Vine Robot Designs for Miniaturization
Tech ID: 33171 / UC Case 2022-986-0

BACKGROUND
The emerging field of soft robotics, which takes inspiration from living organisms, incorporates compliance into the design of robots. Vine robots, a recently-developed subclass of soft robots, consist of a thin-walled tube that is initially inverted inside itself. The externally-located material (the body) grows as the vine robot is pressurized and the internal material (the tail) travels along the inside of the body and everts at the tip. This method of tip-localized growth eliminates relative motion (and therefore friction) between the body and the environment, which has useful applications ranging from medical devices to search and rescue. However, in current vine robot designs, growth length is limited by internal friction between the tail and body, as the tail must travel the entire length of the body to grow out the tip. Therefore, there is a need for an improved vine robot design that reduces this internal friction, enables longer deployed lengths, and allows for smaller robot diameters.

DESCRIPTION
Researchers at the University of California, Santa Barbara, and the University of California, San Diego have developed a set of novel vine robot designs that modify the tail material to achieve greater growth lengths and smaller robot diameters. Rather than simply inverting the tail material inside the body, the tail is either scrunched prior to inversion or scrunched in line with the body without being inverted at all. This minimizes the contact length between the tail and body, reducing the internal friction associated with their relative motion and in turn, offers greater growth length. In addition to enabling longer length deployment and smaller robot diameters, tail material scrunching makes it easier to functionalize vine robots with components that stay located at the tip, such as cameras, since it shortens the contact length between the tail material and the embedded component as the vine robot is pressurized.

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OTHER INFORMATION
KEYWORDS
Vine robot designs,
Miniaturization, Soft robotics,
Internal friction reduction,
Longer-length deployment,
Smaller robot diameters, Tail material scrunching,
Functionalization of vine robots, Component integration at the robot tip, Compliance-based design, Medical devices, Search and rescue applications

CATEGORIZED AS
▶ Agriculture & Animal Science
▶ Devices
▶ Biotechnology
▶ Bioinformatics
▶ Health
▶ Industrial/ Energy
▶ Other
▶ Communications
ADVANTAGES

▶ Reduced friction between tail and body, enabling longer-length deployment
▶ Simpler implementation of components located at vine robot tip
▶ Allows for scaled-down vine robot diameter without compromising growth length

APPLICATIONS

▶ Medical devices (e.g. tracheal intubation, endoscopy, catheters)
▶ Search and rescue equipment for confined areas
▶ Cleaning or inspection tools for hard-to-reach spaces (e.g. complex machinery, aircraft interiors, nuclear facilities)

PATENT STATUS

Patent Pending

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