Workspace Analysis of Multi-section Continuum Pneumatic Arm

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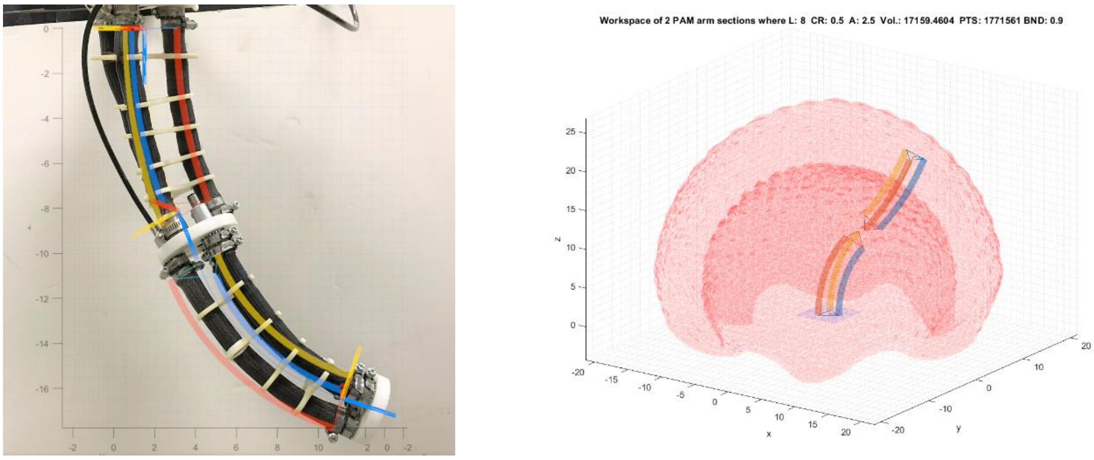
ABSTRACT

Soft Robots achieve desired motion by deformation of their elastic links. In comparison to traditional robots that typically perform high precision operations in structured environments, soft robots offer the ability to adapt to unstructured environments and manipulate objects of varying sizes. Inherent elasticity and continuity allow for whole-arm operations such as grasping, wrapping, and lifting without damaging the manipulated object. Moreover, the operations can be accomplished without prior knowledge of the object through planning or sensing [1]. In order to find the right base orientation and geometrical configuration of a soft robotic arm for tasks that require keeping the manipulated object at a constant orientation, an approach to solve the forward kinematics and analyze the robot's workspaces is developed with supporting experimental validation. There have been several different approaches to solve forward kinematics [2] and the one presented is similar to that in Godage and Walker study [3] but keeps the constant curvature assumption. The studied soft robotic arm is composed of multiple sections that consist of three extensile pneumatic artificial muscles (PAMs) acting as both actuator and structure of the arm. The work includes analysis of the effective workspaces of the arm defined by points in space that the end-effector can reach, as well as constant orientation workspaces (COWs) defined by points of constant end-effector orientation. COWs provide useful information for operations that require keeping manipulated object at fixed angles such as in, e.g. boring, sealing, pushing/pulling handles or inserting bolts during on-site maintenance or repair of vehicles. The workspaces are characterized by their three-dimensional shape, volume, and measures of dexterity.



(a) (b)

Figure 1. (a) Two section PAM robotic arm with overlaid graphic of kinematic model, and (b) representation of the robotic arm's workspace

REFERENCES

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