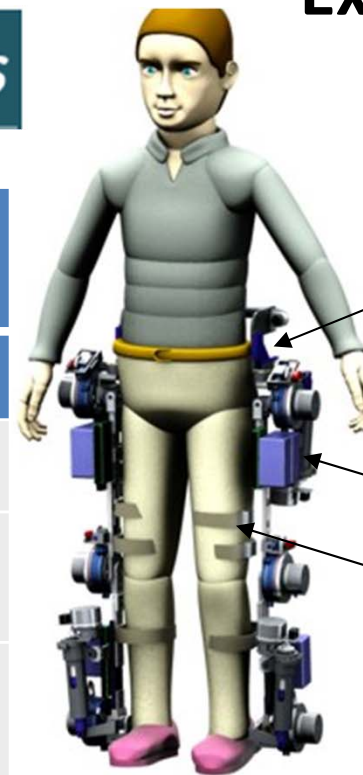


Exoskeleton 2020 Concept

PEMS MEDICAL DEVICE	Class IIA acc. to Directive 93/42/EEC
GENERAL DESCRIPTION	
Application	Gait training / Gait assistance in children affected by Spinal Cord Injury or Neuromuscular diseases.
Functional	Active Trunk- Hip-Knee-Ankle-Foot Orthosis - Provides gait assistance with 3D mobility - Provides assistance in standing up / sitting down
Physical	- It attaches non-invasively to the user body through straps - Adjustable in length and width to children from 95 to 140 cm high

Kinematics (6 DOF's per Leg)	• Hip flexion-extension by rotation about axis (31) in sagittal plane; • Hip abduction-adduction by rotation about axis (32) in lateral plane; • Hip rotation about axis (33) in transversal plane; • Knee flexion-extension by rotation about axis (34) in sagittal plane; • Ankle flexion-extension by rotation about axis (35) in sagittal plane; • Ankle eversion-inversion by rotation about axis (36) in lateral plane;
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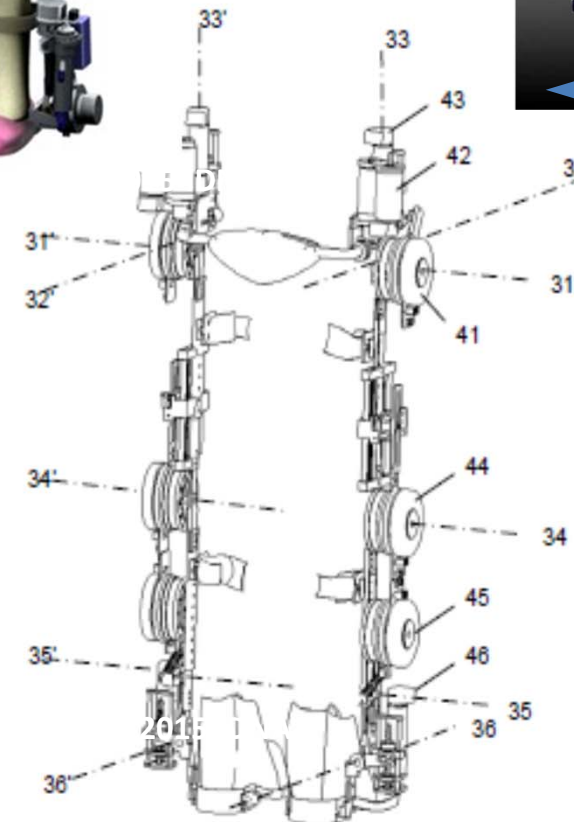
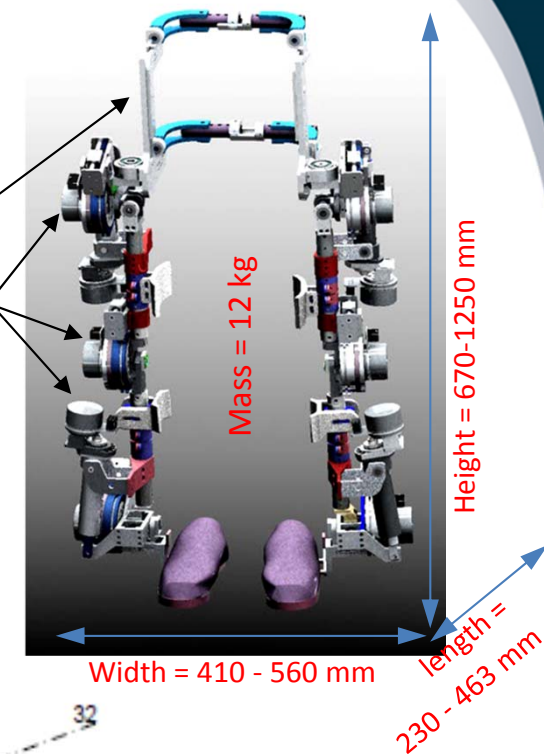


Adjustable frame

Actuators

Batteries

Physical Interface



Environmental Conditions

- Indoors use
- Operational Temperature: from 10 degC to 40 degC
- Humidity : Between 5% and 95% no condensing
- Altitude: < 1000 m above sea level

Mechanical

Primary beams	Ti alloy : ASTM B338
Plates, flanges	Al alloy : TBD
Bolts	Inox steel: TBD
Protective Fairing	PET panels (TBC)

Actuators (per leg)

