergency situations, and smart home robots that aid in daily living for the elderly and disabled. Challenges in creating effective human-robot-AI teams are also addressed, such as issues of trust, communication barriers, and the need for sophisticated decision-making algorithms that can adapt to diverse human behaviors and preferences. The speaker highlights the importance of designing intuitive interfaces that facilitate human-robot interaction and the ethical considerations involved in deploying AI, especially in terms of privacy and autonomy. The talk concludes by emphasizing the transformative impact these collaborative teams can have on society. With ongoing advancements and thoughtful integration, human-robot-AI teams are poised to redefine the landscapes of work, healthcare, and home life, making them more adaptive, safe, and efficient.

Autonomous Systems Development at R&DE(Engrs), DRDO Pune

Speaker: Alok Mukherjee
Designation: Retired Scientist
Department: R&DE(Engrs)
Affiliation: DRDO, Pune

Speaker Bio: Alok Mukherjee did his MSc in Physics with specialization in Electronics from Fergusson College at Poona in 1986. He joined DRDO after his post-graduation and pursued an M. Tech in Computer Science also from Poona University while in service in DRDO. His career has been dedicated to the development and innovation in the field of autonomous systems.

Talk Overview:
This talk delves into the cutting-edge developments in autonomous systems at the Research and Development Establishment (Engineers), DRDO Pune. The speaker outlines the facilities strategic focus on designing and deploying autonomous technologies for defense applications, highlighting major projects and innovations. Emphasis is placed on the integration of robotics, artificial intelligence, and sensor technologies to create sophisticated systems capable of operating in diverse and challenging environments. The presentation showcases several key initiatives, such as unmanned ground vehicles (UGVs) equipped with advanced navigation systems, aerial drones for surveillance and reconnaissance, and robotic systems for bomb disposal and hazardous material handling. These systems are designed to enhance the operational capabilities of the Indian armed forces, improving safety and efficiency while reducing human exposure to danger. Challenges in the development of these autonomous systems are also addressed, including technological hurdles, system reliability, and the adaptation of these technologies to specific military needs. The speaker discusses the rigorous testing protocols used to ensure that these systems can perform under extreme conditions and the ongoing research aimed at further improving their functionality and autonomy. Collaborative efforts with academic institutions and international partners are highlighted as crucial for advancing the state of autonomous system technologies. The talk concludes with a vision for the future, where autonomy becomes a cornerstone of defense strategy, driving innovation and providing a tactical advantage in military operations.

Solutions by Wipro Pari and Challenges faced in Automation

Speaker: Jyotirmoy Ray
Designation: Head
Department: Smart Products
Affiliation: Wipro Automation

Speaker Bio: Jyotirmoy Ray graduated from IIT Delhi in 2017 with a major in Mechanical Engineering and minor in Robotics (under the IDSR programme). He subsequently joined Wipro in their manufacturing and engineering business unit and was one of the first employees of the newly started Industrial Automation business. He has been a part of its growth story from a new small startup in 2018 to India's largest robotics company in 2022. Currently, Jyotirmoy heads the Smart Products and Smart Factories teams in Wipro Pari that is responsible for R&D and deployment of in-house developed robots and Industry 4.0 solutions.

Talk Overview:
This talk provides an in-depth look at the innovative solutions developed by Wipro Pari for automation across various industries, along with the challenges encountered in implementing these technologies. The speaker discusses how Wipro Pari, a leader in providing intelligent automation solutions, has designed systems that integrate robotics, artificial intelligence, and machine learning to enhance efficiency and reduce operational costs for businesses. Key highlights include Wipro Pari's advancements in robotic process automation (RPA), which streamline repetitive tasks, and their development of smart factories where IoT (Internet of Things) technologies predict maintenance needs and optimize production schedules. These solutions have significantly improved the speed and accuracy of manufacturing processes, logistics, and supply chain management. However, the presentation also addresses several challenges faced during these implementations. These include the high initial cost of setting up automated systems, the complexity of integrating new technologies with existing IT infrastructure, and the ongoing need for employee training and adaptation. Moreover, issues such as data security and privacy in automated systems are discussed, emphasizing the need for robust cybersecurity measures.The speaker concludes by underscoring the importance of overcoming these challenges through strategic planning, continuous innovation, and collaboration between technology providers and industry stakeholders. By doing so, companies can fully leverage the benefits of automation to stay competitive in a rapidly evolving digital landscape.

Control of Unicycle Robots Using Model Based Design

Speaker: Jagannath Samantaray
Designation: Senior Engineer
Affiliation: MathWorks

Speaker Bio: Jagannath Samantaray is currently working as a Senior Engineer at MathWorks in the field of Automotive Control domain. His research interests include sliding mode control, output feedback control, Electric vehicle design, and AUTOSAR. He is in the final phase of his Ph.D. degree at the Department of Electrical Engineering, Indian Institute of Technology Roorkee, India. He has authored many works in the domain control and its industrial application in many referred journals and presented at many international conferences.

