GRADUATE STUDENT RESEARCH SEMINAR SERIES (2019)

EXAMINING THE COILING MOTION OF SOFT ACTUATORS REINFORCED WITH TILTED HELIX FIBERS

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Plants move in an unorthodox way. The seed appendage of Stork's Bill plant (Erodium Gruinum) moves in such a way due to 2 physiological features. Plant cells are reinforced by cellulose fibers distributed in a tilted helix pattern — helixes that are tilted at a certain angle with respect to the longitudinal axis of the cell. Another feature is dehydration of cell tissue which causes volumetric shrinking. As a result of the cellulose-fibers and dehydration of cell tissue, the seed appendage can coil and uncoil via a combination of twisting and bending. Coiling motion can be quite useful for robotic manipulation and locomotion purposes. This research proposes and investigates a novel actuator that is inspired and derived from the unique cell wall architecture in the seed appendage of Stork's Bill plant (Erodium Gruinum). This study aims to examine the coiling and uncoiling motion of a soft pneumatic actuator reinforced with tilted helix fibers. A comparison will be examined between proof-of-concept prototypes through experimentation and a FEA model. Soft actuators will be constructed through casting with the assistance of 3D printed molds. The actuator will consist of Kevlar fiber thread wrapped around a silicon rubber body. Completed actuator will be pneumatically pressurized internally and the position of specific points of interest will be recorded as the pressure changes. The nodes on the actuator in the FEA model will correspond to the experimental points of interest. A successful comparison will allow certain parameters to be explored that would be difficult to achieve through experimentation such as stress and strain. Result of this study can pave the way for a new family of soft actuators capable of unprecedented and sophisticated actuation motions, which are particularly appealing for soft robot application.

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