Optimal Pretension in Continuum Robots (2024-048)

A process to achieve optimal preload/pretension in a tendon driven continuum device to increase life of (surgical) robots

Market Overview

Continuous back bone "continuum" robots are prominent within the research community for applications within medicine, nuclear reactors, and aero engines. Within medicine, these robots are used within endoscopic procedures and material elasticity can result in significant inaccuracy in operations. Current methods to overcome this issue include preloading the tendon prior to operation to improve outcomes. These methods include modeling forces to determine preload, but these often do not account for tendon-induced backbone compression and tendon extension. There is a need to improve tension methods for tendon-driven continuum robots (TDCRs). A Clemson University researcher has developed a technology that uses a modeling method to produce optimal preload tension that takes account of tendon-induced backbone compression and tendon extension. This design further improves current methods by not requiring tension in order to determine optimal preload, extending the life-span of these robots.

Technical Summary

The proposed design incorporates a modeling method to produce the optimal preload when the backbone compresses and tendons extend for tendon driven continuum robots (TDCR). Their approach uses simple beam bending theory and exploits geometric symmetry in the design of TDCRs. Furthermore, their design does not require the estimation of robot material properties or tendon extension. With this modeling method, tendons do not need to be under tensions when the robot is in use and preload can be done in real time, removing the need for complicated algorithms used in other methods.

Application
Surgical Robots

Development Stage
Proof of Concept

Advantages

- Technology provides method for determining optimal preload without needing to keep robot in tension
- Preload happens in real time which permits adjustment as needed
- Does not require estimation of robot material properties or tendon tension sensing

About the Inventors

Dr. Ian Walker

Professor of Electrical and Computer Engineering at Clemson University

Professor Walker's research centers on robotics, particularly novel manipulators and manipulation. His group is conducting basic research in the construction, modeling, and application of biologically-inspired "trunk, tentacle, and worm" robots. This work in turn leads to novel approaches to motion planning and operator interfaces for the robots. This work is currently funded by DARPA under the DSO BIODYNOTICS program, by NASA, and by NASA/EPSCoR. Professor Walker is a Fellow of the IEEE and a Senior Member of the AIAA

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