

DEXO

Dual Force-Feedback Arm and Hand Exoskeletons



Overview

DEXO is a product family of arm and hand force-feedback exoskeletons, software and control center, enabling immersive, intuitive and dexterous remote operations. With DEXO, complex robotic teleoperation are made more intuitive and effective thanks to its capability to render force or guidance information during operations. Associated with virtual or augmented reality rendering, DEXO technologies can also be applied to interactive training as well as upper body rehabilitation.

DEXO Arm

The DEXO Arm is an anthropomorphic arm exoskeleton featuring 7 degrees of freedom, aligned with the motions of the human arm. The design is based on a novel patented low cost actuation module that provides a high level of transparency. All joints are featured with absolute position and torque sensing. It is adjustable to operators morphology, and can be assembled in a single or dual (right and left) arms configuration. The exoskeleton presents an optimized kinematic configuration enabling a large work space. A passive gravity compensation extension is available in addition to partial active gravity compensation, to minimize arms fatigue and to ensure a high level of comfort for the operator, even for long periods of time.

DEXO Hand

The DEXO hand exoskeleton offers multi-finger force feedback interactions for accurate and dexterous end-effector operations. It includes 6 active degrees of freedom (one per finger and two for the thumb), plus passive lateral finger joints to improve manipulability and comfort of the user inside the exoskeleton. The hand can easily be interfaced with the DEXO arm exoskeleton or used independently.

Virtual Reality Environment and Control Center

As part of the DEXO solution, additional technologies can be associated with the arm/hand exoskeletons to offer a custom solution to customers.

The DEXO virtual reality environment is built on top of Unity3D, working in association with a dedicated haptics and physical engine allowing accurate and stable haptic rendering while providing immersive capabilities to the operator (e.g. with 3D head mounted displays). It is compatible with the full dual arm and hand exoskeletons configuration.

The DEXO control center features the tools for operations monitoring and control, and is compatible with satellite relayed teleoperation.

APPLICATIONS

- Intuitive and dexterous control of robotic manipulators and end-effectors
- Remote control of space, ground and undersea robotic operations
- Robotic manipulation operations in hazardous or de-structured environments
- Operations requiring high level of human skills and expertise
- Large delay and satellite relayed teleoperation
- Virtual environment based training and simulation
- Force-feedback based rehabilitation and body stimulation
- Entertainment and gaming

SERVICES AVAILABLE

- Individual components or full setup implementation and configuration
- System components adaptation to customer needs
- Virtual reality implementation and integration with exoskeletons control
- System operations

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ABOUT SPACE APPLICATIONS SERVICES

Space Applications Services NV/SA is an independent Belgian company founded in 1987, with a subsidiary in Houston, USA.

Our aim is to research and develop innovative systems, solutions and products and provide services to the aerospace and security markets and related industries. Our activities cover manned and unmanned spacecraft, launch/re-entry vehicles, control centres, robotics and a wide range of information systems.



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DEXO Arm Specifications

Physical and Performance Characteristics

The DEXO arm is a 7-14 (single-dual) degrees of freedom force feedback exoskeleton. It allows to reach 70% of the front human workspace. Each individual arm weights 7kg - fully compensated by an external gravity cancellation system in complement to actuation modules.

The arm exoskeleton can produce 6Nm to 2Nm (continuous) and 15Nm to 4Nm (peak) active torque feedback from the shoulder to the wrist. Each joint is actuated by a brushless DC motor and provides absolute, incremental and torque telemetry.

User Comfort and Adjustments

Four adjustments allow to adapt the size to the P5-P95 adult European Male/Female range. Open rings configuration enable easy set-up of the operator. The user can choose between standing and sitting configuration, with an electric adjustable supporting column structure equipped with an ergonomic seat.

Power

The exoskeleton is powered through standard 220V, 50Hz AC, for a max power consumption of 200W (dual arm configuration)

Safety

The exoskeleton is delivered with a foot pedal interface to enable/disable active control of the exoskeleton.

DEXO Hand Specifications

Physical and Performance Characteristics

The DEXO hand has 6 active degrees of freedom, for a total weight of 0.8kg per hand.

Each actuator is able to provide 2.5Nm peak torque, corresponding to a tip force of 5N.

User Comfort

The range of motion of a single finger covers the full potential motion for flexion/extension of the user's finger, while a 3D printed palm provides a comfortable base structure with the hand.

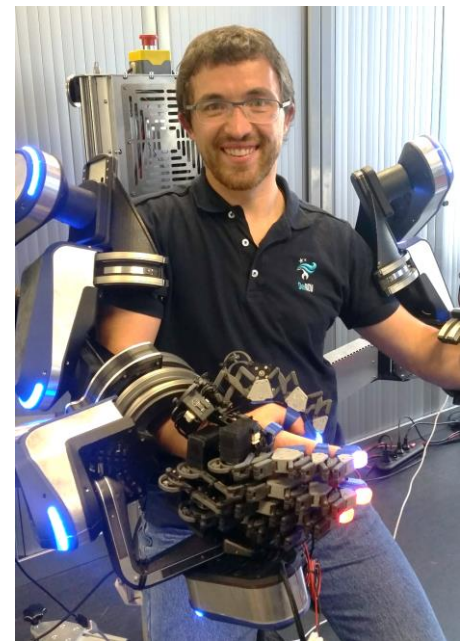
Power

The exoskeleton hand is powered by 24V DC (possibly provided by the arm exoskeleton), for a max power consumption of 50W.

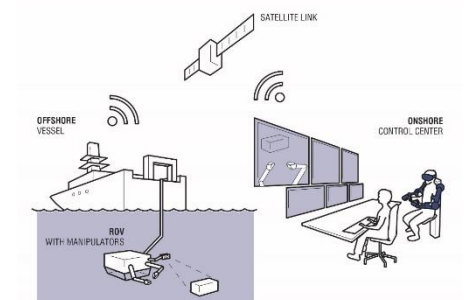
Control Communication

The exoskeleton controller is based on a real-time Linux operating system and is interfaced with the exoskeleton through an EtherCAT bus. Position, impedance or admittance control methods can be configured with an exchange data rate of 1kHz (telemetry and telecommands).

The controller provides high level (ZMQ, ROS) and low-level (EtherCAT interface API) interfaces to external systems as function of the customer applications and requirements. It offers a direct communication interface with the haptic engine of the DEXO Virtual Reality.



Dexo arm and hand exoskeleton



Satellite relayed tele-operation



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