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News & Comments

An Ant That Blasts Itself Out of Danger

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A bear trap strapped to your head might seem like a good idea if you're barely the size of an eyelash and looking for fast-moving prey. The fun doesn't really begin until the gun goes off. You could lose your face in your back pocket even if the trap's arc wobbled a bit.

Trap-jaw ants have found a solution to this problem, making them among the fastest snappers in nature. To determine whether the mechanical jaws of death of trap-jaw ants, Odontomachus brunneus, are able to withstand the insane forces that force them to close, US researchers performed mathematical modeling on the head anatomy of this species.

Biologically, ants' mandibles are spring-powered levers with latches locked in place by hair-trigger mustaches that release when prey tickles them. It's not uncommon for itty-bitty creepy crawlies to use latch-mediated spring actuation (LaMSA). A spring in all kinds of insects' steps (and bites) is provided by elastic energy as biology shrinks.

LaMSAs can be powerful enough to overpower materials, but too much of a good thing could cause it to break apart. A good example of this is the Dracula ant (Mystrium camillae). It is the fastest moving body part in all of nature, able to swing its mouth parts shut at speeds exceeding 320 kilometers per hour.

Despite its slower speed of 196 kilometers per hour, O. brunneus deserves a silver medal for its equally impressive performance. Each mandible rotates at 470,000 rpm to capture its prey in milliseconds by slicing through the air with the slightest touch. The same jaws can also be used to manipulate materials with delicate dexterity, including young.

The ants' ability to switch between being boxers one moment and surgeons the next would require some extremely fine-tuned machinery, so researchers filmed them at high speeds to better understand what was going on. After 65 degrees, each mandible decelerated before resuming its perfect arc. A small amount of shrinkage and shortening occurred as the mandibles closed, causing the ant's head to change shape.

Based on these figures, a set of biomechanical models demonstrated that the exoskeleton itself provided half the energy for swinging. Half of the supply was provided by a large muscle deep within the skull pulling a tendon into tension. They hold each mandible back, ready to pop, as they attach to the inside of each ant's head. The latch lifts when something flicks the trigger, releasing energy from the tendon and launching the tip forward.

A second force is provided by the mandible that pushes the front of the deformed head back into place. By pulling the shrinking tendon and relaxing the exoskeleton, not only speed is provided, but precision is also achieved in dissipating energy evenly, which reduces the likelihood of critical failure.

A dual-action spring is such a clever use of a spring that the researchers wouldn't be surprised to find it in other insects. The prevalence of this skill in making fast and precise movements could be revealed in future research.

KEYWORDS

Odontomachus brunneus, ants, blasts off