Exoskeletons for physical assistance in human motion

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EXO-DAY 2023

29/03, 2023

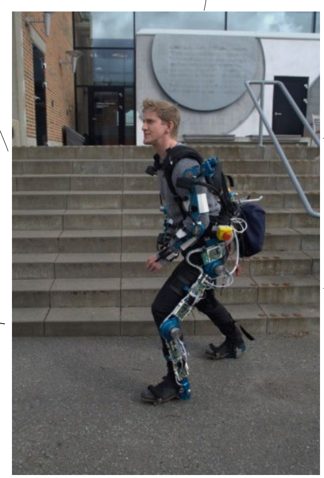
Exoskeletons at AAU Exo Lab

2019

2017

2020

2021



2013

2019 BioX

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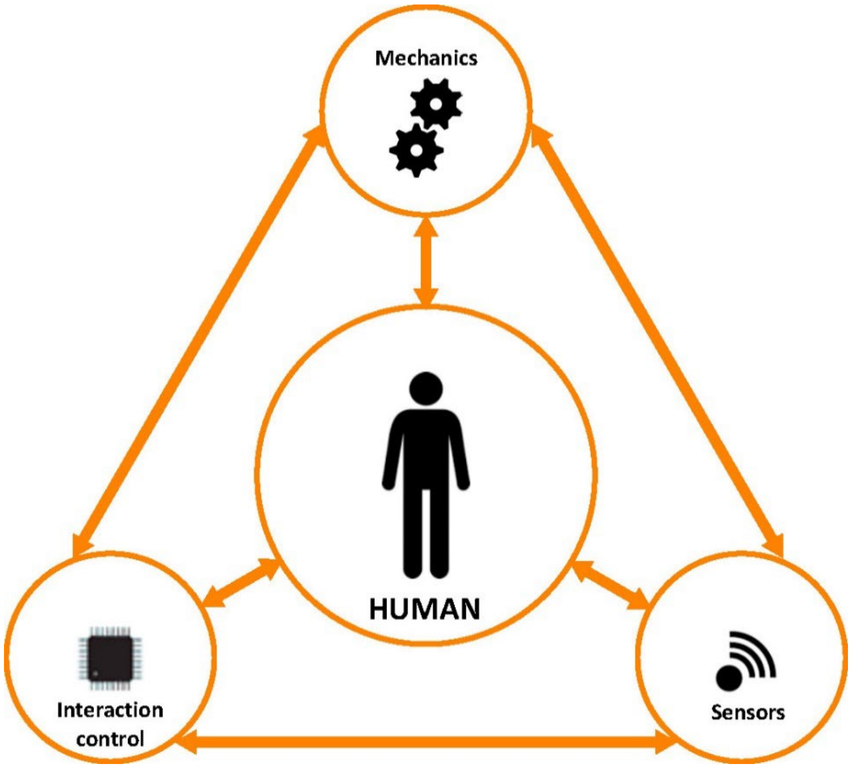
Design and development challenges for exoskeletons



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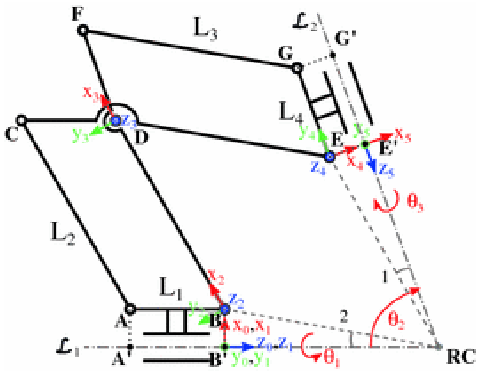
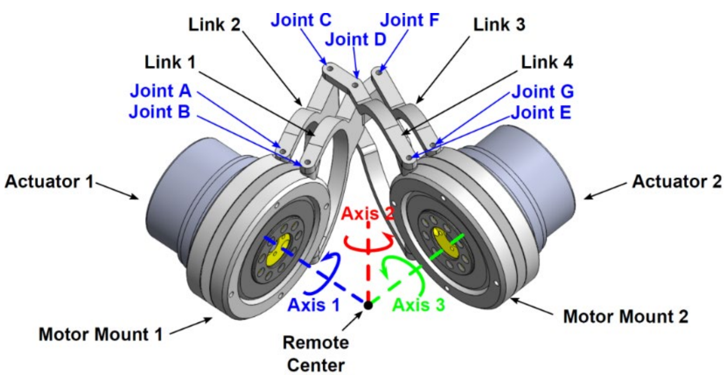
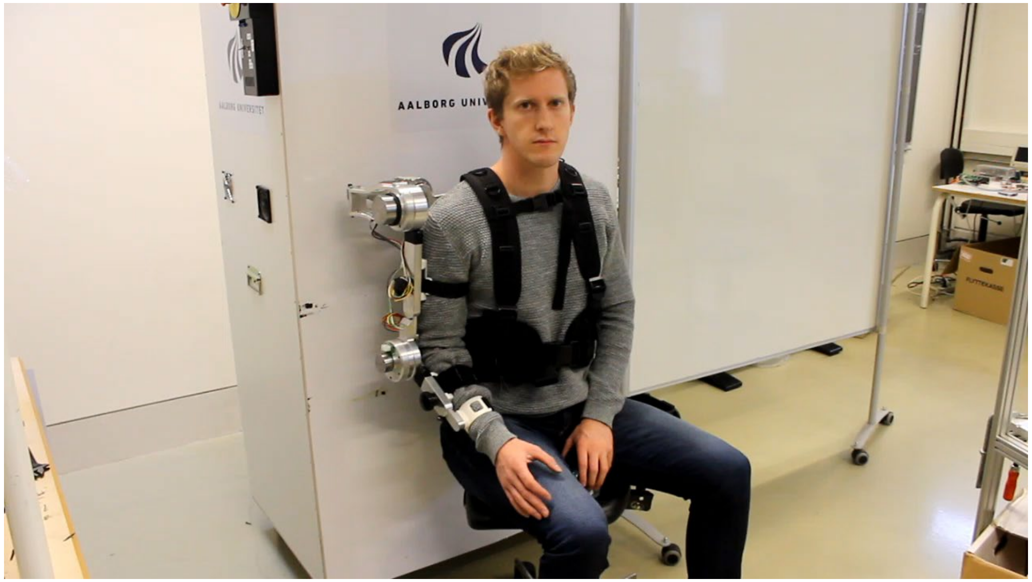
Double-parallelogram shoulder exoskeleton

