Energy storage ankle joint

How does ankle joint rotation affect a cantilever spring?

Rotation of the ankle joint deflectsthe cantilever spring,allowing energy to be stored and released. The shape of the cam profile governs the amount of elastic energy stored in the spring for a given ankle joint rotation. Higher energy storage in the spring results in a larger normal force between the cam profile and cam follower.

How do ankle prosthetics work?

The desired ankle mechanics can be encoded in the shape of each cam profile,and by interchanging the cam profiles at specific points during the stance phase of gait(i.e.,points in the torque-angle relationship),the ankle prosthesis can produce multiple energy storage and return profiles.

Does the energy storage mechanism enhance the assistance of the exoskeleton?

Results: Level ground studies indicate that the energy-storage mechanism enhances the assistanceby increasing the output torque of the exoskeleton. Reductions in metabolic cost (6.4 ± 1.3%,p < 0.05) were observed.

How is energy stored during foot loading phase of stance?

During the foot loading phase of stance energy is stored and locked through a one-way clutch. The potential energy level of the spring is sustained by the clutch mechanism during the mid-stance aspect of gait cycle.

What is the role of the ankle joint in gait?

Published by Cambridge University Press The ankle joint plays a critical role during gait, absorbing energy during collision with the ground, contributing to overall stability, and providing the majority of net positive work for the forward propulsion of the body (Winter, 1991; Farris and Sawicki, 2011; Zelik et al., 2015).

What are energy storage and return feet?

Energy storage and return (ESR) feet are passive prosthesescapable of storing elastic energy during midstance and returning it during late stance to help transition the center of mass over the leading limb (Casillas et al.,1995; Hafner,2006; Versluys et al.,2009).

In this study, the CF AFO was assumed to be a single section (shell, composite) composed of different layers with alternating orientations. Figure 1(a) shows the orientation angles of layers. The outermost layer is the CF Standard (Std) 2 × 2 Twill (Figure 1(b)), and the underlying layers are composed of CF Std Unidirectional (Figure 1(b)) and CF Std 2 × 2 Twill with various ...

Therefore the joint moment changes at the turning point of the jump with AEL suggests no change in elastic energy storage at the ankle (a key joint for storing and returning energy from the highly compliant Achilles tendon), a ...

Previous studies have shown that passive-elastic exoskeletons with springs in parallel with the ankle can reduce the metabolic cost of walking. We developed and tested the use of an unpowered passive-elastic exoskeleton ...

human ankle joint by complex rolling trajectory, which contributes to guaranteeing a locomotion metabolic economy [15, 16]. We focused on the design of rolling conjugate joints and the carbon ber energy-storage foot"s ecient energy storage/release characteristics. Designed to simulate the energy storage and release process of the human foot,

Our goal was to develop a portable ankle exoskeleton taking inspiration from the passive elastic mechanisms at play in the human triceps surae-Achilles" tendon complex during walking. The ...

As seasonal migratory animals, reindeer inhabit the natural habitats in Arctic regions and have evolved their hindlimb joints to adapt to the complex ground conditions there. Inverse dynamics of the joints is an important tool to study foot functions. Herein, with a motion tracking system and plantar pressure data based on kinematics and inverse dynamics of ...

According to one embodiment of the present invention, the walking assistance device according to an embodiment of the present invention, the walking assistance device is a foot foot worn on the wearer"s foot; It is installed on the foot, and includes a foot energy storage unit for storing energy when the foot moves from the initial ground to the load reactor.

To account for any uncertainty in joint power and energy estimates caused by the movement or mis-location of the axis of rotation in NA-ESR prosthetic feet, several groups have incorporated translational power terms into their inverse dynamic analyses (Prince et al., 1994, Geil et al., 2000) on the basis of work in the anatomical foot-ankle (Buczek et al., 1994).

The approach for increasing energy storage and return using the study"s variable-stiffness prosthesis is illustrated in Eq. 1.For stiffness k, we have an angular displacement ((theta)) that ...

A passive mechanism for decoupling energy storage and return in ankle-foot prostheses: A case study in recycling collision energy Hashim A. Quraishi1,2,3, Max K. Shepherd3,4, ... ankle joint rotation. Higher energy storage in the spring results in a largernormal force between the cam

The ankle joint is pivotal in prosthetic feet, especially in Energy-Storing-and-Releasing feet, favoured by individuals with moderate to high mobility (K3/K4) due to their energy efficiency and simple construction. ESR feet, ...

