

# Full Body Exoskeleton

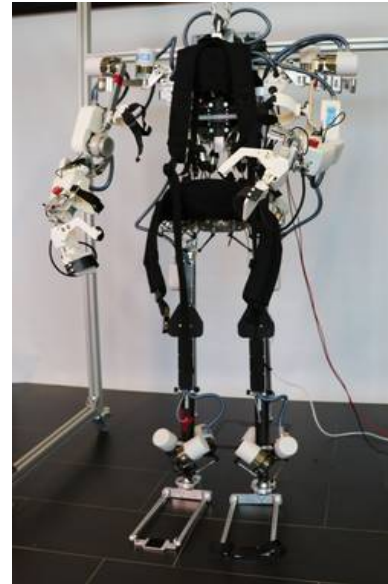
## Exoskeleton for upper body robotic assistance

### System Description

The active full body exoskeleton is a human-machine-interface developed to create synergies between man and machine in order to optimize processes and the workflow of upper body rehabilitation. The exoskeleton has seven contact points to the operator and the kinematic structure follows the human movements. In order to achieve the autonomy required for rehabilitation applications, all processing is performed by a small computing system that is embedded into the system. The kinematic structure has five active degrees of freedom at each arm, six at the back, six at the hip, two at the legs and six at the feet.

### Technical Details

- **Size:** 810mm x 531mm x 1640mm (adjustable) W x L x H
- **Weight:** 41 kg
- **Actuation:** 30 active DOF (20 x BLDC Robodrive, 2x Maxon, 6x Allied Motion)
- 2 active hand interfaces
- 2 vibration motors for haptic feedback
- **Sensors:** 8 x iC-Haus MH, 48 x iC-Haus MU, 2 x Honeywell FG10N, 8 ATI Nano 25, 2 ATI Nano 17, 2 capacitive touch sensors, 6 Waycon cable pull position sensors, 2 Waycon position sensors
- **Electronics:** 2 Arduino Nano, 30 BLDC stacks for distributed joint control, 2 DFKI ZynqBrain V1.1 , DFKI multi e-fuse board
- 3-hierarchical-layer-based control architecture. Robust cascaded velocity-position-current control on the low-level, dynamic control, gravity compensation and biosignal integration at mid-level (for the upper body) and controllability over a Web GUI at high-level
- 3 therapy modes implemented for the upper body: Master-Slave, Teach-In and Replay, gravity compensated free running mode.
- The legs support the user at sitting and standing and transmit the weight of the structure into the ground
- Sitting function at the legs



*The system covers the entire kinematics of the human body*

**Application:** Assistance – and rehabilitation robotics, teleoperation

**Projects:** **RECUPERA-Reha**  
Ganzkörper-Exoskelett für die robotische Oberkörper-Assistenz  
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*The active full body exoskeleton from the back*

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