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NEWS

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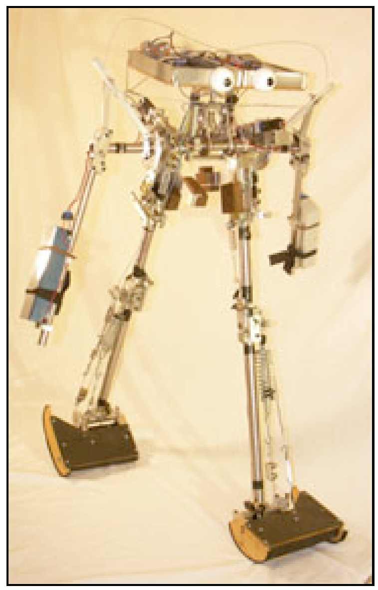
Robots toddle along with human efficiency

Jessica Ebert

Passive dynamics is key to the prowess of mechanical triplets.

Three robots that walk with a human gait have been unveiled. They use a unique system that makes them far more efficient than previous walking machines, requiring only as much energy as a person does for a stroll.



Researchers at Cornell University have developed a robot with close-to-human efficiency.

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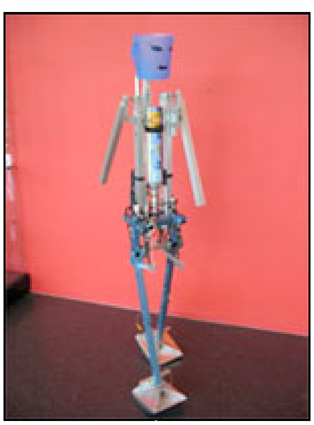
Robots such as Honda's Asimo use about ten times as much energy as a walking human, because all the movement in the leg joints are powered by motors. But the new robots use a system called passive dynamics, which allows the robots' lower legs to swing back into place after each step using gravity alone.

"These robots are the first powered robots that use passive dynamics," says Steven Collins, a mechanical engineer at the University of Michigan, Ann Arbor, who co-authored a research paper describing all three machines in this week's *Science*[1]. The droids were also shown off at the annual meeting of the *American Association for the Advancement of Science* in Washington on 17 February.

Made for walking



Denise, the Delft University robot, walks tall.

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The robots were created by teams at Cornell University in Ithaca, New York, the Massachusetts Institute of Technology in Cambridge, and Delft University of Technology in the Netherlands.

Less motorized movement is the secret to energy efficiency, says Andy Ruina, a mechanical engineer at Cornell. "If not designed well, motors absorb energy," he says. "To decrease the energy absorbed you must decrease the work the motors do."

To that end, Ruina and colleagues expanded the work of Tad McGeer, an aeronautical engineer who founded the Insitu Group, a company based in Bingen, Washington, that develops miniature robotic aircraft.

McGeer pioneered the study of passive-dynamic walkers that could travel down slanted runways powered only by gravity.

In a manner similar to the Wright brothers, who achieved powered flight by meticulously studying gliders and simply adding a motor, Ruina and the other researchers studied these

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downhill robots and substituted small motors for gravity's power, allowing them to walk along level surfaces.

Do the locomotion

The Cornell robot weighs in at about 13 kilograms with legs about a metre long, but the MIT machine, coined the 'Toddler', is just 2.74 kilograms and a mere 43 centimetres tall. Delft's robot comes between the two, weighing 8 kilograms and measuring 1.5 metres in height.

The MIT robot is the first walking machine to use a learning programme that allows it to adapt to changing terrain. "In the very near future we're going to see these robots walking over terrain they've never walked over before," says Russ Tedrake, lead designer of the Toddler.

The stable, humanlike movements of the walkers suggest that passive-dynamic effects are important in the natural mechanics of human walking. Ruina expects that these robots will provide insights into the locomotion of animals, into the biomechanics of foot placement and balance, for example. In addition, the machines could help in designing walking prosthetics that take less effort to use.

Ruina points out that the Cornell and Delft robots can only go forwards, so this is just the first step in developing useful walking machines. "We have a long way to got to keep these robots efficient while improving their versatility," he says. "But it's an exciting time in robotics," adds Tedrake.

Click here to see a prototype of the walking robot.

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References

1. Collins S., Ruina A., Tedrake R. & Wisse M. *Science* **307**, 1082 - 1085 (2005). | Article |

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