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# NSF National Robotics Initiative Grant Aims to Revolutionize Construction Sites with Wearable Robots



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Houtan Jebelli

Assistant Professor Houtan Jebelli will lead a study into the integration of exoskeletons – advanced wearable robots – focused on reducing work-related injuries among construction workers. This research is funded by a grant from the National Science Foundation (NSF) under its National Robotics Initiative program, designed to promote the development and use of robots that work alongside or cooperatively with people to enhance individual human capabilities, performance and safety.

Exoskeletons are not merely tools, but rather advanced robotic partners engineered to provide essential support for lifting, dispersing weight and correcting posture, directly confronting the physical demands that lead to injuries in the construction sector. Despite their potential, the journey towards their full integration on construction sites is fraught with unknowns, especially concerning the possible risks and challenges these robotic aids may introduce to the workers they aim to protect. Jebelli's project aims to illuminate these issues, focusing on the physical, psychological and socio-technical aspects of using wearable robots in the demanding environments of construction sites.

“With more than 7.5 million workers in the U.S. construction sector, the stakes of this research are incredibly high,” Jebelli said. “This project seeks to provide manufacturers with the empirical evidence necessary to develop exoskeletons that are not only more versatile and user-friendly but also customized to accommodate the diverse needs of the construction workforce, ensuring comfort and widespread acceptance across various body shapes and sizes.”

This interdisciplinary initiative merges the latest advancements in immersive technologies, physiological sensing and organizational psychology with the dynamics of wearable robots, embarking on a comprehensive investigation into the complex risks associated with exoskeletons in the construction sector. The project is structured around three objectives.



Amit Ojha, a doctoral student under the supervision of Assistant Professor Houtan Jebelli, evaluates the psychophysiological effects of wearable robots on construction workers, analyzing patterns in the subjects' brainwaves.

The first objective aims to uncover the barriers and facilitators affecting the adoption of robotic exoskeletons within the construction industry, employing a socio-technical perspective to understand the intricate relationship between humans and robots. The second objective will establish an immersive, interactive virtual reality environment, marking a significant advancement in simulating construction tasks with exoskeletons. This virtual workspace is meticulously designed to examine the interactions between construction workers and their robotic aides, assessing physical and psychological risks in a secure, controlled setting. The third objective of the research will develop a new framework for assessing the risks associated with using robotic exoskeletons. By integrating artificial intelligence with objective data analysis, this framework aims to create a novel interpretive pipeline between physiological signals and their practical implications on muscle fatigue, fall risk, joint hyperextension, cognitive workload, trust and vigilance among workers during construction tasks.

The project not only underscores the transformative potential of robotic exoskeletons in reshaping the construction industry but also emphasizes the need for a comprehensive understanding of their impact on worker safety and efficiency. By charting a course toward the safe and effective use of robotics in construction, Jebelli's research promises not just to safeguard workers but to significantly enhance their capabilities, heralding a new chapter in construction technology.

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