Talk Overview:
Mr. Jagannath Samantaray, a Senior Engineer at MathWorks, delivered a comprehensive talk on model-based design (MBD) and its applications in controlling unicycle robots. MBD uses models at various development stages—requirements, design, implementation, and integration—facilitating an iterative and agile design process. The talk highlighted the utility of MBD in generating voltage signals through a power converter to control robot motion, using techniques like sliding mode control (SMC) and PID controllers. Samantaray demonstrated how MATLAB and Simulink can be leveraged for automatic code generation, crucial for tailoring software to specific microcontrollers. He illustrated this with a case study on a power converter's control algorithm and its code generation process. The discussion also covered AUTOSAR, an industry standard providing guidelines for designing and implementing control systems in automotive applications, emphasizing the importance of adhering to such standards to ensure robust and reliable system design. The presentation underscored the role of MBD and automated code generation in designing and controlling robotic systems, particularly highlighting the collaboration between humans and robots. Sliding mode control was discussed in depth, noting its robust performance in various industries such as automotive, aerospace, and industrial automation, where it is used for critical functions like traction and stability control. Samantaray concluded by affirming the adaptability of the discussed concepts across different platforms and their implementation using Simulink for practical, industry-standard compliant applications.

Restoring Human Movement With Ultrasound

Speaker: Biswarup Mukherjee
Designation: Assistant Professor
Department: Center for Biomedical Engineering (CBME)
Affiliation: Indian Institute of Technology Delhi

Speaker Bio: Biswarup Mukherjee is currently an Assistant Professor at the Center for Biomedical Engineering at the Indian Institute of Technology Delhi. His broad research interest is to develop sensors and instrumentation to augment function in individuals with motor disabilities. He has been the recipient of several awards including the best doctoral thesis award from IIT Madras and the Innovation Discovery Award at MGH.

Talk Overview:
The presentation focuses on using ultrasound-based technology to enhance prosthetic control and rehabilitation for individuals with mobility impairments due to conditions like stroke, diabetes-related amputations, and traumatic injuries. The speaker outlines the current state of prosthetic devices, ranging from simple body-powered systems to advanced myoelectric units that utilize surface electromyography (EMG) for control. Despite the sophistication of these devices, many users revert to less complex models due to challenges in control. The talk introduces ultrasound-based control as a non-invasive alternative to EMG and invasive methods, which often involve surgical risks. This new technique, known as sonomyography (SMG), leverages muscle contractions detected via ultrasound to offer more intuitive and natural control of prosthetic devices. By capturing the mechanical actions of muscles, SMG provides a clearer and more direct correlation between intended movements and prosthetic responses. Clinical ultrasound systems are utilized to track muscle movements, and a machine learning database helps classify different grasping actions for real-time prosthetic control. Demonstrations show how users, including amputees, can effectively operate prosthetics using SMG, offering proportional control that mimics natural movements closely. The presentation also explores challenges in integrating ultrasound technology into wearable prosthetics and refining the control mechanisms. The potential integration of haptics to provide feedback and enhance the intuitiveness of prosthetic devices is discussed. Overall, the speaker emphasizes the transformative potential of ultrasound in prosthetics, advocating for continued research to further innovate and improve the quality of life for those with movement disorders.

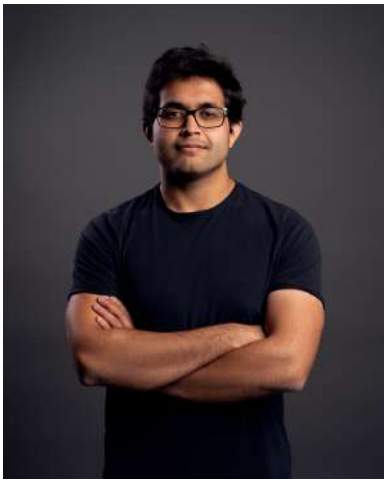
Overview of Autonomous Navigation Research at IIT Hyderabad

Speaker: P Rajalaxmi
Designation: Professor
Department: Electrical Engineering
Affiliation: IIT Hyderabad

Speaker Bio: P Rajalakshmi, is a Professor in the Department of Electrical Engineering, CYIENT Chair Professor in Future Communications, Project Director of Technology Innovation Hub on Autonomous Navigations (TiHAN) at IIT Hyderabad. Her research areas: Autonomous Navigations, drone based sensing, wireless communications, Internet of Things, Cyber Physical Systems targeting applications like autonomous transportation – aerial and terrestrial, agriculture, healthcare, environmental monitoring, and smart buildings. She has been handling R&D projects funded by industry and Government of India in these areas. Along with fundamental research in IoT/CPS domain, she also emphasizes on translational research. Out of her research activities, she has filed 15 patents, 2 copyrights, published over 40 Journals and 135 conference peer-reviewed papers. She was awarded Young Faculty Research Fellowship under Visvesvaraya Programme. She is also Member of CII Telangana Digital Transformation and IT Panel since August 2018.

Talk Overview:
This talk provides a comprehensive overview of the ongoing research in autonomous navigation at IIT Hyderabad, highlighting key innovations and developments in the field. The speaker discusses various projects underpinning the advancement of autonomous systems, including drones, self-driving cars, and robotic assistants. The focus is on the integration of artificial intelligence and machine learning technologies to enhance the decision-making capabilities and operational efficiency of these autonomous vehicles. Central to the discussion is the development of sophisticated algorithms that enable real-time processing and interpretation of vast amounts of sensory data, essential for the navigation and maneuvering of vehicles in complex environments. The research team employs a multidisciplinary approach, combining insights from robotics, computer vision, and data analytics to improve the accuracy and safety of autonomous navigation systems.The presentation also covers collaborative efforts with industry partners to test and validate these technologies in real-world settings, ensuring they meet safety and regulatory standards. Future directions for the research include refining these technologies to address challenges such as dynamic obstacle avoidance and optimal route planning in unpredictable conditions. The talk underscores IIT Hyderabad's role as a leader in autonomous navigation research, driving innovations that could transform transportation and mobility solutions globally.

