Docket #: S15-383

Soft robotic device capable of growth

Mechanical engineers at Stanford have patented a soft robot with a vine-like structure capable of growing over 100 times in length. The pneumatics-powered robot can withstand being stepped on, extend through gaps a quarter of its height, climb stairs as large as a meter per step, and navigate over rough, slippery, sticky, and aquatic terrain – or, at a smaller scale, through tortuous blood vessels. Within its region of growth, it provides sensing like traditional mobile robots, and a physical conduit, such as a water hose that grows to a fire, an oxygen tube that grows to a trapped disaster victim, or a catheter that grows to a tumor.



One Type of Vine Robot at Various Lengths

To see charmlab vine robots in action, see the publications and related web links videos.

Image courtesy the charmlab

Stage of Development-Prototype

The researchers have made a variety of robot prototypes and run them through challenging tests.

Applications

- **Autonomous robots for hazardous environments**. For example, the robot could grow into a burning building to the base of a fire and deliver water to put out the blaze, or grow to a trapped individual and deliver oxygen.
- **Medical and surgical devices** as an **active catheter**. In place of a tube that is pushed through the body, this type of soft robot could grow without drag along delicate structures.

Advantages

- **Highly extendable** - Researchers have demonstrated this robot can grow as much as 100 body lengths, up to 70 meters.

Publications

- Hawkes, E. W., Blumenschein, L. H., Greer, J. D., & Okamura, A. M. (2017). A soft robot that navigates its environment through growth. *Science Robotics, 2* (8), eaan3028. DOI: 10.1126/scirobotics.aan3028
- Greer, J. D., Morimoto, T. K., Okamura, A. M., & Hawkes, E. W. (2017, May). Series pneumatic artificial muscles (sPAMs) and application to a soft continuum robot. In *2017 IEEE International Conference on Robotics and Automation (ICRA)*(pp. 5503-5510). IEEE.
- Kubota, T., Stanford researchers develop a new type of soft, growing robot. (19 July 2017). *Stanford News*.
- Evangelista, B., (31 July 2017). New robot grows like a vine to reach tight spaces. *San Francisco Chronicle*.
- Hawkes, E. W., Okamura, A. M., Greer, J. D., & Blumenschein, L. H. (2021). *U.S. Patent No. 10,954,789*. Washington, DC: U.S. Patent and Trademark Office.

Patents

- Published Application: 20190217908
- Issued: 10,954,789 (USA)

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