TECHNOLOGY

High Robot

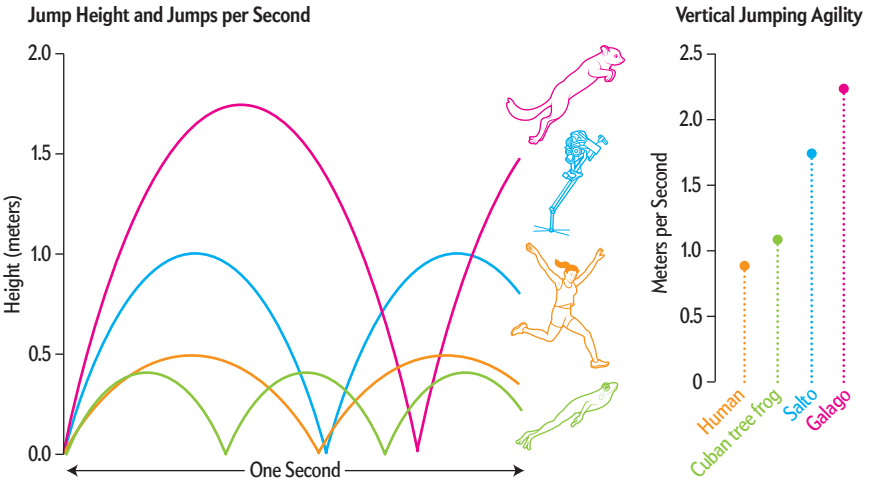
Mimicry of a small African mammal enabled the development of a more agile robot

Robots are notoriously lousy jumpers. Some can jump high, but not repeatedly, over a short period. And vice versa. Duncan Haldane, a roboticist and Ph.D. student at the University of California, Berkeley, realized one implication of this shortcoming—many existing bots cannot maneuver large gaps and high hurdles at, say, a disaster site where they are doing rescue work. So Haldane turned to the animal kingdom to study nature's best jumpers, hoping to select one as a model for a more agile, autonomous machine.

Haldane started by creating a measure to assess both how high and how rapidly an animal could jump. His further research determined that nature's best continuous jumper is the galago, or bush baby, a nocturnal primate native to Africa. The galago's agility metric was twice that of any contemporary jumping robot. The results were detailed in a recent issue of *Science Robotics*.

The galago's legs and muscles are optimized for crouching, a position that helps it store potential energy in its tendons. Haldane translated those physics to fashion a robot he named Salto. It weighs just 100 grams (about the mass of a bar of soap) and has a one-meter vertical jump. But more remarkably it can jump off a floor to a target on a wall and ricochet an average of another 1.21 meters higher. The mechanics of the new jumping system, Haldane says, could be applied to any robot. And that means it is only a matter of time before more of our mechanical friends can leap tall buildings, at least in multiple bounds.

—Erin Biba



To develop Salto, researchers studied the jumping behavior of several animals, including the galago, a small African primate with remarkable agility. Jumpers were compared using vertical jumping agility, a metric that combines height and the number of jumps done in one second.

SOURCE: "ROBOTIC VERTICAL JUMPING AGILITY VIA SERIES-ELASTIC POWER MODULATION," BY DUNCAN W. HALDANE ET AL., IN *SCIENCE ROBOTICS*, VOL. 1, NO. 1, ARTICLE NO. EAAG2048; DECEMBER 6, 2016

ENERGY

Green Hydrogen

A viable solar-powered approach for making hydrogen fuel might be within reach

Hydrogen is currently used to upgrade crude oil and synthesize ammonia, a critical building block of the fertilizers applied in modern agriculture. It also could be valuable as a feedstock for generating green electricity and as an ingredient in environmentally friendly fuel cells to power cars and trucks. But hydrogen is commonly produced from natural gas heated by steam, which results in greenhouse gas emissions and other environmental problems. Thus, scientists have been working to replace this process with one that taps a renewable energy source—and just such a breakthrough was announced in a paper recently published in *Nature Energy*.

The new approach relies on a photoelectrochemical (PEC) device, a type of solar cell that can potentially split water molecules more efficiently than other methods. Scientists have long struggled to design a PEC device that is both efficient and durable enough to be cost-effective. A key advance came 18 years ago, when John Turner, an electrochemist at the U.S. National Renewable Energy Laboratory, designed a device that comprised layers of gallium indium phosphide and gallium arsenide semiconductors. These materials convert sunlight to electricity more efficiently than other options. Turner's design held the record for the highest solar-to-hydrogen conversion efficiency until 2015. But the acidic solution to which the cell was exposed while in use quickly broke it down, making the hydrogen it produced too expensive.

For the new design, researchers led by chemist Jing Gu of San Diego State University added coatings to the semiconductor layers to prevent acid corrosion. These protective coatings significantly extended the life of Turner's high-efficiency design and produced a PEC device that retains 80 percent of its capabilities in durability tests. A "hydrogen economy" in which consumers can make their own hydrogen to power their cars and heat or cool their homes may not yet be imminent, but at least this engineering feat makes such a future sound a little less like utopian hype. *—Melissa C. Lott*

Graphic by Brown Bird Design (figures) and Amanda Montañez (graphs)