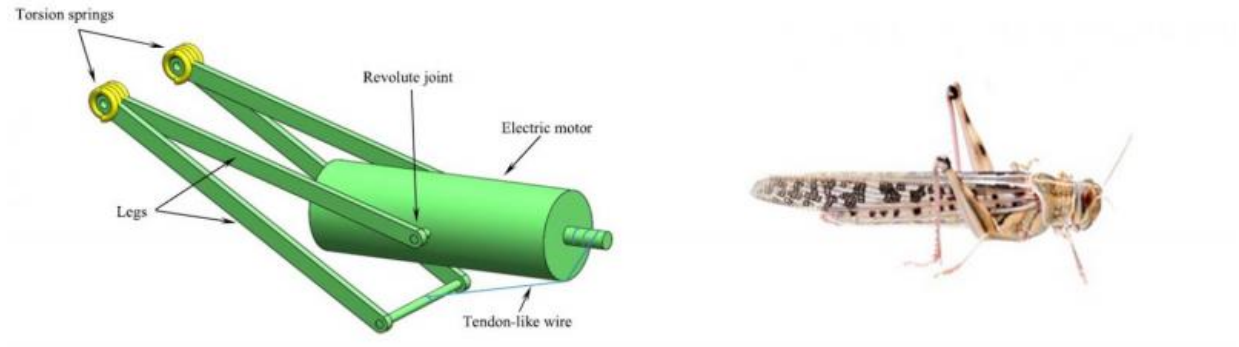
Locust-inspired robot can jump 11 feet high (w/ video) (Updated)

December 10 2015, by Lisa Zyga



Conceptual design of the robot compared to a desert locust. Credit: Zaitsev, et al.

(Tech Xplore)—Researchers have built a locust-inspired robot that is just 5 inches (13 cm) long and weighs 23 grams, but despite its small size can jump 11 feet (3.35 m) high and cover a horizontal distance of 4.5 feet (1.37 m). This jump height is more than twice the height of similar-sized jumping robots, and is 25 times higher than its own length. The robot could have applications in search-and-rescue missions, reconnaissance, and environmental monitoring in rough terrain.

The team of researchers, Valentin Zaitsev, et al., that developed the miniature jumping robot is from Tel Aviv University and Ort Braude College, both in Israel, which inspired the name of the robot: TAUB (Tel

Aviv University and Braude College).

"We demonstrate a design that is closer to nature," Zaitsev told *Tech Xplore*. "In addition, the design enables a significant increase in stored energy. Both these aspects result in better performance compared to previous robotic designs."

As the researchers explained, the main reason why TAUB can jump so much higher than previous robots is because of its ability to store significantly more energy in the torsion springs in its "leg joints." It does this by using a simple lever mechanism inspired by the way that the desert locust jumps by using its strong hind legs to catapult itself into the air.

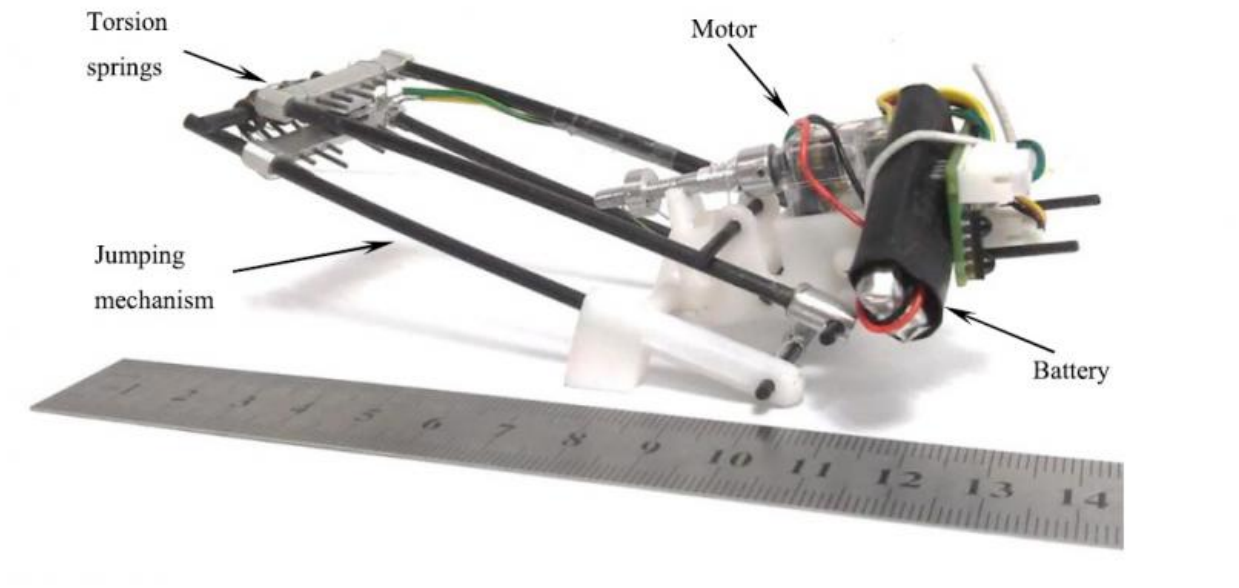
The locust catapults itself in a three-stage process. First, the legs are bent in the preparation stage. Then the legs are locked in place at the joint. Finally, a sudden release of the flexor muscle on the upper leg unlocks the joint and causes a rapid release of energy. This creates a fast kicking movement of the legs that propels the locust into the air.

Instead of attempting to produce an exact imitation of the entire locust body and jumping procedure, the researchers focused on some of the specific biomechanical features of the locust's highly successful jump mechanism.

The TAUB robot's jump mechanism is based on a tendon-like wire that connects a miniature electric motor on its body to the ends of its legs. When the motor rotates, the wire pulls both tibias (lower legs) toward the body, storing the required energy. A special locking mechanism holds the legs securely in place after loading completes. When the motor spins in reverse, uncoiling the wire, at a certain point it unlocks the legs, causing the torsion springs at the joints to quickly release their stored energy. This in turn produces a kicking movement similar to that of the

legs of the locust.

The robot design is fairly simple: its body was printed on a 3D printer using ABS plastic (the same material that Legos are made of), the legs are made of stiff carbon rods, and the torsion springs are made of music wire steel. The braided tendon-like wire is similar to fishing line. A small on-board battery powers the robot, which is remotely controlled using an on-board microcontroller.



Prototype of TAUB, the 23-gram miniature jumping robot. Credit: Zaitsev, et al. ©2015 IOP Publishing Ltd

The researchers are currently working on a gliding mechanism that will enable the robot to extend its jumping range, lower its landing impact, execute multiple steered jumps, and stabilize the robot while airborne. Stability is particularly important because when the robot's center of

mass deviates by even a few millimeters, the robot can roll in the air. Rolling makes it difficult to steer the robot, wastes energy, and makes landing more complicated.

"We plan two main goals," Zaitsev said. "The first is a jumping-gliding mechanism that will increase the robot's range and stabilize the robot while airborne. This mechanism, which is also inspired by the locust, will allow the robot to execute multiple jumps and to perform steering actions. The second goal is to develop a jumping mechanism with the ability to right itself, which will also incorporate the ability to perform control steering. In such a way, the robot will be able to navigate in a specified area."

More information: Valentin Zaitsev, et al. "A locust-inspired miniature jumping robot." *Bioinspiration & Biomimetics*. DOI: 10.1088/1748-3190/10/6/066012