Institut "Jožef Stefan" Ljubljana, Slovenija

TECHNOLOGY OFFER

A NOVEL QUASI-PASSIVE MECHANISM WITH STIFFNESS MODULATION FOR PROSTHETIC OR ORTHOTIC JOINT

Fields of use

Physiotherapy and orthopaedic Technology; Rehabilitation and training; Exoskeletons and prostheses; Biomedical Engineering; Biorobotics

Current state of technology

TRL4. Technology validated in the lab.

Type of cooperation

Technical cooperation agreement, Joint venture agreement, Licence agreement

Intellectual property

A patent application was filed at the Slovenian Intellectual Property Office in 2023.

Developed by

Jožef Stefan Institute

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Summary

The Jožef Stefan Institute has developed a novel quasi-passive mechanism with incorporated stiffness modulation. The proposed mechanism can be used in exoskeletons to assist the wearer or in prostheses.

The mechanism is not limited to legs and can be applied to any human joint. Additionally, when the valve is on, the air circulates freely in the cylinder and is not compressed, allowing free and unimpeded walking when needed. Thus, the mechanism can provide support or free movement.

Description of the invention

Exoskeletons are an area of research primarily focused on outperforming human strength, improving performance, preventing injury, increasing the safety of weakened limbs, or accelerating and improving the rehabilitation process and enabling paralyzed people to regain mobility.

Although the technology is widely used in rehabilitation, there are still some obstacles to its widespread application, such as the actuators, which are usually mechanically complex and therefore heavy.

Pneumatic actuators offer high power density and are well suited for exoskeletons, but they require a compressor to pump compressed air into the actuator. Moreover, compared to the variable stiffness in healthy muscles that can be adjusted efficiently and easily when needed, variable stiffness in robotic actuators requires additional mechanical components that in turn increase the complexity of the product. But variable stiffness in exoskeletons is a much-needed property to achieve optimal performance when switching between different actions, e.g. jumping, walking, and running.

To overcome this issue, a Slovenian research institute developed a novel quasi-passive mechanism with incorporated stiffness modulation. The mechanism is intended for an exoskeleton that assists the wearer in bending the knee, such as during prolonged crouching or squatting. The mechanism is not limited to legs and can be applied to any human joint. Furthermore, it can also be used in prostheses. When the wearer of such a device squats, descends the stairs or performs any action that involves bending the knee, the air cylinder spring generates the force that is in turn exerted when extending the leg to support the wearer. When the valve is on, the air circulates freely in the cylinder and is not compressed, allowing free and unimpeded walking when needed. Thus, the mechanism can provide support or free movement.

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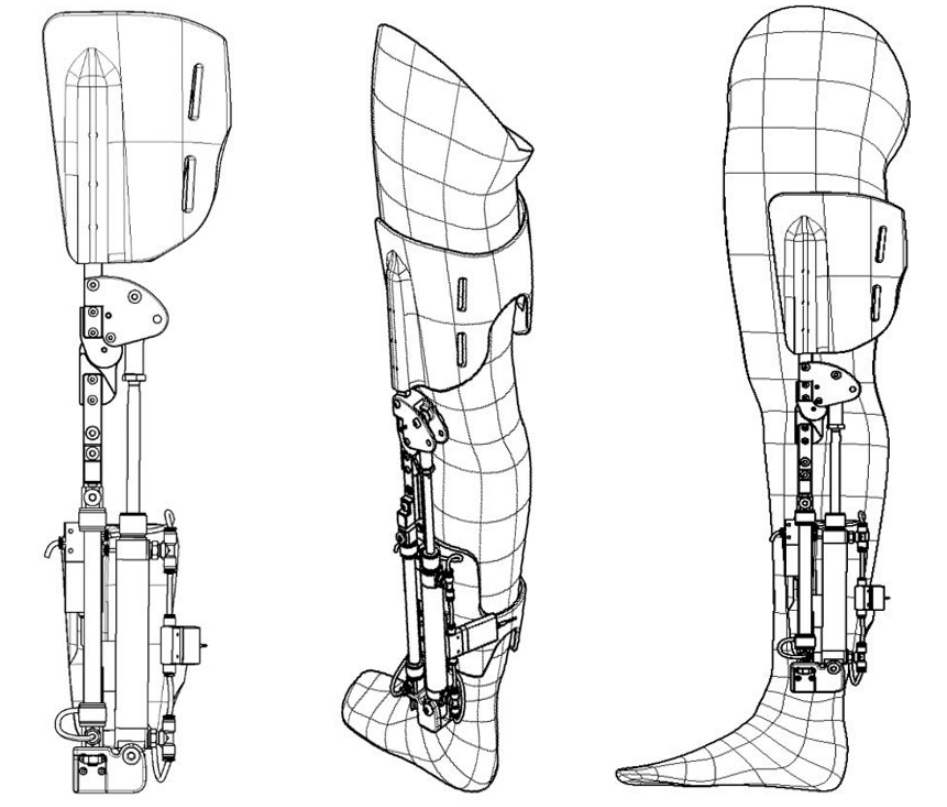

Main Advantages

The invention comprises a quasi-passive mechanism (it uses electricity only to drive the valves), meaning the actuator does not generate energy, but only stores it in the form of elastic energy to provide support. Additionally, it is portable and lighter than other existing systems. The length of the pneumatic muscle can be adjusted in real time, changing the active length of the pneumatic cylinder and thus the force. The valves require 24 V of power and are controlled by a DC trigger signal in the range of 3 to 30 V. The signal can come from a PC or a microcontroller, depending on the portability requirements.

About us

The technology has been developed at the Department of Automatics, Biocybernetics and Robotics, Jožef Stefan Institute, whose researchers have several decades of experience in different fields of robotics and biocybernetics, including exoskeletons, and humanoid and collaborative robotics. The Jožef Stefan Institute is the leading Slovenian institute with over 1150 employees, covering a broad spectrum of basic and applied research.

Partner Sought

Partners are sought among the companies that specialise in the development or production of exoskeletons and prostheses. The role of the partner sought is to apply the novel quasi-passive mechanism with stiffness modulation in exoskeletons or prostheses. If the partner is able to implement the method successfully, they will be invited for the commercialization of its results. If the partner is able to implement the mechanism successfully, they will be invited for the commercialization of its results.