Robots take it all in their (human) stride

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Tread carefully, Robocop. Watch your step, R2D2. Scientists yesterday introduced a new generation of robots with a human stride, using the power of gravity, the wattage of a light bulb and an idea borrowed from Victorian children's toys.

Robots - even movie robots - tend to move jerkily, or clank along on large, flat feet. Asimo, the automated android pioneered by Honda, has a bipedal gait that consumes at least 10 times the energy spent by a human in a brisk walk.

So scientists from Cornell University, the Massachusetts Institute of Technology (MIT) and the University of Delft in Holland chose a different starting point, they reveal today in the journal Science. And yesterday they let one metal model each fitfully strut its stuff on the catwalk at the American Association for the Advancement of Science meeting in Washington.

All three robots sprang from a simple mechanical ancestor: a toy designed in the early 19th century to walk down a shallow slope under the force of gravity. Because yesterday's robots stepped out on level ground, a small electric motor replaced gravitational power in each case.

All three silicon cyborgs use a technique of "passive-dynamic" walking. That is, they do what humans do and swing along with a minimum of effort, exploiting their own inertial momentum. Gravity-powered walking toys work by swaying from side to side, allowing first one foot and then the other to swing forward. Humans reduce the swaying and bend the knees to lift the moving foot off the ground, and two of the three new robots do the same. All three have arms that swing in synchrony with the opposite leg, to keep balance.

The Cornell robot supplies power to the ankles to push off. When the first foot hits the ground, a simple microchip command tells the second to step out. A spring, made taut and released with each step, keeps the robot stepping out on level ground, using about the wattage of a light bulb in a

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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