The invention discloses a kind of passive energy storage ankle-joints and foot mechanism for lower limb assistance exoskeleton, including ankle-joint unit, sufficient side plate unit and foot pad unit;Ankle-joint unit includes shank bar and the compressed spring being arranged in shank bar and ankle-joint guide rod;Sufficient side plate unit includes sufficient side panel, foot pad and ...

The driving ability of passive exoskeletons is limited. To reduce the energy consumption of wearers, based on the characteristics of the semi-active ankle exoskeleton, this paper proposes to use NiTiCu-based shape memory alloys (SMA) as the energy storage source to improve the power density.

Shank 6. Ankle joint energy storage unit 7. Ankle Figure. 1. Overall configuration of the single leg. 1 Top cover 2. Screw 3. Guide sleeve 4. motor 5. reducer 6. Electromagnetic clutch 7. Rack 8. Guide rod 9. Bearing 10. Check ring 11. Angle encoder 12. Gear shaft 13. Cushion 14. Spring Figure.2 Energy storage unit The thigh module consists of ...

The biological ankle dorsiflexes several degrees during swing to provide adequate clearance between the foot and ground, but conventional energy storage and return (ESR) prosthetic feet remain in ...

Designed to simulate the energy storage and release process of the human foot, to achieve the energy storage when the prosthetic foot is on the ground and the energy released ...

Methods: A quasi-passive ankle exoskeleton is designed to integrate the merits of both active and passive exoskeletons, which captures the heel-strike energy loss and recycles it into ...

Individuals with lower limb amputation experience reduced ankle push-off work in the absence of functional muscles spanning the joint, leading to decreased walking performance.

When the human ankle joint needs auxiliary torque, the SMA releases the energy stored by the bias spring and transfers the energy to the ankle exoskeleton to achieve the ...

Abstract. To reduce energy consumption while a human is walking with different loads, an active energy storage mechanism and a gait cycle prediction method are proposed, and then a wearable ankle assistance robot ...

These results provide insight into the relationships between ankle dorsiflexion, energy storage and return, and leg loading, which may lead to more effective prosthetic devices to improve amputee gait.

To enhance ankle push-off and to decrease the high energy cost of walking, carbon composite Ankle Foot Orthoses (AFOs) can be prescribed in patients with weakness of the plantar-flexor muscles (Bartonek et al., 2007, Desloovere et al., 2006, Wolf et al., 2008).This type of AFO functions like a spring; it stores energy starting from mid-stance and returns energy at ...

In an effort to improve amputee gait, energy storage and return feet have been developed that store mechanical energy in elastic structures in early to mid-stance and return ...

Flex-Foot Modular II is characterized by extremely lightweight, durability, high energy storage and release feet. 100% carbon fibre provides amputees with smooth and continuous movement from heel to toe. All ages and impact levels will benefit from an unparalleled 95% energy storage and return.

By mimicking intact ankle torque and efficiently storing and returning energy at the ankle joint, this new design may contribute to reducing amputees" metabolic cost of walking. ...

Overall the two energy storage and return prostheses (C-Walk and Flex-Foot) demonstrated improved performance when contrasted to the solid ankle cushioned heel prosthesis (Hsu et al. 2006). Altering manufacturing ...

Sanno et al. 14 reported that positive joint work was redistributed towards proximal lower limb joints during a prolonged fatiguing run. The authors speculated that this may increase metabolic cost of running because the joint work was performed by proximal muscle-tendon units, which have been assumed to be less equipped for storage and return of energy 15, 16 and ...

To reduce energy consumption while a human is walking with different loads, an active energy storage mechanism and a gait cycle prediction method are proposed, and then a wearable ankle assistance ...

Symmetric ankle propulsion is the cornerstone of efficient human walking. The ankle plantar flexors provide the majority of the mechanical work for the step-to-step transition and much of this work is delivered via elastic recoil from the Achilles" tendon - making it highly efficient. Even though the plantar flexors play a central role in propulsion, body-weight support and swing ...

Carbon-composite Ankle Foot Orthoses (AFOs) can be prescribed to overcome the reduced ankle push-off [7], [8], [9], and to decrease the elevated energy cost of walking [6].These carbon-composite AFOs hold spring-like properties, which potentially enable the storage of energy at the beginning of the stance phase and the return of this energy at the end of the stance ...

In addition, a carbon fiber energy-storage foot was designed based on the human foot profile, and the dynamic response of its elastic strain energy at different thicknesses was simulated and analyzed.

A lightweight and energy-efficient ankle joint is able to lower the actuator peak power and/or energy consumption per gait cycle, while adequately fulfilling the profile matching constraints. ...

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