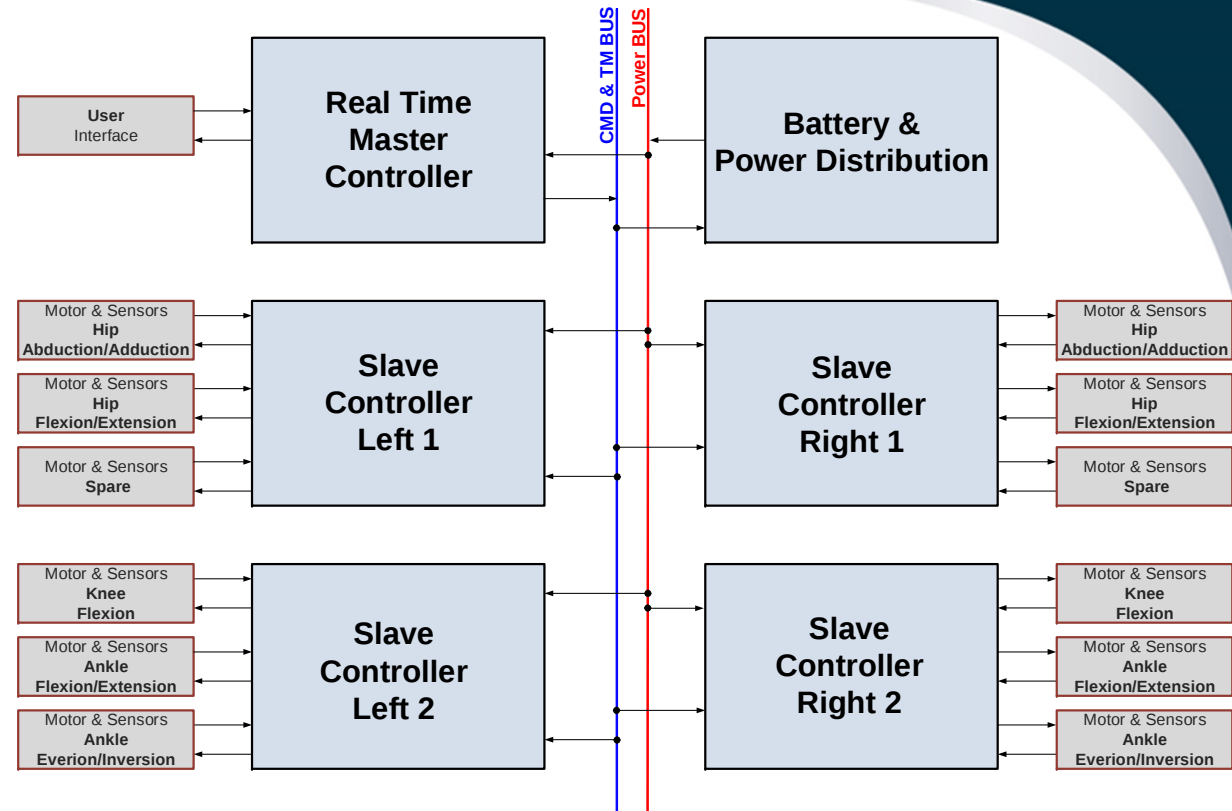
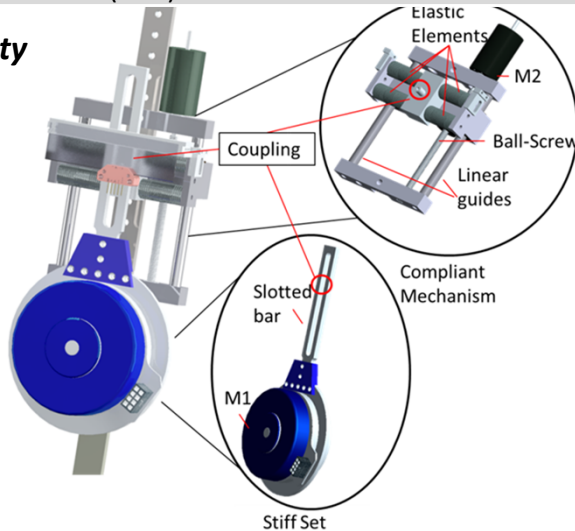
Motors	5 brushless motors x 70 W @ 24 VDC
Reduction Gearbox	- Sagital plane: 3 x Harmonic Drive 160:1 - Lateral plane: 2 x (3:1 planetary stage + 10x3 worm gearbox)
Elastic set	Spring: $K > 54.6 \text{ N/mm}$

Electrical Power

Battery set	- Replaceable : 2 x Li-ion 15 Ah @ 24 VDC (TBC) - Protection & Safety board: OCV - External charger
DC Bus	24 VDC $\rightarrow$ controllers + motor drives
Current Consumptions	- Nominal: 6.5A (TBC) = 2 A per motor + 0.5 A for electronics - Peak: 9A (TBC)

ARES (Adjustable-Rigidity and Embedded Sensor)

PATENT P201330882
(13/06/2013)
PCT/ES2014/070422
(23/05/2014)



Control

Master Controller (off-the shelf)	- HW: National Instruments (MyRIO). - SW: LabView platform
Slave controllers (ad-hoc)	- Motor drives: Maxxon ESCON 50/5 (TBD) - Microcontroller: ATMEL (TBD)

Sensing

Motor position & speed	Hall effect + optical encoder MILE
Joint position	Absolute magnetic sensor AS5045
Orthotic foot	8 x Sparkfun Force Sensitive Resistor 0.5" $\varnothing$ sensing area
Inertial unit (TBC)	SparkFun IMU Fusion Board ADXL345 & IMU 3000

Communications (*) the network will be likely unified to a CANbus topology

Battery	SIMBUS (TBC): Monitoring SoC
Master & Slave Controllers	SSI