> The past two decades, the field of soft robotics has sparked significant interest among many scientific disciplines. Contrary to rigid robots, soft robots explore soft materials that significantly enhance the robot's dexterity, enable a rich family of motion primitives, and enhance environmental robustness regarding contact and impact. Since its inception, soft robotics has exemplified its potential in diverse areas such as safe manipulation, adaptive grasping, exploration under environmental uncertainty, rehabilitation, and the biomimicry of many animals. By exploring the uncharted versatile nature of soft materials, soft robotics paves the way towards achieving biological performance in modern-day robotics. This thesis aims to further the advances in soft robotics by addressing some of the open multidisciplinary challenges within this (currently) young field of research.