Supporting Information for *"A Collapsible Soft Actuator Facilitates Performance in Constrained Environments"*

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May 27, 2022

Abstract

Complex environments, such as those found in surgical and search-and-rescue applications, require soft devices to adapt to minimal space conditions without sacrificing the ability to complete dexterous tasks. Stacked Balloon Actuators (SBAs) are capable of large deformations despite folding nearly flat when deflated, making them ideal candidates for such applications. This paper presents the design, fabrication, modeling, and characterization of monolithic, inflatable, soft SBAs. Modeling is presented using analytical principles based on geometry, and then using conventional and real-time finite element methods. Both one and three degree-of-freedom (DoF) SBAs are fully characterized with regards to stroke, force, and workspace. Finally, three representative demonstrations show the SBA's small-aperture navigation, bracing, and workspace-enhancing capabilities.

Introduction

This interactive supplementary material includes:

1. Video on SBA fabrication
2. Video on real-time FEM
3. Video on small aperture navigation
4. Video on self-stabilization
5. Video on workspace enhancement
6. Interactive graphic of SBA layers
7. 2D CAD file for SBA layers

Please reach out to Jacob Rogatinsky (jrogat@bu.edu) or Tommaso Ranzani (tranzani@bu.edu) with further questions or requests.

Videos

Rich media available at https://youtu.be/7608bZNgVfc

Rich media available at https://youtu.be/68zzbzUl6mA

Rich media available at https://youtu.be/7nDmEyFcGSo

Rich media available at https://youtu.be/3gepB5iewv8

Rich media available at https://youtu.be/eJOF6twD1B8

Interactive Figures

Figure 1: An interactive graphic from Solidworks shows the constituent layers for a 1-DoF SBA. The layers with the green tinge represent TPE, and the layers with the grey tinge represent Teflon. Use the left mouse button to rotate, the right mouse button to pan, and the scroll wheel to zoom. Use the "explode" feature in the left toolbar to better visualize the individual layers and components. Use the home button in the top toolbar to reset the scene.

Files

Hosted file

`3DoF_SBA.dwg` available at https://authorea.com/users/464658/articles/559457-supporting-information-for-a-collapsible-soft-actuator-facilitates-performance-in-constrained-environments

The above file contains the AutoCAD (AutoDesk) drawing for the constituent layers of the 3-DoF SBA used in this work. The layers can be laser-cut and fabricated according to the process outlined in this work.