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A Variable Stiffness Soft Actuator for Hand Rehabilitation

Soft robotic actuator customizes stiffness to expand stroke rehabilitation therapy.

In the wake of devastating strokes, millions of people around the world every year lose mobility, especially in the fine motor functions of their hands. Traditional treatments for loss of hand function focus on simple physiotherapy, including exercises like opening and closing the hand, curling and extending the fingers, and performing various stretches. These exercises are often repetitive, focusing on only a limited set of basic hand postures while neglecting more complex or diverse motions. Research has shown that alternative treatment strategies, which incorporate a wider array of complex hand motions, can improve the efficacy of hand rehabilitation while also decreasing pain levels during the process. However, incorporating these sophisticated techniques can be difficult for physiotherapists, as they are often unable to achieve the perfect angle, pressure, and position of hand movements due to differences between patients and their changing needs as rehabilitation progresses.

Researchers at Purdue University have developed an innovative solution to aid physiotherapists in helping stroke patients achieve better results with less pain. Their design is based on a sophisticated actuator system capable of achieving precise variations in stiffness at specific points along an armature designed to fit over the hand. These precise changes in stiffness can present new and unique challenges to the patient each time they receive therapy, in exact accordance with their changing needs. This technology combines patient customization with medical precision to produce better patient outcomes.

Technology Validation:

Validated via an initial computer simulation, followed by practical testing of a single prototype. Results differed due to air leaks in the prototype. Initial testing employed Finite Element Analysis simulations with hyper-elastic nonlinear material settings, predicting actuator behavior under varying

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pressure. The experimental tests were performed using a variety of pressure settings, and results indicate that the proposed soft variable stiffness actuator can achieve diverse hand rehabilitation guidance postures under the desired force, making it applicable to next-generation hand rehabilitation

Advantages:

-Improved therapy efficacy

-Wide range of customization, including variable stiffness over individual nerves and the potential to create many different hand poses/exercises

-Decreased pain

-Variable therapy prevents the formation of tendon adhesions within the finger joints, preserving hand mobility

Applications:

For use in hand physiotherapy, particularly in the case of stroke victims, but also applicable wherever loss of function has occurred and may be treated with passive motion physical therapy.

TRL: 4

Intellectual Property:

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