ME Seminar

A Roadmap towards next generation bionic limbs

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ABSTRACT

Neuroprosthetics for the upper limb represent a rapidly evolving field at the intersection of neuroscience, biomechanics, and robotics, aiming to restore motor function and independence for individuals with limb loss or neuromuscular impairments. Recent advances in neuromusculoskeletal modelling, neural interfacing, and wearable robotics have enabled the development of intelligent prosthetic devices capable of delivering naturalistic control and sensory feedback. By integrating real-time electromyographic (EMG) signals, cortical or peripheral neural inputs, and proprioceptive modelling, next-generation upper limb neuroprostheses can interpret user intent with improved accuracy while providing adaptive assistance in daily activities. Key research directions include the design of lightweight, energy-efficient actuators; non-invasive and implantable neural recording techniques; and closed-loop control strategies that combine feedforward motor commands with feedback from tactile and proprioceptive sensors. Clinical translation of these technologies requires rigorous evaluation, including CE certification, long-term usability studies, and trials with diverse patient populations to ensure safety and efficacy. Furthermore, collaborative efforts between engineers, clinicians, and industry are critical to bridge the gap between laboratory prototypes and accessible clinical solutions. Ultimately, intelligent neuroprosthetics for the upper limb aim not only to restore lost function but also to enhance embodiment, user comfort, and quality of life, marking a transformative step in assistive healthcare technologies.

ABOUT THE SPEAKER

Dr. Amartya Ganguly is a Senior Scientist and Group Leader for Intelligent Neuroprosthetics at the Munich Institute of Robotics and Machine Intelligence (MIRMI), TU Munich, Germany. He earned his PhD from the University of Hull, UK, and as a postdoctoral researcher at Keele University, UK contributed to developing the state-of-the art real-time neuromusculoskeletal model of the human hand. Dr. Ganguly has worked across leading European innovation programmes, including the prestigious Horizon 2020 Innosup initiative, where at Marsi Bionics he tested the world's first paediatric exoskeleton and co-developed a biomechanics laboratory with CSIC-CAR Madrid. His expertise also extends to clinical applications of hand models through collaborations with the University of Heidelberg, INRIA, and CNRS Montpellier under the EIT Health project. With extensive experience in neuromusculoskeletal modelling, CE certification of medical devices, wearable assistive technologies, and clinical trials, Dr. Ganguly is also the recipient of the Indo-German Early Career Award (IGSTC-PECFA). In addition, he is an active member of the EU COST Action initiative for Wearable Robotics, fostering collaboration between academia and industry to advance assistive technologies.

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