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Giving soldiers a high-tech leg up

DECEMBER 8, 2005 [MD Staff](#)

Those whiz kids at Darpa are at it again. This time they want to use technology to let soldiers carry up to 220 lb in backpacks over all types of terrain, terrain vehicles can't get through, and for extended lengths of time.

Those whiz kids at Darpa are at it again. This time they want to use technology to let soldiers carry up to 220 lb in backpacks over all types of terrain, terrain vehicles can't get through, and for extended lengths of time. They believe the key is wearable robotic exoskeletons and have invested \$50 million in the project. One recipient, a design team at the University of California, Berkeley, is under the lead of Mechanical Engineering Prof. H. Kazerooni. They've completed work on their first prototype, Bleex 1 (for Berkeley lower extremity exoskeleton) and are working on Bleex 2.

Bleex 1 consists of a pair of hydraulically powered leg braces, more than 40 electronic sensors, a control computer, and an internal-combustion engine providing power from an attached backpack. The plastic and carbon-fiber braces are affixed rigidly to the soldier through a customized pair of standard Army boots, with more compliant and giving connections at the chest and waist. These looser connections prevent blisters and abrasions.

The 2-hp engine turns a pump to pressurize the hydraulic system with 1,000-psi fluid. Hydraulics power the actuators, giving the exoskeleton its muscles and letting it move. The engine also turns a generator for electricity. The device carries about a quart of gas, enough for 15 min of high-powered walking. After experimenting with a number of fuels, including concentrated hydrogen peroxide, Kazerooni decided on using gasoline based on its power density. It also lets the device be refueled in the field. If Darpa has its way, however, the exoskeleton delivered to the Army will probably use JP-4, the common battlefield fuel for tanks, humvees, and other armored vehicles.

Key to controlling Bleex 1 is the lack of operator controls. Instead, Berkeley researchers clinically analyzed the human gait and programmed the robotic legs to follow that pattern. The wearer simply moves his limbs, and the suit detects that movement and powers the suit to follow. The backpack load is almost entirely supported by Bleex. But because the device is so sensitive to inputs, it is almost unstable, says Kazerooni. The operator is needed to provide balance.

"The pilot is not 'driving' the exoskeleton," says Kazerooni. "Instead, the control algorithms in the computer constantly calculate how to move the exoskeleton so that it moves in concert with the human."

Each leg has five electronic modules connected in a high-speed synchronous



Bleex 1, an experimental exoskeleton, lets a person carry a 70-lb load, along with the 100-lb Bleex 1 itself, but feel as if he is carrying a 5-lb load.



The final version of Bleex will let soldiers carry 200-lb backpacks.

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