

Dual Arm Exoskeleton

Exoskeleton for upper body robotic assistance

System Description

The active dual arm 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 five contact points to the operator and the kinematic structure follows the human movements of the arms. 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.

Technical Details

- **Size:** 0.7m x 0.9m x 0.9m W x L x H
- **Weight:** 29,7 kg (9,4 kg exoskeleton and 20,3 kg wheelchair)
- **Actuation:** 10 active DOF (6 x BLDC Robodrive, 2x Maxon, 2x Dynamixel),
- 2 active hand interfaces
- 2 vibration motors for haptic feedback
- **Sensors:** 8 x iC-Haus MH, 16 x iC-Haus MU, 2 x Honeywell FG10N, 2 ATI Nano 25, 2 ATI Nano 17, 2 capacitive touch sensors
- **Electronics:** 2 Arduino Nano, 10 BLDC stacks for distributed joint control, 1 DFKI ZynqBrain V1.1 as central control computer
- 3-hierarchical layer control architecture. Robust cascaded velocity-position-current control on the low-level, dynamic control, gravity compensation and biosignal integration at mid-level and controllability over a Web GUI at high-level
- 3 therapy modes:
 With the Master-Slave mode it is possible to control and move one arm with the other, resembling the classical mirror therapy approach.
 With the Teach-In and Replay mode movements from the arms can be tracked and saved, in order to replay them once or several times. The replayed trajectories can be triggered via EMG or EEG.
 In the gravity compensated free running mode the arms can be moved at will. Models of the human arm can be activated in order to compensate for the weight of the user's arms



The system covers the entire kinematics of the human arm

Application: Assistance – and rehabilitation robotics

Projects: **RECUPERA-Reha**
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The active dual arm exoskeleton in its resting state

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