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Why Seahorses Have Square Tails

Engineers show that the animals' prism-like tails are mechanically superior to cylindrical ones

Unlike the tails of almost all other animals, seahorse tails are more like square prisms than cylinders. (Helmut Corneli/imageBROKER/Corbis)

By Rachel Nuwer
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Seahorse tails are peculiar appendages. Unlike those of most animals, the cross-section of a seahorse tail is shaped like a square prism rather than the usual cylinder. Further increasing their mystique, seahorses do not use their tails for swimming, as other fish do, but rather as giant fingers used for anchoring on coral or snatching up tasty shrimp that stray too near.

The seahorse tail is so idiosyncratic that it might be an asset for the field of robotics. American and Belgian researchers are turning to the odd extremity for clues about how to better design flexible but strong grasping devices. As they report today in *Science*, seahorse-inspired creations could find applications in search-and-rescue missions, industry, medicine and more.

While a number of animals have prehensile tails—monkeys, opossums and chameleons, to name just a few—the seahorse's tail is uniquely strong. Homegrown armor in the form of skeletal plates covers seahorses' bodies—tail included. Despite the rigid materials, however, the seahorse tail is nearly as flexible as the fleshier tails of its land-dwelling counterparts.

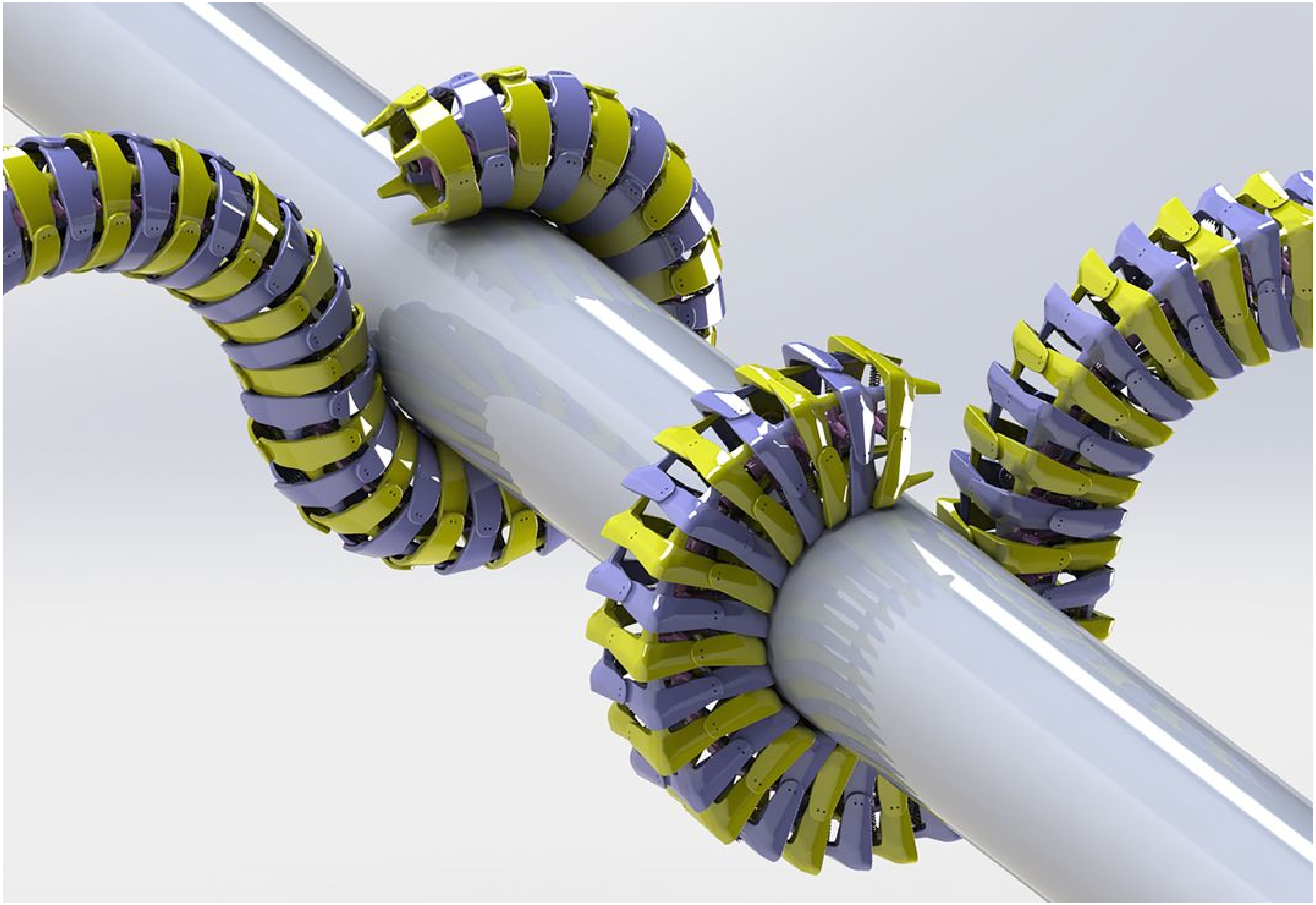
"Nature makes things just strong enough not to break, and then flexible enough to do a wide range or tasks," paper co-author Ross Hatton, an assistant professor of robotics at Oregon State University, says in a statement. "That's why we can learn a lot from animals that will inspire the next generation of robots."

Hatton and his colleagues decided to study seahorse tails in particular because they suspected the strange square structure must have evolved for a reason, and perhaps imbues those animals with some unique abilities. To put their hunch to the test, they created computer models and 3-D printed representations of seahorse tails composed—like those found in nature—of 36 square segments, which are in turn made up of four L-shaped plates. In the center, the vertebral column is held in place by connective tissue.

They also created a digital and 3-D printed model made of overlapping round structures—the equivalent of how a seahorse tail would be built if it was shaped like the tails of most other animals. Their cylindrical creation is unlike anything found in nature, but creating it gave the team a point of comparison for testing the square tail's abilities.

The researchers ran experiments on both models in which they applied various degrees of crushing and distorting pressure. They found that while the cylindrical tail gets smooshed and damaged if enough force is applied, the square tail flattens out by allowing its bony plates to slide past each other, deflecting damage away from the vertebral column and giving it the ability to absorb more energy before it is broken.

This mechanical trick gives the seahorse's tail the strength to withstand the jaws of some would-be predators, as well as the elasticity to quickly and almost effortlessly twizzle back into place after it has been uncoiled. Moreover, compared to a circular tail, the square tail enjoys more contact points with the surfaces it grabs onto, allowing it to be a more dexterous gripping device. The round tail had a greater range of movement—but that advantage came at the cost of strength and durability.



Models of the cylindrical tail, left, and the square-prism tail. (Michael M Porter, Clemson University)

In the hands of humans, a robotic seahorse tail could be a boon for safely navigating tight crevices in the human body and then performing surgery, or for exploring the crannies of a collapsed building and removing debris blocking a victim's rescue. Those applications, however, are likely years away from being realized.

In the meantime, the team did at least solve the riddle of why seahorses have square tales. As they note in the paper, “engineering designs are convenient means to answer elusive biological questions when biological data are nonexistent or difficult to obtain.”

About Rachel Nuwer

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