# Bugs give robotic arms a hand

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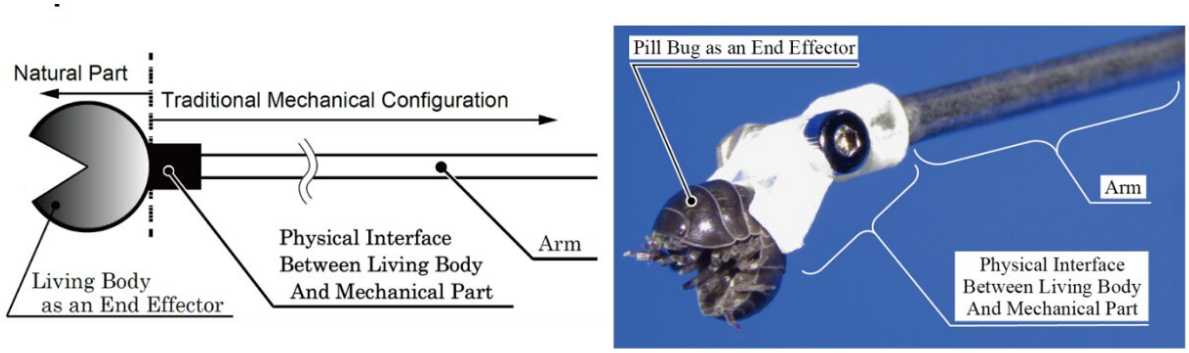


Graphical abstract. Credit: *arXiv* (2023). DOI: 10.48550/arxiv.2306.03906

Researchers at three Japanese universities exploring the potential benefits of collaborations between robots and living creatures found bugs in their project.

That's because they put them there. Specifically, pill bugs, also known as woodlice, part of the family of Armadillidiidae, were selected for their experiment because of the tiny critters' natural reflex to grasp objects.

Researchers at Japan's Yamagata, Keio and Tohoku universities who specialize in interactive biorobotics wanted to explore how reflexive habits of an entire organism with an exoskeleton can be applied to robotic behavior.

"This approach departs from traditional methodologies by leveraging the structures and movements of specific body parts without disconnecting them from the organism, all the while preserving the life and integrity of the creature," Researcher Josephine Galipon said in a paper, "Biological Organisms as End Effectors," published on the *arXiv* pre-print server June 6.

Their conclusion: Pill bugs as well as chitons (marine mollusks) can be used as functional grippers when attached to the hands of robotic arms.

They noted that prior experiments with attachments to the ends of robotic arms (also known as "end effectors") utilized body parts such as grafted skin or muscle tissue, but none used an entire organism.

The researchers designed a 7mm-wide harness attached to a robotic arm. It weighed 0.76 grams. A demonstration video provided by the team shows the pill bug closing its shell upon contact with a tiny piece of cotton. It grasped it for about two minutes before release.

Seeking to replicate such functionality for underwater tasks, the researchers created a similar device for the chiton.

They found the chiton grasped any object placed before it, including cork and wooden and plastic objects. That is notable since traditional suction devices can't attach to cork or wood.

Also, since chitons seek to avoid light, the researchers surmised that this behavior may be exploited in future experiments where chiton movements are guided by laser beams.

"We don't mean it as a replacement for robotics, but as a kind of new direction or new way to do both biology and robotics," Galipon said.

The researchers listed a number of promising tasks that might benefit from the grasping reflex of organisms:

- Grippers using a living gecko could retrieve items using microstructures at the ends of their toes.
- Octopus, squid and frogs have appendages with strong suction capacities.
- Sea cucumbers can alternate between flexible and rigid grasping that would be beneficial for tasks requiring varying degrees of retention.
- Bacteria's flagella, capable of swimming and grasping, could be harnessed and turned into micro-handling machines.

The researchers also envisioned grasping devices using carnivorous plants such as the Venus flytrap and Australian sundew.

The researchers took pains to note that they did not harm any organisms in the experiments. Perhaps conscious of growing concerns in the scientific community over the ethical treatment of non-vertebrates, most recently demonstrated in a scathing report by professors at Kent State University and the University of Maryland condemning the "omen" of "necrocapitalism" after researchers used dead spiders in a project, the Japanese team stressed their commitment to ethical treatment of organisms.

"It will be crucially important to enforce bioethics rules and regulations, especially when dealing with animals that have higher cognition," they said. "[We] recommend caution when handling any type of animal, and to exercise mindfulness in avoiding their suffering as much as possible and to the best of our knowledge."

**More information:** Josephine Galipon et al, Biological Organisms as End Effectors, *arXiv* (2023). DOI: 10.48550/arxiv.2306.03906