

Resource-efficient soft exoskeleton for people with walking impediments

July 12 2019, by Julia Goetz

XoSoft

Soft modular biomimetic exoskeleton to assist people with mobility impairments

γ - prototype

Control

Gait segmentation

- Insole sensors → Stance phase
- IMUs → Swing phase
- Knee soft sensors → Swing phase

Control strategy per subject

- Event based
- Time based

Monitoring and Feedback

XoSoft Connected Monitor

- System configuration/control
- Sensor and control data
- 3D motion analysis
- Remote/clinical application
- Central storage data/results

XCM analysis and feedback

- Performance & behavior
- Context by activity segmentation
- Gait analysis (gait pattern, foot clearance, ...)
- Dynamic balance support



Actuation

Up to 6 simultaneous actuators

Reaction time < 100 ms

1. Pneumatic system
2. Electronics
3. Battery
4. Pneumatic tubes
5. Soft clutches
6. Elastic bands

Garment

Hip – Flexion/extension

Knee – Flexion/extension

Ankle – Dorsi/plantar flexion

7. Backpack support
8. Safety handle
9. Loose pants
10. Fixation straps
11. Support pads
12. Shoulder straps
13. Belt
14. Actuator attachment
15. Knee caps

Sensors

16. IMUs
17. Knee soft sensors
18. Insole sensors

www.xosoft.eu



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Credit: IIT Istituto Italiano di Tecnologia

A lot of people have lower limb mobility impairments, but there are few

wearable technologies to enable them to walk normally while performing tasks of daily living. XoSoft, a European funded project, has brought together partners from all over Europe to develop a flexible, lightweight and resource-efficient soft exoskeleton prototype.

Frail elderly, incomplete spinal cord injury, and post-stroke patients often require walking aids to assist in walking. Current assistive aids such as wheelchairs or rollators are typically bulky, relatively inflexible, and often only partially support [movement](#). Further, they typically do not encourage or support the activation of the legs. Remaining active and mobile for as long as possible is highly important for physical and cognitive health, and to prevent further atrophy. To address this challenge and provide individual assistance to those affected, nine partners from seven European countries have developed the "XoSoft" prototype of a soft exoskeleton as part of an EU research and innovation project. XoSoft is designed to be easy to wear, comfortable, serviceable and compatible with the daily life of the users, helping augment autonomy and individual performance of the users.

Movement provides energy

The heart of XoSoft is a system giving the user quasi-passive actuation based on elastic bands and custom made pneumatic soft clutches. The elastic bands are stretched and put under tension through the movements of the wearer. The elastic bands have the ability to store and release sufficient energy to support the patient while walking. This process is controlled by clutches that engage and disengage at the right moments to control energy exchange, and consequently provide support to the wearer.

XoSoft is resource efficient and allows the wearer to control their movements. This flexibility is made possible by the system accurately recognizing the patient's movements. Sensors in the garment register the

movements and send the information to a controller. The controller in turn interprets the gait phase of the user and controls the activation or deactivation cycle of the clutches.

System use in laboratory and clinical environments

The XoSoft system has potential to be used by individuals who require low to moderate mobility assistance. The clutches are currently powered by a vacuum generated by compressed air connected and mounted in a backpack, which is suitable for laboratory and clinical environments. The combination of clutches and elastic bands will certainly be reused and further developed in future soft exoskeletons bringing the developed innovations and systems closer to market, including potential use at home and for everyday life.

End users at the center

Innovations are often driven by technology without involving future users. XoSoft has been developed taking into account the needs and requirements of users, as well as their affiliates such as family members and physiotherapists, by involving them in the design process from the start. This ensures a higher acceptability by the users. Multiple versions of the XoSoft prototype were developed with each progressing innovative and novel technologies. These include smart materials, sensors and actuators as well as biomimetic control, monitoring and connected health systems, which in turn were integrated into a single system for laboratory testing and clinical testing.

The use of novel technologies in [smart materials](#), advanced algorithms for biomimetic control, user centered design, and an energy efficient implementation provided the technology and user need basis to accomplish XoSoft.

Provided by CORDIS

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