Servo-Controlled Semi-Rigid Exoskeleton Designed for the Human Knee

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Musculoskeletal injuries are occurring more and more frequently, with one of the main causes being the increasing number of new patients who sustain knee structure injuries. Currently, exoskeletons that assist the knee joint are either fully rigid or soft systems, which induce the risk of misalignments due to the complicated nature of the kinematics of the knee joint or require additional anchors or mechanical parts that may cause discomfort or force unnecessary weight upon the user. In this paper, a semi-rigid exoskeleton principle is introduced. This exoskeleton addresses the concerns of both rigid and soft exoskeletons while performing the same benefits by establishing a pre-determined route for the tendon. This exoskeleton can provide up to 37.26Nm assistive torque to the knee joint. The system's effectiveness was validated through a series of experiments which included testing its range of motion, total tensile force, and accuracy and safety of the pose detection system. The prototype had successful results, and the overall system is efficient, flexible, and easy to use. Future work will focus more on a customizable system in which the users can determine the amount of assistive torque force they need to be applied to their knee joint depending on their current physical ability.

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