**Introduction**

Due to the rigidity that is inherent in traditional robotics, researchers explore the possibility of implementing soft materials in robotics, to complement human-robot interactions. This branch of robotics is referred to as ‘soft robotics.’ Soft robots exhibit continuum body motion, and they offer high compliance concerning traditional robots. Although the advantage of soft robots is their softness and compliance, their inherent flexibility complicates the development of accurate dynamical models. Moreover, soft robots differ fundamentally from traditional robots by having an unconventional structure that lacks joints and links. Therefore, the classic modeling approaches, such as Denavit-Hartenberg, cannot be applied directly. We aim to develop a generic modeling approach for soft robot manipulators.

**Modeling of \( N \)–link Soft Robot Manipulator**

In this work, we consider a serial-chain soft robot manipulator. Similar to the trunks of elephants, the manipulator is capable of bending and elongating. To represent the deformation of the manipulator, we consider a time-varying spatial curve passing through the geometric center of the continuum body. The kinematics of the soft robot manipulator can be described using special kinematics based on differential geometry \([1]\). Due to the excessive deformation of the body, it might be difficult to characterize the dynamic properties of each link. Thus, an accurate approximation of the flexible soft robot manipulator can be obtained by discretizing the continuum body into multiple slices with individual inertia and stiffness properties. The dynamics of the total system can then be acquired by integrating each slice using the Euler-Lagrange formalism.

**Results and Future Work**

To illustrate the proposed modeling approach, we synthesized a planar soft robot manipulator model with three serial-chained links (\( N = 3 \)). The simulation results are shown in the figure below. In the extent of our work, it is worth investigating experimental validation of the dynamic model, and the synthesis of accurate and robust control techniques for these systems.

**References**