The machines use what the researchers called a "passive-dynamic design" that closely mimics the way humans walk. Earlier robots required motors to move each leg, knee and ankle, requiring a lot of power.

The passive-dynamic design uses gravity, along with muscle-like springs and motors. The energy required is just a small fraction of that needed by other walking robots, said Andy **Ruina,** a Cornell University researcher.

Ruina said the walking robots move like humans, falling and catching themselves as they move forward. This essentially is the same movement people use, a motion toddlers must master to walk.

Another robot designed by Russell Tedrake of Massachusetts Institute of Technology is equipped with sensors that help the machine learn to walk in a way similar to humans' gait. Appropriately, the machine is called Toddler.

"It can learn to walk in 20 minutes," Tedrake said. "Once it learns to walk, then it adapts its gait to new terrain."

-- Associated Press

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because humans don't always walk downhill, but that these new machines demonstrate that there is nothing special about gravity as a power source.

Gravity-powered walking toys walk downhill by swaying from side to side, allowing first one foot and then the other to swing forward. Human beings minimize the swaying and bend their knees to allow the moving foot to clear the ground, and two of the three new robots do the same. All three robots have arms synchronized to swing with the opposite leg for balance.

The Cornell robot supplies power to the ankles to push off. When the forward foot hits the ground, a simple microchip controller tells the rear foot to push off. During the forward swing of each leg a small motor stretches a spring, which is finally released to provide the push.

The Delft robot uses a pneumatic push at the hip, and the MIT robot uses electric motors that directly move the ankle. Control programs in the Cornell and Delft robots are extremely simple, while the MIT robot uses a learning program that lets the robot teach itself to walk, which it can do in about 600 steps.

The fact these robots can walk with a humanlike gait with simple control programs "suggests that steady-state human walking might require only simple control as well," the researchers say. "The success of human mimicry demonstrated here ... strongly suggests an intimate relationship between body architecture and control in human walking." ■

MAKE CONTACT:

Andy Ruina's research page:
www.tam.cornell.edu/Ruina.html#research

Video and other supporting materials:
www.aaas.org/news/releases/2005/0217robot.shtml

fridge. The Delft pneumatic robot, fitted only with a plastic bucket for a head, begins with a gas-powered push at the hip rather than the ankle. "Already, our robot seems to be at least 10 times more efficient than anybody else's," said Andy Ruina, professor of theoretical and applied mechanics at Cornell.

MIT scientists took the logic of "one step at a time" even further. They developed a silicon stroller called Toddler: it learned to stand upright and step out the way a baby does, by trial and error. But Toddler had a head start: it was fitted with a "learning programme" that taught it to walk in less than 20 minutes, or 600 steps, without any further help from its anxious academic parents. Yesterday, it shuffled shyly into the limelight and then stopped. "On a good day," said Ross Tedrake of MIT, "it will walk on any surface."

Steven Collins, formerly of Cornell but now at the University of Michigan, has already begun applying the lessons of the robot rambler to a powered prosthetic foot for amputees.

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