



1/2 *ErgoJack in industrial application*
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ERGOJACK – SMART WEARABLE ROBOTICS SYSTEM FOR INTELLIGENT ERGONOMICS SUPPORT

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Painful back problems are one of the most common reasons for sick leave in Germany. They mainly affect employees in logistics, manufacturing and services whose daily work routine involves repetitive, physically challenging sequences of movement. ErgoJack is designed to combat the risk of repetitive strain injury.

Welders can remain bent over a machine component for hours on end – it is only a matter of time before such a constrained posture results in back pain. If workers execute such jobs for a number of years, while failing to adopt ergonomic postures or neglecting to take regular breaks and compensatory exercise, permanent injuries are by no means uncommon. The same applies to employees who continually have to lift heavy objects.

ErgoJack is an intelligent soft orthosis designed to prevent such injuries. It relieves back strain by animating the person wearing it to carry out stressful sequences of movement

in an ergonomic way and encouraging them to take regular breaks. Yet the truly unique feature of ErgoJack is its real-time movement analysis based on machine learning and AI. This distinguishes the orthosis from the range of commercially available exoskeletons, which inherently amplify all kinds of movement, including unergonomic ones, and merely divert the load force to less stressed parts of the body. ErgoJack technologies could potentially be integrated in such systems as they prevent accentuation of ergonomically inadvisable movements.

Movement analysis is based on motion sensors (inertial measurement units, IMU) integrated in the vest, which compare pre-learned movement patterns with actual body movements. A vibrating alarm gives wearers real-time feedback should they assume postures or make movements injurious to their health. One model with passive thigh springs also supports propping up, e.g. when lifting a crate.



3 A side view of ErgoJack with lockable hip joint and leg brace ...
 4 ... and from behind showing battery and computing unit

ErgoJack at a glance

Challenges

- Continual increase in the average age of the industrial workforce
- Increased risk of sick leave through disorders of the locomotor system
- Common causes: unergonomic, repetitive movement, heavy lifting, constrained postures
- Improved ergonomics is the key to keeping healthy
- Need for intelligent systems to support workers' body movements

Objectives

- A modular wearable soft-robotics system to assist movement of the upper body
- Intelligent real-time movement analysis for identification of ergonomic and unergonomic movements
- Intuitive and simple force assistance
- Option of integration in digital networks for extended data analysis and interaction with automation systems
- Use in manufacturing, logistics and services

Technology

- Modular soft-robotics upper body orthosis with optional force assistance:
- Motion sensors, embedded controller, vibration module and battery all integrated in the orthosis
 - Real-time movement measurement and analysis
 - Inertial motion sensors (inertial measurement unit, IMU) on shoulders, back and thighs
 - Automatic recognition and classification of movement patterns compares pre-learned movement patterns with actual body movements and evaluates them in a few hundred milliseconds. Computation takes place directly in the orthosis.
 - Learning process conducted with a miniaturized movement training dataset
 - Real-time user feedback via vibrating alarm
 - Various options are possible: a sensors-only textile vest; a brace-based upper body vest with sensors and spring effect for support of the spine; and a lightweight vest with sensors and spring units for force support on the spine and when straightening up
 - A lockable lateral hip joint allows for force assistance to be switched on and off, thus enabling alternating activities in standing and sitting
 - Battery capacity is sufficient for an entire working shift with no need to recharge
 - Encapsulated electronics may stay in the orthosis during washing (in development)

Customer Benefits

- Ergonomics improvement: motivates wearers to adopt ergonomic behavior
- A class apart from exoskeletons: does not support unergonomic movements
- High usability
- Reduces employee sick leave
- Can be integrated in digital networks for production planning and monitoring in industrial production, logistics and services

Range of Services

- Technology transfer and development support for system providers
- Demonstration and customer-specific evaluation in industrial environments
- Customer-direct pilot application including customized developments and data analysis

Project Partner

- Fraunhofer Institute for Reliability and Microintegration IZM