

NASA and IHMC develop robotic exoskeleton for space and possible use on Earth

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A new robotic space technology spinoff derived from NASA's Robonaut 2 project someday may help astronauts stay healthier in space and aid paraplegics in walking here on Earth. Robonaut 2, the first humanoid robot in space, currently is working with astronauts aboard the International Space Station.

NASA and The Florida Institute for Human and Machine Cognition (IHMC) of Pensacola, Fla., with the help of engineers from Oceanering Space Systems of Houston, have jointly developed a [robotic exoskeleton](#) called X1. The 57-pound device is a robot that a human could wear over his or her body either to assist or inhibit movement in [leg joints](#).

In the inhibit mode, the [robotic device](#) would be used as an in-space exercise machine to supply resistance against leg movement. The same technology could be used in reverse on the ground, potentially helping some individuals walk for the first time.

"Robotics is playing a key role aboard the [International Space Station](#) and will be critical in our future [human exploration](#) of deep space," said Michael Gazarik, director of NASA's Space Technology Program. "What's extraordinary about space technology and our work with projects like Robonaut are the unexpected possibilities space tech spinoffs may have right here on Earth. It's exciting to see a NASA-developed technology might one day help people with serious

ambulatory needs to begin to walk again, or even walk for the first time. That's the sort of return on investment NASA is proud to give back to America and the world."

Worn over the legs with a harness that reaches up the back and around the shoulders, X1 has 10 [degrees of freedom](#), or joints—four motorized joints at the hips and the knees, and six passive joints that allow for sidestepping, turning and pointing, and flexing a foot. There also are multiple adjustment points, allowing the X1 to be used in many different ways.

X1 currently is in a research and development phase, where the primary focus is development, evaluation and improvement of the technology. NASA is examining the potential for the X1 as an exercise device to improve crew health both aboard the space station and during future long-duration missions to an asteroid or Mars. Without taking up valuable space or weight during missions, X1 could replicate common crew exercises, which are vital to keeping astronauts healthy in microgravity. In addition, the device has the ability to measure, record and stream back in real-time data to flight controllers on Earth, giving doctors better insight into the crew's exercise.

X1 also could provide a robotic power boost to astronauts as they work on the surface of distant planetary bodies. Coupled with a spacesuit, X1 could provide additional force when needed during surface exploration, providing even more bang for its small bulk.

Here on Earth, IHMC is interested in developing and using X1 as an assistive walking device. Using NASA technology and walking algorithms developed at IHMC, X1 has the potential to produce high torques to allow for assisted walking over varied terrain, as well as stair climbing. Preliminary studies using X1 for this purpose have already started at IHMC.

"We greatly value our collaboration with NASA," said Ken Ford, IHMC's director and CEO. "The X1's high-performance capabilities will enable IHMC to continue performing cutting-edge research in mobility assistance and expand into rehabilitation."

The potential of X1 extends to other applications, including rehabilitation, gait modification and offloading large amounts of weight from the wearer. Preliminary studies by IHMC have shown X1 to be more comfortable, easier to adjust, and easier to put on than older exoskeleton devices. Researchers plan on improving on the X1 design, adding more active joints to areas such as the ankle and hip, increasing the potential uses for the device.

Designed in an extremely short timeframe, X1 came from technology developed for Robonaut 2 and IHMC's Mina exoskeleton. NASA's work in robotic exoskeleton systems complements work done by other government agencies, such as the Defense Advanced Research Project Agency's Exoskeletons for Human Performance Augmentation Program.

NASA's Game Changing Development Program, part of NASA's Space Technology Program, funds the X1 work. NASA's [Space Technology](#) Program focuses on maturing advanced space technologies that may lead to entirely new approaches for [space](#) missions and solutions to significant national needs.

More information: For additional information about IHMC, visit: www.ihmc.us

For information about the X1 and Robonaut, visit: www.nasa.gov/robonaut

Provided by NASA

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