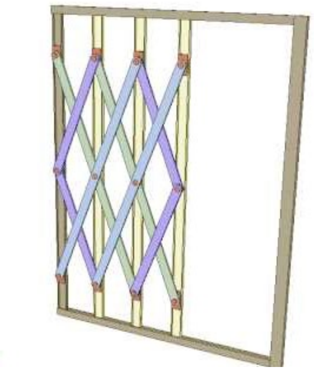


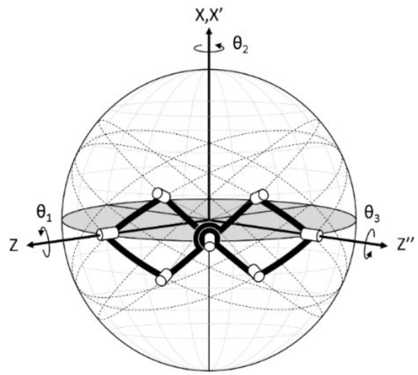


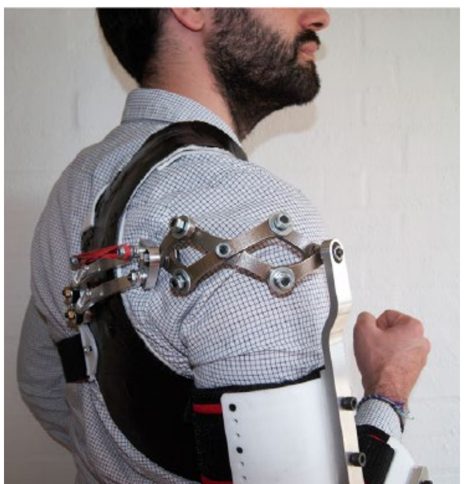


S. Christensen and S. Bai, Kinematic Analysis and Design of a Novel Shoulder Exoskeleton using a Double Parallelogram Linkage, *ASME J. Mechanisms and Robotics* 2018, 10(4), 041008

