Mechanism for the Autonomous Control of a Vine Robot
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BACKGROUND

The emerging field of soft robotics, which takes inspiration from living organisms, incorporates compliance into the design of robots. “Vine” robots, one specific subclass of soft robots, are made of a thin-walled membrane that is initially inverted inside itself. When inflated via an applied pressure, it uninverts and grows from the tip. This behavior makes vine robots ideal for a variety of applications ranging from tracheal intubation to search and rescue. Current designs, however, have several limitations. Since most vine robots store their inverted body material in a reel located at the base, it must travel the entire inflated length to achieve growth or retraction, accumulating friction. This limits the vine robot’s length and retraction capability, especially in tortuous paths. Additionally, since most vine robots are steered by lengthening or shortening one side of the membrane, turning is restricted to approximately constant curvatures. This limits the vine robot’s ability to navigate obstacles. Thus, there is a need for an improved control mechanism that enables vine robots to overcome these limitations and realize their full potential.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed a new mechanism for controlling vine robots, called a steering-reeling mechanism (SRM). At low pressures, the SRM behaves like a stationary reel, extending the tip of the robot by unreeling body material. At higher pressures, the entire SRM is advanced through the body, allowing for reeling and unreeling of body material from the tip instead of the base. This decreases the pressure required to grow the body by drastically reducing internal friction, enabling the vine robot to grow to greater lengths and providing it with the ability to retract at any length, even in tortuous paths. Instead of applying continuous deformation along the entire length of the body, steering is accomplished by a bending motor, which rotates the two segments of the SRM relative to one another to create a sharp turn. Coupled with the ability of the SRM to advance, this enables sharp turning at any point along the body, greatly improving the vine robot’s ability to navigate obstacles.

ADVANTAGES

▶ Suitable for tortuous paths with three dimensional steering and more achievable angles of approach
▶ Enables full retraction of vine robot at any length and orientation
▶ Overcomes body length restrictions caused by internal friction
▶ Maintains constant growth pressure with increasing length

APPLICATIONS

▶ Medical devices
  ▶ Tracheal intubation
  ▶ Endoscopy
  ▶ Catheters
▶ Search and rescue devices
▶ Cleaning or inspection devices
  ▶ Complex machinery
  ▶ Aircraft interiors
  ▶ Nuclear facilities

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OTHER INFORMATION

KEYWORDS
soft robot, robot, vine, SRM, navigate, steering, paths, Tracheal intubation, Endoscopy, search and rescue, inspection, Autonomous

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