Role of Human-Robot Interaction to enable automation in SME



Speaker: Rishabh Agarwal
Designation: CEO
Affiliation: Peer Robotics

Speaker Bio: Rishabh Agarwal is the CEO of peerrobotics.ai with a background in research in the area of human-robot collaboration. He completed his M.Tech from UMD College Park in Systems Engineering and B.Tech from IIT Delhi with an interdisciplinary specialization in robotics.

Talk Overview:
The talk by Rishabh Aggarwal from Peer Robotics explores the transformative role of collaborative robotics in modern manufacturing and various industries. He discusses how robots, particularly autonomous mobile robots developed by Peer Robotics, are being used to assist humans by taking over repetitive tasks, thereby allowing humans to focus on more cognitive and complex activities. This synergy between human and robot workers facilitates a learning environment where robots enhance their capabilities through direct human interaction. He highlighted the challenges small and medium enterprises (SMEs) face with traditional automation, such as high costs and complexity, and proposes human-robot collaboration as a cost-effective solution. This approach not only improves efficiency but also supports local and lean production systems. He exemplifies how these robots can learn and navigate autonomously within their environments, akin to onboarding a new team member, making it easier for SMEs to integrate advanced technologies and attract talent. The concept of collaborative robotics (cobotics) is emphasized, where robots work alongside human colleagues, enhancing rather than replacing human capabilities. This can drive innovation and growth, particularly in the manufacturing sector. The presentation concludes with a positive reception from the audience, including IHFC representatives who recognize the potential of robotics and AI in future technological advancements. Discussions post-presentation focus on potential collaborations, safety in robotics, and the broader application of robotics in fields like medicine, defense, and agriculture, underlining the ongoing importance and innovation potential of human-robot interactions.

Digital Transformation in Design and Manufacturing

Speaker: Ramesh Shankar
Designation: Program Manager
Affiliation: Autodesk

Speaker Bio: Ramesh Shankar is a Senior Program Manager at a Autodesk, specializing in overseeing and implementing large-scale projects across various technological domains.

Talk Overview:
The presentation centered around digital transformation in design and manufacturing, advocating a shift from traditional methods to connected, flexible processes. The speaker underscored the need for faster, personalized product development and enhanced customer experience, citing case studies of significant efficiency gains and rapid, complex product creation. Emphasizing customer engagement and feedback, the discussion highlighted how modern consumer preferences shape product design. The role of Autodesk in supporting various industries through educational initiatives and resources like project-based learning modules and Fusion 360 was also discussed. The speaker encouraged attendees to leverage these tools for improvement and innovation, mentioning an upcoming showcase at Robocon for practical engagement. Although there are no free Autodesk licenses for startups, affordable options are available. The overall message was that digital transformation is not merely a technical change but a comprehensive shift in mindset to meet evolving industry and consumer demands.

Nuances of Designing Cognitive Robots through Case Studies at SMSS lab, IIT Kanpur

Speaker: Bishakh Bhattacharya
Designation: Professor
Department: Mechanical Engineering
Affiliation: IIT Kanpur

Speaker Bio: Bishakh Bhattacharya, a Professor at IIT Kanpur's Mechanical Engineering Department, specializes in areas like Vibration Control and Structural Health Monitoring. He's significantly contributed to Cognitive Science, Space Technology, and developed innovations for ISRO and GAIL. With global collaborations and visiting professorships in Sheffield and Waseda University, he's an award-winning researcher, deeply involved in India's NPTEL initiative and serves on several international editorial boards. His work spans from robotics and AI to Smart System Design.

Talk Overview:
The 31st edition of IHFC's CoboTalks webinar, led by Prof. Bishakh Bhattacharya at IIT Kanpur's SMSS Lab, focused on the relatively unexplored field of child-robot interaction in cognitive robotics. This research aims to develop adaptive intelligence in robots, enabling them to learn from and respond to real-world situations dynamically. By studying various parameters affecting child-robot interaction, the team hopes to build robots that can interact effectively with humans. Prof. Bhattacharya referenced John Boyd's OODA Loop to describe the decision-making process aimed at replicating in robots, addressing challenges in physical and social interaction, development, and integration. The team's experiments, including trust games between children and the robot 'NAO', aim to model socially adaptive robots based on their findings. This innovative work at the SMSS Lab represents a significant stride in cognitive science, robotics, and artificial intelligence, offering insights into the potential of human-robot interaction.

Collaborative Robotics – An Indo-Danish Perspective

Speaker: Søren Tranberg Hansen
Designation: Deputy Head of Mission
Department: Science and Innovation Consul
Affiliation: Innovation Centre Denmark, India

Speaker Bio: Soren Tranberg Hansen holds an Industrial Ph.D. in robotics and a Graduate Diploma in Business Administration. The Industrial Ph.D. was a collaboration between Danish Technological Institute and Aalborg University and involved a half-year visit to the Cognitive Computing Lab at Georgia Tech in Atlanta. Søren Tranberg Hansen has more than 17 years of experience as a consultant, entrepreneur and researcher, combining expert knowledge in tech with innovation and business development. He has been working as a fundraiser and project manager on a large number of innovation projects – primarily within the fields of robotics and artificial intelligence. Today, Søren Tranberg Hansen works as a science & innovation consul at the Danish Innovation Center in Bangalore, connecting innovation systems between India and Denmark.

