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Analytical and Learning Model of a Hybrid-Fluidic Elastomer Actuator for Reliable Control and Perturbation Detection

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We are developing a pneumatic Hybrid-Fluidic Elastomer Actuator (H-FEA) by combining an additively manufactured internal structure and silicone elastomer. It is evident that in many soft robotic applications, there is a need to be able to sense shape of the robot and collision with the environment. To address these needs, we are developing an analytical model of the nonlinear kinematics of the H-FEA with internal energy-based models that combine both the linear and nonlinear components of the H-FEA. Using the analyical model, we are able to determine the shape of the actuator given the internal pressure. To extend this model and detect external perturbations in obstructed environments, we propose to use a probabilistic learning model. This learning model is trained on mapping of the input volume to determine perturbation or collision probability at the state given by the analytical model.

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