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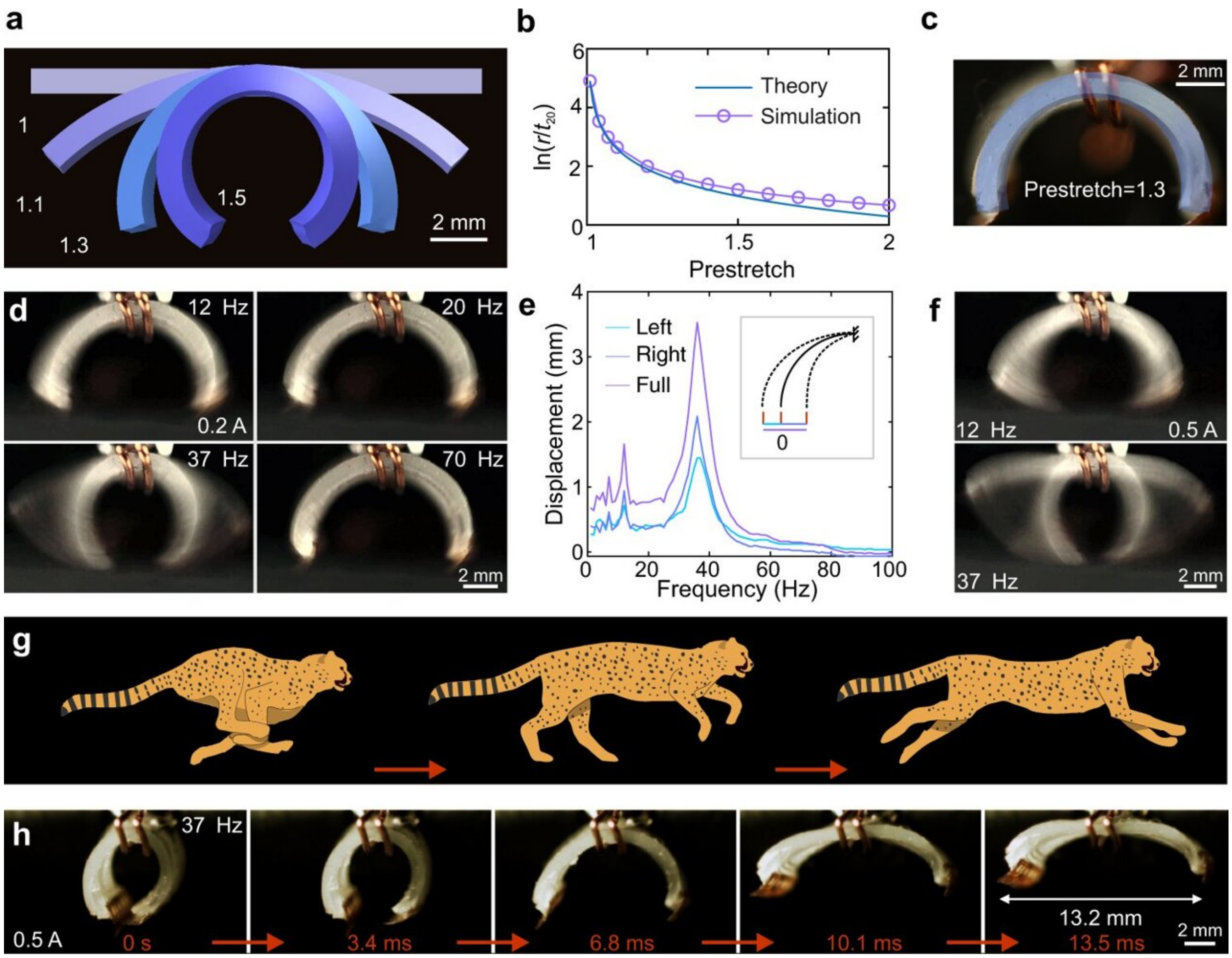
Watch tiny electromechanical robots that are faster than cheetahs for their size

August 10 2022, by Bob Yirka



Design and characterization of small-scale SEMRs. a Simulated shape of the bilayer film with different prestretches: 1.0, 1.1, 1.3, and 1.5. b Simulated and calculated radius of the bilayer film as a function of the applied prestretch. c Superimposed pictures of the experimental and simulated SEMR shapes (side view) with a prestretch of 1.3. d Snapshots of the SEMR vibrations for 0.2 A square-wave current with different frequencies (Supplementary Movie 2). The 37 Hz and 12 Hz frames correspond to the main and the second-largest spectral maxima, which can be seen in e. e Horizontal displacement of the left foot of the robot subjected to a 0.2 A square-wave current at different frequencies (Supplementary Movie 2). The robot is mounted on the top of a magnet and clamped in the middle with copper wires. The inset illustrates three displacements (Left, Right and Full). They correspond to the maximum displacement from the reference “0” position (no current) to the left (extension), right (contraction) and their sum, respectively. The top curve (Full) shows the full range of the foot displacement. f Frames from the vibration test for 0.5 A square-wave currents at frequencies of 12 Hz and 37 Hz (Supplementary Movie 2) illustrate the range of motion away and close to the resonance frequency. g Illustration depicting a running cheetah. h Snapshots from the high-speed camera video (Supplementary Movie 2), which show stages of the robot movement driven by a square-wave current (0.5 A, 37 Hz). Credit: *Nature Communications* (2022). DOI: 10.1038/s41467-022-32123-4

A team of researchers at Johannes Kepler University, in Austria, has developed a series of tiny, steerable electromechanical robots that can walk, run, jump and swim at high speeds for their size. In their paper published in the journal *Nature Communications,* the group describes how they built their robots and suggests possible uses for them.

As the researchers note, many animals can move quickly—cheetahs, for example, or gazelles. These traits have evolved to help the animals either capture prey or elude capture by predators. Creating robots with similar speed capabilities has been a goal of scientists for many years, but achieving it has proven to be difficult. In this new effort, the researchers built a series of robots using soft, tiny electromagnetic actuators with embedded liquid metal coils that are fast for their size.

To make their robots, the researchers printed liquid metal coils onto different substrates that had different desirable characteristics, such as bendability. The coils were printed in a way that would allow different parts of the substrate to be manipulated in a desired way—bending just one part, for example, could allow for a back end to swish like a tail when swimming like a fish. Bending other parts allowed for walking, jumping and steering. The researchers also added other elements to enhance performance, such as sawtooth or L-shaped feet. All of the robots were controlled using a magnetic field and powered via a tether or battery pack.

The researchers used body lengths per second (BL/s), which allows for comparisons with not just other tiny robots, but robots of all sizes, and even animals. A formula I racecar, for example, can move at approximately 50 BL/s.

In testing their robots, the researchers found that their postage-stamp-size tethered running robot could move at approximately 70 BL/s on its best surface and approximately 35 BL/s on arbitrary surfaces—its untethered robot, burdened with a battery pack, could only manage 2.1 BL/s. They also found their tethered swimming robot could swim at approximately 4.8 BL/s. To put the results into perspective, a cheetah runs at between 20 and 30 BL/s.

More information: Guoyong Mao et al, Ultrafast small-scale soft electromagnetic robots, *Nature Communications* (2022). DOI: 10.1038/s41467-022-32123-4