Talk Overview:
This talk provides an insightful exploration of collaborative robotics from an Indo-Danish perspective, highlighting the synergies and innovations driven by partnerships between India and Denmark in the field of robotics. The presentation delves into the concept of collaborative robots (cobots), which are designed to work alongside humans in a shared workspace, enhancing productivity and safety across various industries. The speaker discusses the rapid growth of cobots in both countries, emphasizing their role in manufacturing, healthcare, and service industries. Particular attention is given to the unique contributions of Danish technology in precision and design, combined with India's prowess in software and integration capabilities. This combination has led to the development of highly efficient and adaptable robotic systems that are easy to program and can perform complex tasks alongside human workers. Challenges such as cultural differences in workplace integration, technical training, and adaptation to collaborative environments are also addressed. Solutions involving joint ventures, shared research initiatives, and workforce training programs are proposed to overcome these hurdles. The talk showcases several case studies of successful Indo-Danish collaborations in robotics, including the use of cobots in automotive assembly lines and pharmaceutical production. These examples illustrate the tangible benefits of international cooperation in advancing robotic technology. In conclusion, the presentation underscores the potential of Indo-Danish partnerships to innovate and push the boundaries of what collaborative robotics can achieve, suggesting a promising future for cobot implementation globally. This cross-cultural approach not only enhances technological development but also fosters a deeper understanding and collaboration between the two nations in the robotics domain.

Prosthetic Hand: Commercial versions vis-à-vis TU Bionic Hand

Speaker: Nayan M. Kakoty
Designation: Professor
Department: ECE
Affiliation: School of Engineering, Tezpur University

Speaker Bio: Nayan M. Kakoty obtained his bachelor's degree in electrical engineering from Jorhat Engineering College and Master of Technology in Bioelectronics in 2006. Dr. Kakoty's Ph.D. was in the area of Rehabilitation Robotics in July 2014 from Tezpur University. His work in research and academics has been awarded with Best Paper Award in ACM International Conference on Advances in Robotics 2013, India

Talk Overview:
Dr. Nayan Kakoty delivered a compelling presentation focused on the groundbreaking advancements in prosthetic technology spearheaded by Tezpur University, particularly highlighting the TU Prosthetic Bionic Hand and its ongoing developments in collaboration with the I-HUB Foundation for Cobotics (IHFC). Addressing the pressing issue of a significant rise in hand amputation cases across India, Dr. Kakoty emphasized the critical need for more sophisticated prosthetic solutions to enhance the quality of life for amputees, help combat prevailing social stigmas, and overall improve well-being. He provided a detailed historical overview of prosthetic hand development, marking the technological advancements that have culminated in the use of Electromyography (EMG) technology. This innovation has been pivotal in achieving more precise and lifelike functionalities in prosthetic hands, making everyday tasks more manageable for users. Since 2015, the TU Bionic Project in partnership with IHFC has been at the forefront of developing a high-quality EMG-controlled prosthetic hand. This initiative not only bridges the gap between healthcare and technology but also underscores IHFC's deep commitment to healthcare robotics.The session highlighted the transformative potential of these advanced prosthetics in revolutionizing medical care and rehabilitation practices in India. Dr. Kakoty's discussion pointed out the various technical, ethical, and social dimensions involved in the deployment of such technologies, aiming to foster a broader understanding and acceptance of bionic enhancements as a normative healthcare solution. This initiative is poised to make a significant impact on the field of medical prosthetics and offers a promising future for amputees seeking to regain normalcy and functionality in their lives.

Industrial Artificial Intelligence

Speaker: Surjya K. Pal
Designation: Professor
Department: Mechanical Engineering
Affiliation: IIT Kharagpur

Speaker Bio: Surjya K Pal is a Professor in the Dept of Mechanical Engineering at Indian Institute of Technology, Kharagpur. He has held the position of Lord Kumar Bhattacharyya Chair Professor in Manufacturing at IIT Kharagpur. He is the Founder Chairperson of the CoE in Advanced Manufacturing Technology; and holds the role as a visiting professor at the University of Connecticut, USA, he also holds a visiting professorship at the University of Huddersfield, UK. He has published 316 research articles, including 193 peer-reviewed Journal Papers, 15 International Book Chapters, 91 Conference papers, and has 17 patents filed. His innovation, "Low-cost AI solution for metrological inspection," is selected in the top 3 by INDIAai Lab2Market (The National AI Portal of India, a MeitY, NeGD, and NASSCOM initiative). As a result of his collaboration with TATA Consultancy Services, he holds two joint patents with TCS. He is the author of many books and has successfully executed a huge number of projects

Talk Overview:
IHFC's 34th CoboTalk, delivered by Dr. Surjya K. Pal, Chairperson of the Centre of Excellence in Advanced Manufacturing Technology (CoEAMT) at IIT Kharagpur, discussed the integration of collective intelligence and AI in manufacturing. He emphasized the need for collaboration between academia and industry to innovate and create smart machines, aligning with India's "Make-in-India" and "Atmanirbhar Bharat" campaigns. Dr. Pal highlighted the benefits of collective intelligence, such as enhanced data processing, smart automation, and advanced simulation, which contribute to more efficient and competitive industries. However, he also addressed challenges like poor data quality, system adaptability, and integration issues. The talk concluded with an emphasis on the necessity of collaborative efforts to develop AI technology that is truly intelligent, capable of learning, solving complex problems, and continuously improving. This, according to Dr. Pal, is crucial for the future of AI in India and for realizing the full potential of initiatives like CoEMAT and IHFC.

