ME Seminar

Engineering the Future: Wearable Robots for Hands and Upper Body

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ABSTRACT

Wearable robotic interfaces work closely with human users, providing unique opportunities for physical human-robot interaction and motor skill training. These interfaces have applications across diverse fields, including virtual and augmented reality, neuromuscular rehabilitation and surgical training. However, the design, modeling and control of truly effective wearable robotic interfaces pose significant challenges, requiring a deep understanding of the coupled-human robot system. This talk will focus on wearable robotic devices that leverage human biomechanics, psychophysics and neuromuscular control to achieve effective system performance. For virtual and augmented reality applications, wearable pneumatic and electrostatic displays that successfully render fine and coarse tactile pressure, vibration and kinesthetic haptic feedback on the hand will be presented. Additionally, wearable devices developed for rendering squeeze, tactile pressure and vibration haptic feedback on the wrist will be discussed. For rehabilitation applications, the first wearable robotic device with series elastic actuation for hands, enabling bidirectional torque control of individual finger joints, will be introduced. To ensure effective control for hand rehabilitation, control algorithms based on motor learning theory that automatically learn a subject-specific model of the hand-robot system, providing the correct level of haptic assistance to promote optimal recovery, will be presented. Finally, the talk will conclude with future research directions on how wearable robotics can address pressing societal challenges in India, highlighting their potential to improve quality of life.

ABOUT THE SPEAKER

Priyanshu Agarwal is an experimentalist with a passion for developing innovative solutions in the field of wearable robotics. His research interests span both fundamental and applied aspects of the design, modeling and control of upper-body wearable robotic systems. He has been a Research Scientist at Meta Reality Labs Research, USA (formerly Facebook Research) for the past 6 years. He received his Ph.D. in Mechanical Engineering from the University of Texas at Austin in 2017, supported by George J. Heuer, Jr. Ph.D. Endowed Graduate Fellowship. Priyanshu is a recipient of the Outstanding Researcher Award from the National Center for Simulation in Rehabilitation Research at Stanford University and three Best Paper Awards at international conferences. He has published over 40 papers in peer-reviewed journals and conferences and has filed 29 US patents. He also served on the program committee of 2018 Robotics: Science and Systems Conference and currently serves as a Review Editor for the journal Frontiers in Robotics and AI: Robotic Control Systems.
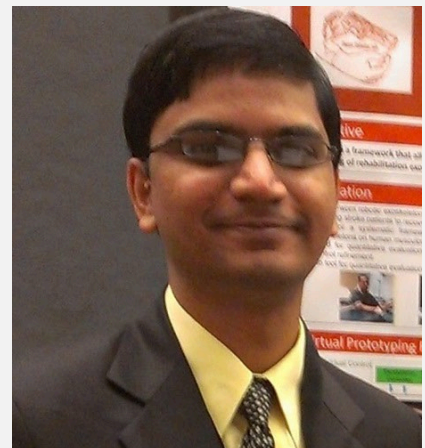
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