Adaptive behavior through synchronization and compliance

Brian Mirletz,[1]

Abstract. Traditional approaches to robotics are rigid, highly centralized, and computationally expensive. This contrasts the flexible, agile, and highly distributed bodies and nervous systems of animals. Many neurobiological studies have shown the importance of compliance and adaptability in both the neural and mechanical systems of animals, and the role of sensory feedback in synchronizing these systems. The emerging field of soft robotics seeks to incorporate these animal like characteristics by improving the passive dynamics of robots and simplifying their interactions with the environment. Tensegrity robots, a class of soft robots with mechanics inspired by the continuous tension networks of vertebrate physiology, offer exciting possibilities for physically realizable systems that can make effective use of biologically inspired, distributed control with a compliant physical system. In particular, the oscillatory dynamics of the tensegrity structure can be synchronized with a rhythmic central pattern generator (CPG), and incorporate environmental information through sensory feedback. This dynamical systems approach creates locomotion that can adapt to rough terrain, and minimal descending commands can produce goal directed locomotion, and shows that consideration of the entire neuromechanical system inspires new methods for adaptive behavior in robotics.

[1] Case Western Reserve University/NASA Ames Research Center, email: brt6@case.edu