Drone Technology Development for Open Cast Mines

Speaker: Pushpraj Mani Pathak
Designation: Professor
Department: Mechanical and Industrial Engineering Department
Affiliation: IIT Roorkee

Speaker Bio: Pushparaj Mani Pathak is a Professor at Indian Institute of Technology (IIT), Roorkee, India. He was graduated from National Institute of Technology Calicut, India in 1988 in Mechanical Engineering. He completed his M. Tech in Solid Mechanics and Design from IIT, Kanpur in 1998. Later he was awarded the PhD degree from IIT, Kharagpur in 2005. His areas of research are Robotics, Dynamics, Control, and Bond Graph Modelling. He is in Mechanical and Industrial Engineering Department, IIT, Roorkee since 2006. He has co-authored a book on Intelligent Mechatronic Systems: Modeling, Control and Diagnosis published by Springer, London in year 2012. His two MOOCs course through National Programme on Technology Enhanced Learning (NPTEL), on Mechatronics and Modelling and Simulation of Dynamic Systems are very popular. He is founder of a start-up RoboLife Private Limited. The start-up works in taking robotics products developed in robotics lab to market. He is a Member of ASME, RSI, AMM and IFToMM Technical committee for Multi Body Dynamics.

Talk Overview:
The talk delved into the significant challenges faced in opencast mining operations, emphasizing the removal of topsoil and its impact on soil erosion, excavation stability, and the increased risks of landslides and collapses. These issues arise due to factors such as excavation depth, angle, and weather conditions. Traditional monitoring methods, including manual inspections, visual checks for instability, and instrumentation on cracks, were discussed for their inherent limitations in providing real-time and detailed insights. Satellite remote sensing offers a broad overview but lacks the precision required for effective monitoring. The talk highlighted drone technology as an innovative solution to these challenges, offering close-range inspections and detailed measurements of overburden and coal stocks. Drones can significantly enhance safety through improved slope and blasting monitoring, thereby reducing the risk of accidents. Additionally, they can boost productivity by optimizing logistics and operational efficiency in mining processes. The presentation emphasized the ongoing development of drone technology by a team at IIT Roorkee, supported by IHFC. This initiative aims to address the inherent problems of opencast mining, providing both economic and operational benefits, and marking a significant advancement in modern mining practices.

Telerobotic Ultrasound: Will it be a game changer in medicine?

Speaker: Chandrashekhara S H
Designation: Professor
Department: Department of Radiodiagnosis and Interventional Radiology, IRCH,
Affiliation: AIIMS, New Delhi

Speaker Bio: Chandrashekhara S. H. is a Professor in the Department of Radiodiagnosis and Interventional Radiology at the Institute Rotary Cancer Hospital (IRCH), All India Institute of Medical Sciences (AIIMS), New Delhi. His clinical and research interests include Interventional Radiology, Oncoradiology, and Cardiovascular Radiology. With over 130 indexed publications and more than 70 abstracts, Prof. Chandrashekhara has made significant contributions to the field. He has authored over 20 chapters in books and presented over 100 papers, posters, and lectures at national and international conferences, earning numerous awards, including recognition from the Radiological Society of North America (RSNA). He serves as the Joint Secretary of the Central Indian Society of Vascular and Interventional Radiology (ISVIR) and the Society of Gastrointestinal Tumor (SIGT). His collaborative projects with IIT Delhi include innovations in telerobotic ultrasound and the development of indigenous auxetic vascular stents, reflecting his commitment to advancing medical technology and patient care.

Talk Overview:
IHFC's 36th CoboTalk, delivered by Dr. Chandrasekhara, focused on a groundbreaking telerobotic ultrasound system designed for imaging abdominal organs. This cutting-edge system provides full control and perception of the ultrasound probe, mimicking manual techniques while addressing challenges like precise probe positioning and variable pressure required for accurate diagnosis. The system's controller ensures smooth and vibration-free movements, allowing the probe's 6D posture and applied pressure to be transmitted to a remote doctor. This innovation eliminates the need for on-site personnel, making it particularly useful in settings where access to specialists is limited. Successfully tested at AIIMS, Delhi, this tele-robotic system demonstrates significant potential for use in various medical scenarios, including trauma settings, remote rural locations, infectious environments, and specialized ultrasound procedures like echocardiography and interventional ultrasound. It also has applications in intraoperative imaging and remote expert consultations. With further technological advancements, this system could revolutionize medical practice, enhancing patient care and accessibility to expert diagnostics in diverse healthcare environments.

Artificial Intelligence Augmented Robotic Neurorehabilitation

Speaker: Shyamanta M Hazarika
Designation: Professor
Department: Mechanical Engineering
Affiliation: IIT Guwahati

Speaker Bio: Shyamanta M. Hazarika is an INAE-SERB, DST Abdul Kalam Technology Innovation National Fellow and a Professor at IIT Guwahati, where he leads the Biomimetic Robotics and Artificial Intelligence Lab. He is also part of the Mehta Family School of Data Science and AI. Previously, he was a Professor of Computer Science and Engineering at Tezpur University and a Vertretungsprofessur of Cognitive Systems and Neuro-Informatics at the University of Bremen, Germany. He holds a B.E. in Mechanical Engineering from Assam Engineering College, an M.Tech. in Robotics from IIT Kanpur, and a Ph.D. in Artificial Intelligence from the University of Leeds. His research focuses on Bionic Prosthetics and Robotic Neurorehabilitation, with interests in AI, ML, and Rehabilitation Robotics. He collaborates with ROAR Lab, Columbia University, USA; BCI Lab, University of Essex, England; Cognitive Neuro-Informatics Group, University of Bremen, Germany; and ITO Lab, Gifu University, Japan. He has received substantial funding from various sources.

