

Mechanical modeling and simulation of soft machines

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Abstract

Inspired by various creatures existing in nature, we propose several smart and soft structures as soft machines. Including the peristaltic pump consisting of short tubular modules, the bistable actuator and the fiber-reinforced laminates. We investigate the performance of this soft pump under hydraulic pressure and voltage via experiments and an analytical model. An analytical model is developed within the framework of the nonlinear field theory, and its predictive capacity is checked by experimental observations. It is observed that the smart structures module undergo finite deformation and may experience electromechanical instability during operations. The effects of the prestretch, aspect ratio, and voltage on the performance of the modules are characterized by the analytical model. This work can guide the designs of soft active structures in the field of artificial organs and industrial conveying systems.