

THE FRONT LINE

News from the field

Cracking the exoskeleton quandary

Clemson team studies why devices aren't more widely used

As exoskeletons have advanced as ever-more sophisticated devices to ease workers' physical strains, their actual use hasn't yet become commonplace.

To find out why, a team of Clemson University industrial engineers launched a research project supported by a National Science Foundation grant of \$4 million. The effort, led by professor and IISE member Divya Srinivasan, is targeted at making exoskeletons less of a sci-fi entity and more adaptable as a tool used daily for workplace tasks and other functions.

The research to date has shown that exoskeletons work best when subjects perform specific, controlled tasks. Though several major companies have also expressed interest in adopting exoskeletons and trying pilot programs, Srinivasan said there are gaps in applying them to real jobs. She listed barriers to more widespread deployment that include use of exoskeletons in industrial workflow, understanding the social and organizational culture needed to implement them and enabling faster design-to-device cycle time.

"Our research is trying to ask, 'Where is this bottleneck?'" she told *news.clemson.edu*. "What's missing between the laboratory research versus the practical considerations when you get the exoskeletons out there?"

The team's research is focused not just on exoskeletons as a tool like any other piece of equipment but as part of a more complex socio-technical system with a wider range of factors for business as well as social, physical and psychological impacts.

"We're saying we need to evolve and think about this in a systemic way," Srinivasan said.

Team member Jessica Avilés, a postdoctoral fellow in Srinivasan's lab, said her focus is more on exoskeleton use for physical rehabilitation to help amputees and older adults move and function easier.

"There's a lot of different exoskeleton research in industry



Clemson University Ph.D. student Rahul Narasimhan demonstrates an exoskeleton that supports the back while Jessica Avilés (left) and Divya Srinivasan (right) observe.

and manufacturing, but there is also a big need in rehabilitation," Avilés said. "Can you improve walking, mobility and quality of life with exoskeletons?"

Ph.D. student Rahul Narasimhan, who learned about Srinivasan's research after launching an exoskeleton startup in India, wanted to learn more about such uses.

"She was trying to figure out how they affect older people and people working in industry and how they can reduce the disorders you get from overworking," Narasimhan said. "That was a real impact. I wanted that."

Collaborators on the project include Virginia Tech, the University of South Florida, Brigham Young University, the Florida Institute for Human and Machine Cognition, exoskeleton manufacturers and representatives from the manufacturing and construction industries.

"Dr. Srinivasan's extensive research into exoskeletons and her prior experience in leading major federally funded studies position her and her team for success," said Kevin Taaffe, chair of Clemson's Department of Industrial Engineering and an IISE member."

Photo courtesy of Clemson University