Vine Robots: Achieving Mobility and Construction Through Growth

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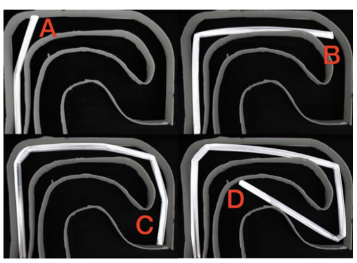
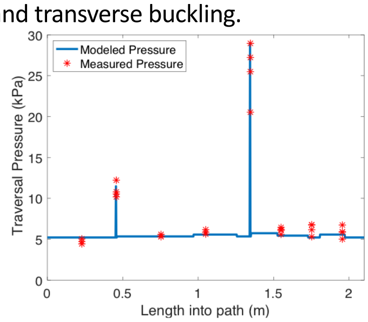
vinerobots.org

Modeling of Environmental Interactions

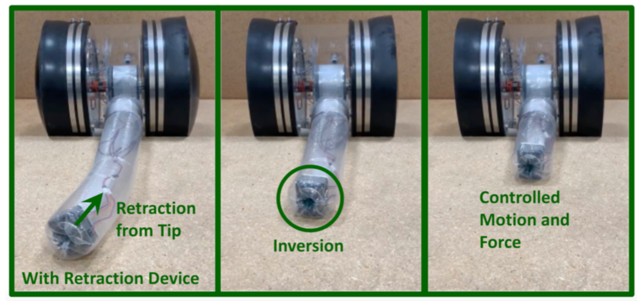
Considering both internal due to the robot's configuration and external based on environmental interactions, we built a piecewise model that describes the minimum pressure to traverse a path consisting of curvature and axial and transverse buckling.





Retraction without Buckling

We solve the problem of uncontrolled buckling during retraction, enabling controlled motion during retraction as well as growth.



Teleoperated Soft Growing Manipulator

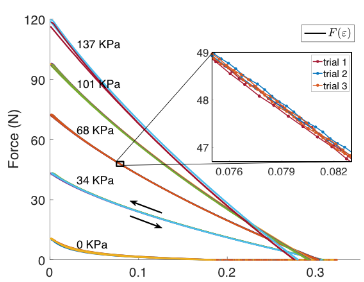
We demonstrated that human-safe soft growing robots can be intuitively controlled and used for pick-and-place tasks.

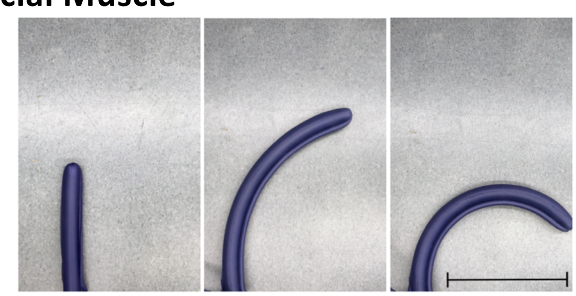
Granular Fluidization and a Burrowing Robot

Our burrowing robot eliminates skin drag by extending from its tip. Lift and form drag are controlled with granular fluidization, created by air blowing from the tip. The robot can burrow and turn in both the vertical and horizontal planes in dry sand.

Fabric, Pneumatic Artificial Muscle

We present a simple, highly conformable pneumatic artificial muscle made of a thin, single layer of woven, bias-cut fabric. Experiments show that the muscle exhibits repeatable, near-linear behavior with less than 1% hysteresis, over an order of magnitude less than that of McKibben muscles.





Recent Publications: ◆ Naclerio, N., and Hawkes E.W. Fabric Artificial Muscle. **RA-L 2020**. F. Stroppa, M. Luo, G. Gerboni, M. M. Coad, J. Walker, and A. M. Okamura. Human-centered Control of a Growing Soft Robot for Object Manipulation. **WHC 2019 (WIP).** ◆ M. M. Coad, L. H. Blumenschein, S. Cutler, J. A. Reyna Zepeda, N. D. Naclerio, H. El-Hussieny, U. Mehmood, J. H. Ryu, E. W. Hawkes, and A. M. Okamura. Vine Robots: Design, Teleoperation, and Deployment for Navigation and Exploration. **RAM 2020.** ◆ L. T. Gan, L. H. Blumenschein, Z. Huang, A. M. Okamura, E. W. Hawkes, and J. A. Fan. 3D Electromagnetic Reconfiguration Enabled by Soft Continuum Robots. **RA-L 2020.** ◆ M. M. Coad, L. H. Blumenschein, N. S. Usevitch, E. W. Hawkes, and A. M. Okamura. Retraction of Soft Growing Robots without Buckling. **RA-L 2020.** ◆ B. H. Do, V. Banashek, and A. M. Okamura. Dynamically Reconfigurable Discrete Distributed Stiffness for Inflated Beam Robots. **ICRA 2020 (Accepted).** ◆ F. Stroppa, M. Luo, K. Yoshida, M. M. Coad, L. H. Blumenschein, and A. M. Okamura. Human Interface for Teleoperated Object Manipulation with a Soft Growing Robot. **ICRA 2020 (Accepted).** ◆ J. D. Greer, L. H. Blumenschein, R. Alterovitz, E. W. Hawkes, and A. M. Okamura. Robust Navigation of a Soft Growing Robot by Exploiting Contact with the Environment. **IJRR 2020 (Accepted).** ◆ **Recent Provisional Patent Applications:** ◆ USPTO 62/940750, Discrete Distributed Variable Stiffness in Inflated Beam Robots. ◆ USPTO 62/914435, Device to Allow Retraction of Soft Growing Robots without Buckling.

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