Be more specific

Paper #

Mechanical Evolution of Flexible Systems with Reinforcement Learning

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Main Takeaway:

An actor critic RL algorithm can be used to train an agent which can define mechanical parameters of a flexible system to maximize performance given a consistent control input.

Extended Abstract::

including dramatically lower energy efficiency

can not easily

Legged systems have many advantages when compared to their wheeled counterparts. For example, their ~~ability to~~ navigate extreme, uneven terrain. However, there are disadvantages when using legged locomotive systems as well, ~~efficient energy consumption as an example~~. A potential solution to this problem ~~might be~~ is the inclusion of non-rigid components within the locomotive system. Research has been conducted that shows using flexible components in operating legged locomotive systems not only increases their efficiency but also their performance.[cite]

~~Still, the advantages are not easily gained without overcoming additional challenges.~~ ~~The mathematical representation of~~ flexible systems are highly non-linear in nature and are therefore difficult to develop controllers for using traditional methods ~~such as PID control~~. Using non-rigid joints in systems is a more mechanical solutions which has been studied to solve some of the difficulties found in developing a controller for flexible systems, too. However, these types of systems lack the ability to present the capability of truly flexible system. awkward

This has brought to light the direction of using more intelligent methods involving training neural networks to represent the non-linear model of the systems and/or the control strategy itself. awkward ~~Using a reinforcement learning-based approach to learn the weights of the networks is a popular approach and is the general approach taken in this paper.~~ Beyond tasking a reinforcement learning algorithm with defining an agent which will properly control a highly non-linear system, ~~it is considered that~~ this method can be used to define an agent which can learn mechanical parameters ~~of a system~~ such as the size and flexibility of links.

keep as 1 paragraph

shown

proven has a very specific meaning (mathematical proof, etc.)

Previous work has ~~proven~~ shown that such a method used on rigid systems is successful at defining both mechanical parameters and control strategies, meshing the two to allow a system to accomplish a task. [cite] In addition to use concurrently

methods which seek to ~~utilize~~ reinforcement learning to generate~~s~~ design parameters and control strategies ~~in unison for systems~~, there are methods which use evolutionary strategies to accomplish the same goal [cite]. ~~However evolutionary learning is not considered further in this work~~.

In this work

~~It is proposed that~~ rather than tasking a reinforcement learning algorithm with learning both the mechanical design and control strategy for accomplishing a task, instead task the algorithm to solely optimize the mechanical design to match a given control input. The proposed method ~~would in theory, regardless of the given initial mechanical design,~~ optimize(s) ~~that~~ the design to mesh with the given control input to accomplish the task. Awkward

Meaning?

k in LaTeX to put in math italics ← Do for all math symbols inline in text ← that said, k is probably not needed in this sentence

A mass-spring-damper environment is used to represent a flexible single-legged system, which is tasked with jumping as high as possible given a consistent input defined in (paper). An actor-critic algorithm is utilized to train an agent which will modify the spring constant (k) within the environment to accomplish the task. The reward signal used during the training ~~of the weighted~~ neural networks is directly coupled to the height which the single-legged system jumps to, so that the algorithm learns a spring constant ~~(k)~~ which seeks to maximize the jump height. Stable Baselines defined TD3 algorithm is used to train our agent and an OpenAI type environment is used to define our environment.

Avoid 1st person

- preliminary results

Keywords: Reinforcement Learning, Actor-Critic, Neural Network, Flexible Systems