Tentacle-Like Robots to Access Tight Spaces in Manufacturing and Medical Applications

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Summary

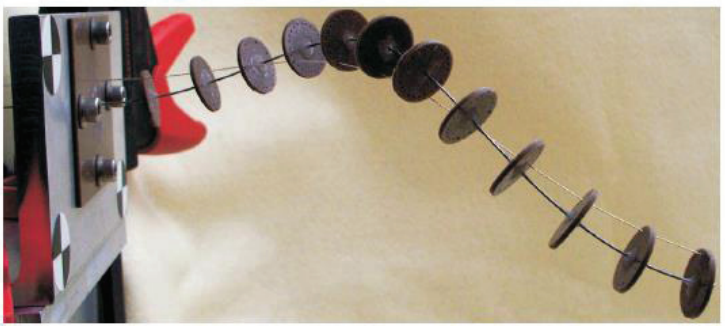
Vanderbilt researchers have developed a novel method for enabling tentacle-like robots to reach into tight spaces in manufacturing or medical applications. This is useful for industrial inspection tasks, assembly of products like airplane wings with complex geometry, or making medical endoscopes reach places in the body they cannot reach today. The new invention involves routing actuation wires along a flexible arm through curved paths along the robot.

Addressed Need

- Tentacle-like robots are needed for industrial tasks like inspection, spray painting, and assembly inside complex devices (e.g. airplane wings).
- Endoscopes cannot maintain dexterity when reaching “around corners” in the human body
- Conventional robots use straight tendons, and can achieve only circular trajectories

Technology Description

Current flexible robots use an elastic backbone with pull wires routed along it. The robot bends as motors mounted at its base apply tension to the wires. The current invention involves routing the pull wires through nonlinear paths along the backbone. For example, a helically wrapped wire can cause the backbone to achieve a helical shape using a single wire. The current invention enables the use of multiple control wires simultaneously, all routed through curved paths. It also describes the response of the robot to external loading. This is enabled via use of rod theory to describe the shape of the robot as a function of tendon tensions, tendon routing paths, and external loads. Use of this approach and model enables much more diverse workspaces to be designed.



Unique Features and Competitive Advantages

- Enables a greater variety of shapes and paths for the robot
- Enables the workspace of the robot to be customized based on task requirements
- Enables a flexible robot to carry a significant payload
- The model can be integrated into existing robots to allow for better control

Technology Development Status

- The model and techniques described above have been tested.
- Peer reviewed Publication: D. C. Rucker and R. J. Webster III, “Statics and Dynamics of Continuum Robots with General Tendon Routing and External Loading,” IEEE Transactions on Robotics, 27(6), 1033-1044, 2011. Available online at http://research.vuse.vanderbilt.edu/MEDlab/sites/default/files/RuckerStaticsTRO11.pdf

Intellectual Property Status

- U.S Utility Patent 9,289,899 issued on 3/22/2016.
- Additional information on the “Bio-Inspired Robots“ research program and technology videos: http://research.vuse.vanderbilt.edu/MEDlab/research/bio-inspired-robots

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