Talk Overview:
The talk highlighted the significant role of technological advancements, particularly in Artificial Intelligence (AI) and Robotics, in transforming healthcare. A key focus was on Robotic Neurorehabilitation, an emerging field that combines robotics and neuroscience to develop innovative technologies for individuals with neuromotor disabilities. By integrating AI, Robotics, Neuroscience, and Rehabilitation, new strategies for motor therapy are being devised, offering the potential for profound improvements in patient outcomes. The presentation provided an overview of how AI and Robotics are driving transformative changes in neurorehabilitation practices. It explored the emerging technologies that are reshaping rehabilitation, emphasizing their potential to impact the world in ways previously unimaginable. The research conducted at the Biomimetic Robotics and Artificial Intelligence Lab at IIT Guwahati was showcased, illustrating the strides being made toward developing these novel therapeutic interventions. This research highlights the potential to redefine neurorehabilitation, enhance therapeutic interventions, and significantly improve the quality of life for individuals with neuromotor impairments. The talk concluded by envisioning a future where these technologies continue to evolve, offering new possibilities for healthcare and beyond.

Advancement in Drone Technology and Entrepreneurship

Speaker: Krithiga RS
Designation: CEO
Department: Drone Manufacturing Hub
Affiliation: Jet Aerospace Aviation Research Center

Speaker Bio: Krithiga RS is the CEO of Jet Aerospace Drone Manufacturing Hub and a distinguished figure in the Aerospace and UAV industry with over six years of experience. Her career is marked by her close work with the dynamic student community, focusing on their welfare and development. Krithiga holds significant roles, including Nodal Centre Coordinator for the ISRO/IIRS Outreach Programme, Drone Trade Examiner for the Ministry of Skill Development, and a certified drone instructor and pilot through DGCA RPTO. Her academic involvement is equally impressive, as she served as the Director of Academics at the Aeronautical Sector Skill Council and contributed to the Board of Studies for prominent institutions such as VIT and PSG Group. Krithiga is also part of advisory committees for accreditation processes in various institutions.

Talk Overview:
The talk provided an in-depth exploration of the evolving field of drone technology, starting with an introduction to drones and their wide-ranging applications across various industries. It highlighted the innovative advancements in drone intelligent systems, showcasing how these technologies are enhancing capabilities in sectors such as agriculture, logistics, surveillance, and environmental monitoring. The presentation also delved into the entrepreneurial opportunities emerging in the drone industry, emphasizing how startups and businesses can leverage these technologies to create new solutions and services. Additionally, the talk addressed the challenges faced by drone professionals and enthusiasts, including regulatory hurdles, technological limitations, and safety concerns. By exploring both the opportunities and obstacles in the field, the talk offered valuable insights for those interested in pursuing a career or business in drone technology. It concluded by encouraging innovation and collaboration to overcome the challenges and fully realize the potential of drones in transforming industries and improving everyday life.

Control Challenges in Non-linear Robotic Systems

Speaker: Indra Narayan Kar
Designation: Professor
Department: Electrical Engineering
Affiliation: IIT Delhi

Speaker Bio: Indra Narayan Kar is a distinguished Professor of Electrical Engineering at IIT Delhi, where he has been a faculty member since 1998. His research interests include incremental stability analysis, robotics, cyber-physical systems, time-delay systems, and distributed optimization. Prof. Kar earned his B.E. from B.E. College, Howrah, and his M.Tech and Ph.D. from IIT Kanpur. He was also a research student at Nihon University, Japan. He has been honored as an ABB Chair Professor and an Institute Chair Professor and is a Fellow of the Indian National Academy of Engineering and a Senior Member of IEEE. Prof. Kar's interdisciplinary work integrates electrical engineering, computer science, and mechanical engineering to develop robust control strategies for robotic systems. He has published extensively in international journals and conferences, and he holds several patents. His contributions to robotics and electrical engineering have gained national and international recognition. Through his research and leadership, he continues to influence the academic community at IIT Delhi and beyond.

Talk Overview:
The presentation explored the intricate control challenges inherent in non-linear robotic systems, with a focus on diverse configurations such as mobile robots, snake robots, quadrotors, and scenarios involving human-robot collaboration. These robotic systems are pivotal in advancing the field of robotics, providing versatile solutions for a wide range of applications, from industrial automation to complex service tasks. Prof. Kar highlighted the significant challenges posed by non-linear dynamics and complex control environments in achieving precise, reliable, and efficient robotic operations. He explained how mobile robots must navigate unpredictable terrains and dynamically changing environments, necessitating adaptable real-time control strategies. Similarly, snake robots, which are designed to operate in confined or otherwise inaccessible spaces, require high flexibility and precision to maneuver effectively. The presentation examined various advanced control algorithms, such as time-delayed and event-triggered control schemes, that enhance the adaptability and performance of robotic systems in complex scenarios and resource-constrained environments. Prof. Kar's insights shed light on cutting-edge research and technological advancements in robotic control systems, emphasizing the importance of efficiency, safety, and human-centric design for the future of robotics.

