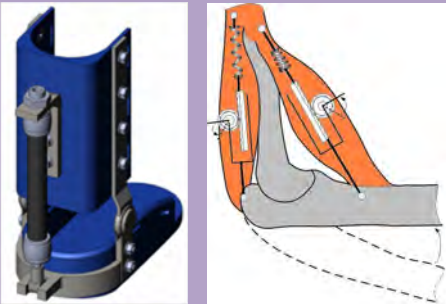


ACTIVE ANKLE-FOOT ORTHOSIS ACTUATED WITH AN ARTIFICIAL PNEUMATIC MUSCLE

PNEUMATIC ARTIFICIAL MUSCLES

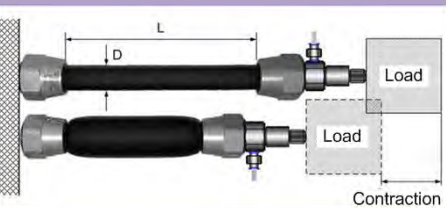
Pneumatic artificial muscles (PAMs) are suitable actuators for use in **bionic systems**, i.e. biologically inspired design of technical systems, where the application of biological methods and processes found in nature are used to improve engineering systems and modern technological products.

Due to their adaptive compliant, elasticity, flexibility and lightweight, PAM actuators can be used for system design and control as an attempt to replicate human movement.



The pair of PAM actuators put into an antagonism configuration imitate a human biceps-triceps system and emphasize the analogy between this artificial muscle and human skeletal muscle.

Powered by compressed air, the PAMs radially expands when axially contracted and converts the radial expansive force into axial contractile force.



CONSTRUCTION

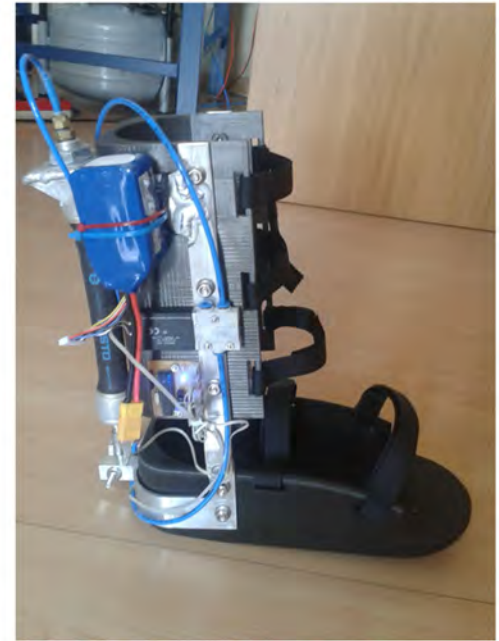
This prototype of an active ankle-foot orthosis was made by using a CAD software and then printing plastic parts using a 3D printer. In order to reduce the weight of the orthosis, the plastic parts are made with hollow interiors.

The orthosis can be attached to the patient's leg with strap belts.

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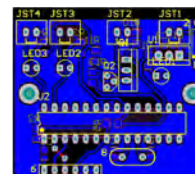
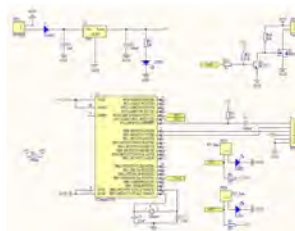
Construction process of active ankle-foot orthosis actuated by PAM

Ankle-foot orthoses can be passive or active orthoses. Passive foot orthoses generally use various spring mechanisms for supporting the patient's gait.

This **active ankle-foot orthosis**, unlike conventional passive orthoses, contain powered mechanism for lifting the foot into a position that is necessary for normal gait. The powered mechanism uses a pneumatic artificial muscle driven by a solenoid valve.

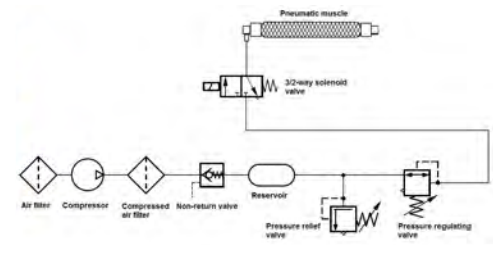
In order to make the device portable, the system should only be equipped with an external compressed gas source, which the user should carry on his/her back.

Electrical scheme



Microcontroller
ATmega 328P

Pneumatic scheme



OPERATING PRINCIPLE

On the bottom side of the orthosis two switches are built-in: in the areas under the heel and toes. The micro controller receives a signal from the first micro switch located on the heel and then activates the timer and waits for a signal from the second microswitch. After receiving the second signal, the microcontroller stops the timer and activates the valve over the same period of time that has elapsed between the two signals. This principle allows the patient to control the walking speed, which helps to keep his/her stability.