Vision behind Kaidoko and how Startups on AI are built

Speaker: Anish Batra
Designation: Co-Founder
Affiliation: Kaidoko

Speaker Bio: Anish Batra is the Co-Founder of Kaidoko, World's First Individualised Psychologist based on Artificial Intelligence. Kaidoko is an IHFC, IIT Delhi and Nasscom backed Startup! An ex-Amazon Employee who worked in the AWS division under Development and Mobile Services on leading Cloud Services such as Lambda, API Gateway, SNS, Kinesis, Cloud Formation impacting global businesses such as Netflix, AirBnb, Dow Jones, to name a few! He has publications and patents in the field of Data Sciences, Cognitive Sciences, Automation Systems. He has been awarded honours in the field of research and an excellence award in the field of AI by DR. M.P. Poonia (Vice Chairman, AICTE, Government of India). He held the 1st Rank in the University for the Graduate Research submission; awarded by DCP of Cyber Cell Anyesh Roy. Anish is good with operations, building scalable products and strategizing better customer satisfaction and service processes.

Talk Overview:
The interactive session explored how Artificial Intelligence (AI) is leveraged to develop impactful solutions that improve lives across various sectors. The discussion focused on the types of AI-driven solutions that are most effective in addressing real-world challenges and enhancing human experiences. Participants delved into the critical role that ethics play in the development and implementation of AI technologies, ensuring that these innovations are used responsibly and for the greater good. The session also provided insights into the vision behind Kaidoko, a platform dedicated to creating AI solutions that are not only technologically advanced but also aligned with ethical principles and societal needs. Attendees gained a deeper understanding of how Kaidoko approaches AI development, prioritizing transparency, fairness, and inclusivity. The session encouraged participants to think critically about the future of AI and its potential to transform industries, improve quality of life, and drive positive societal change. Through engaging discussions and interactive activities, the session inspired a collaborative approach to harnessing AI for meaningful and lasting impact.

Living with Robots: A New Era of Human-Robot Coexistence

Speaker: Satoko Shibata
Designation:Japanese Voice Over Artist

Speaker Bio: Satoko Shibata is an international relations and sales specialist with extensive experience in the science and technology sectors. From 2002 to 2008, she worked at Miraikan, where she focused on international science museum networking, organizing global events, exhibitions, and conferences. In 2008, she transitioned to Kokoro Company Ltd., a Sanrio subsidiary, serving as an international sales specialist until 2010. At Kokoro, she played a pivotal role in promoting and selling animatronic robots, including the humanoid "Actroid," to museums, research institutions, and the entertainment industry globally. Her work helped to strengthen Japan's presence in advanced robotics. Currently, Satoko leverages her global expertise as a voice-over artist, collaborating with clients around the world, bringing her unique cross-cultural insights to her work.

Talk Overview:
In her talk, Satoko Shibata underscores Japan's leadership in humanoid robot development during the early 2010s, featuring advanced creations like Honda's ASIMO and Kokoro's Actroid. These robots, deeply rooted in Japan's cultural narrative, reflect the nation's long-standing embrace of friendly, familiar robotic characters seen in popular media, such as "Astro Boy," "Gundam," and "Doraemon." Shibata contrasts this perspective with the West, where robots are often viewed through a lens of functionality or as mere exhibits. Drawing from her professional experience as a sales manager at Kokoro, she highlights how robots were typically seen in business or institutional settings. However, in a personal story—where she used Kokoro's I-Fairy robot as the wedding witness and MC—Shibata illustrates how robots can transcend these roles, showing their potential to integrate into human lives in more personal and emotional ways. This event marked a pivotal shift, demonstrating the harmonious coexistence between humans and robots in daily life, beyond mere tools or devices.

Technology-Assisted Care in Japan

Speaker: Tomohiro Shibata
Designation: Professor
Affiliation: Kyushu Institute of Technology

Speaker Bio: Tomohiro Shibata received his Ph.D. from the University of Tokyo in 1996 and pursued robotics research as a JSPS and JST researcher. He worked on computational neuroscience using humanoid robots at ATR and later became an associate professor at Nara Institute of Science and Technology, focusing on robotics, computational neuroscience, and assisted living. Currently, he is a professor at Kyushu Institute of Technology and leads the Smart Life Care Co-Creation Laboratory, which develops nursing care robots. He has received numerous awards, including the RSJ Young Investigator Award (1992), Best Paper Awards from the Japanese Neural Network Society (2002, 2015), and the Best Application Paper Award from IROS (2015). Shibata is a fellow of the Robotics Society of Japan (RSJ), an executive board member of the Japanese Neural Network Society, and actively involved in various professional societies, including IEEE and the Robotics Society of India.

Talk Overview:
In his presentation, Tomohiro Shibata addresses how Japan, home to the world's highest aging population, is tackling its severe caregiver shortage by promoting the development and deployment of care robots. Since 2012, the Japanese government has supported initiatives to create and implement robotic technologies designed to meet the rising demands of caregiving. Shibata's personal experience, inspired by his mother's battle with Parkinson's disease, drives his laboratory's research on robots and information systems specifically aimed at caregiving and rehabilitation. The talk provides an in-depth look at the cutting-edge research conducted in his lab, highlighting how robots are being developed to assist caregivers and improve the quality of life for care recipients. Shibata also offers a broader overview of the current state of care robot development in Japan, showcasing advancements that help address the physical and emotional challenges of caregiving. His presentation underscores the vital role of technology in transforming elderly care, presenting innovative solutions that foster a more sustainable and compassionate care environment for the future.

Future of Modern Robotics at Addverb: Merging planning; perception and control into one?

Speaker: Rajesh Kumar
Designation: Lead Research and Development
Affiliation: Addverb Technologies

Speaker Bio: Rajesh Kumar is a leading the R &D facets in Modern Robotics at Addverb Technologies (addverb.com) which is a robotics manufacturing and embodied AI company. He has been working on writing software and intelligence modules for Legged Robots, Collaborative Arms, exoskeletons and haptic devices. Earlier, he has also worked on dedicated vision systems; teleoperation modules; grasping and in-hand manipulation modules; mobile robots (SLAM architectures) and other robots like cable driven robots etc. He has published around 30 papers in journals and conferences and has filed more than 12 patents. He holds a B.Tech from Indian Institute of Technology Delhi and a PhD from Indian Institute of Technology Delhi.

Talk Overview:
In this talk, Rajesh explores the intriguing question of whether perception, control, and planning are distinct functions or part of a unified system in robotics and autonomous systems. Traditionally, perception focuses on gathering and interpreting data, control on executing actions, and planning on strategizing future movements. However, the integration of these components is becoming essential for developing truly intelligent systems.The presentation highlights how advancements in sensor technology and data processing are blurring the lines between perception and planning. Modern control algorithms increasingly rely on real-time sensory input and predictive modeling to enhance decision-making and adaptive behavior. Through case studies and examples involving cobots, legged robots, and human-allied robots developed at Addverb, the talk emphasizes how these functions are intertwined. The discussion also addresses design challenges in unifying these processes and considers their importance for the future of autonomous systems. It prompts the audience to rethink the distinct roles of perception, control, and planning and their potential as a cohesive whole.

Robotic and Sustainable 3D Construction

Speaker: Pradeepkumar Sundarraj
Designation: Founder
Affiliation: Kelvin6K

Speaker Bio: Pradeepkumar Sundarraj is an innovative entrepreneur and scientist dedicated to transforming the world through technology. With a Ph.D. in Mechanical Engineering specializing in Solar Thermal Engineering, he brings extensive expertise in renewable energy and sustainable technologies. As the founder of Smarterz Lab Private Limited, Dr. Sundarraj pioneered Kelvin6k, a groundbreaking robotic 3D printing system for sustainable construction. His diverse experience includes postdoctoral research at the German Aerospace Center, focusing on solar-powered cement production and hydrogen generation. Dr. Sundarraj has contributed to research at the National Renewable Energy Lab in the USA and held teaching positions at prestigious institutions. With multiple publications in high-impact journals, he excels in developing innovative solutions for global challenges. Dr. Sundarraj's unique blend of academic knowledge, engineering skills, and entrepreneurial spirit makes him a dynamic speaker on sustainable technologies and innovation.

Talk Overview:
In his presentation, Pradeep explores the transformative role of robotic technology and sustainable practices in the field of 3D construction, emphasizing how automation is reshaping the construction industry. He highlights how advancements in robotic systems are enabling faster, more efficient, and environmentally friendly building processes, which are crucial in responding to the growing demands of urbanization and housing. By leveraging automation, the construction industry can achieve not only significant time savings but also reduce material waste and energy consumption, aligning with global sustainability goals. Pradeep's talk also covers real-world applications of these technologies, demonstrating how they are already being employed to tackle construction challenges. Additionally, he discusses the future potential of integrating robotics and sustainable practices more deeply into construction to meet the needs of an expanding global population. By focusing on innovative methods, the talk provides insights into how these advancements will contribute to creating more sustainable urban environments and address the pressing issue of housing shortages in a resource-efficient manner.

The future of AI agents

Speaker: Prathvi Palekar
Designation: Founder
Affiliation: Pixuate

Speaker Bio: Prathvi is the Founder and CTO of Pixuate, an AI video analytics company. He started Pixuate 10 years ago, with a focus to build products in the domain of image processing and computer vision, and since then built 30+ enterprise applications. Prathvi's key strengths are building robust and scalable deep tech products, solution designing and seamless technology architecture.

Talk Overview:
The 44th Cobotalks session on "The Future of AI Agents" provided a deep dive into the rapidly evolving capabilities of AI agents and their growing presence in everyday life. The speaker highlighted how AI agents are advancing in intelligence and are increasingly being integrated into industries such as healthcare, finance, and customer service, where they are automating tasks, enhancing decision-making, and improving efficiency. He discussed how AI agents are not only becoming more capable of handling complex tasks but are also shaping the way individuals and businesses interact with technology. A significant portion of the session focused on the ethical implications of AI agents' growing influence. As these technologies become more embedded in society, concerns around privacy, data security, algorithmic bias, and the potential for job displacement are becoming more pronounced. He emphasized the importance of responsible AI development and the need for frameworks that ensure AI is used ethically and transparently. He also explored the future trajectory of AI agents, discussing their potential to address societal challenges if developed with ethical considerations at the forefront. Overall, the talk offered a balanced perspective on the opportunities and challenges presented by AI agents, stressing the need for thoughtful and responsible innovation as these technologies continue to advance and permeate everyday life..

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