A compact shoulder exoskeleton - CXD



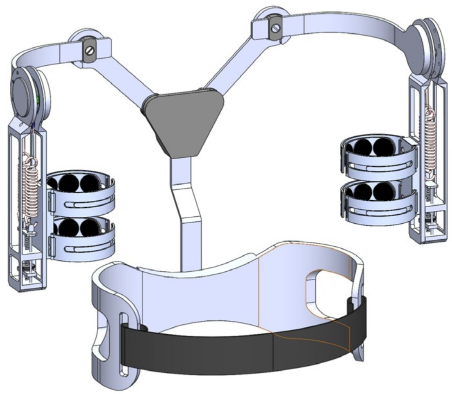


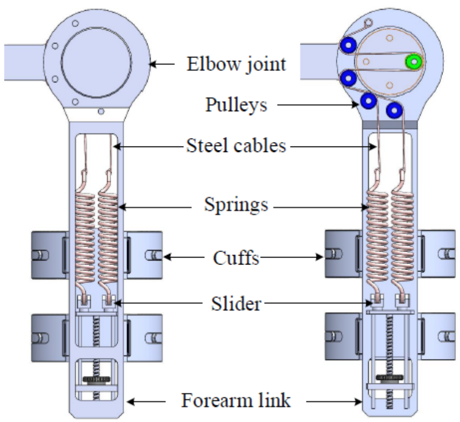


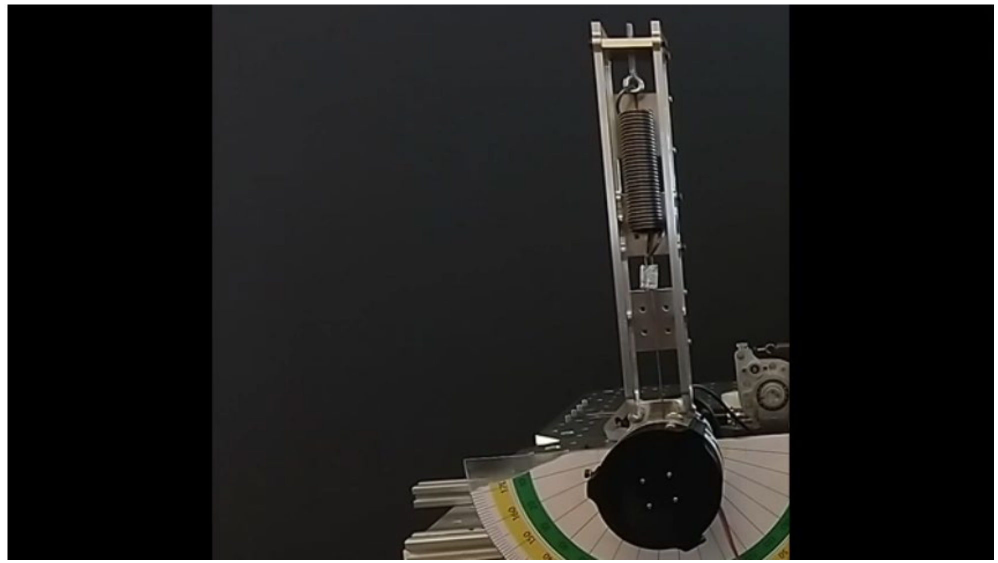
Able to reach 94.97% of the volumes of the full active reachable workspaces

M. Castro, J. Rasmussen, M. S. Andersen, S. Bai, *Mechanism and Machine Theory,* 132:264-278, 2019

A new passive upper-body exoskeleton







F. Balser, R. Desai, A. Ekizoglou and S. Bai, 2022， IEEE Robotics and Automation Letters

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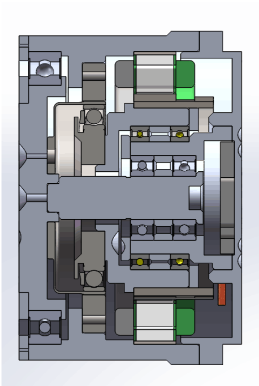
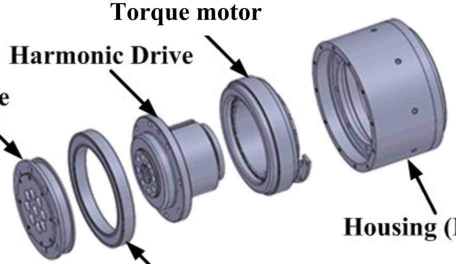
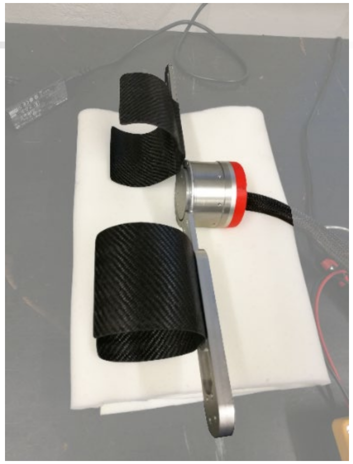
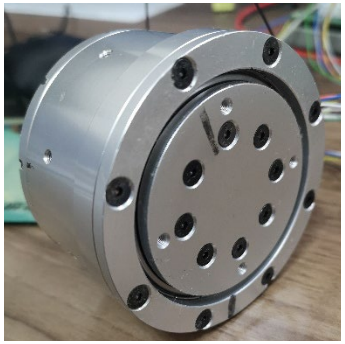
Other research and development
(1)Integrated driving unit









Parameters

- Length: 48mm
- Outer diameter: 72mm
- Weight: 0.6 Kg
- Maximum torque: 50 Nm

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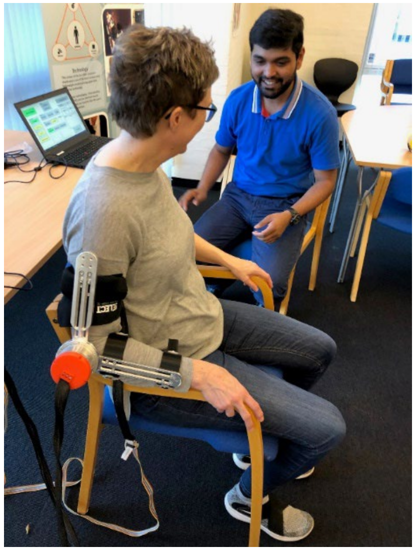
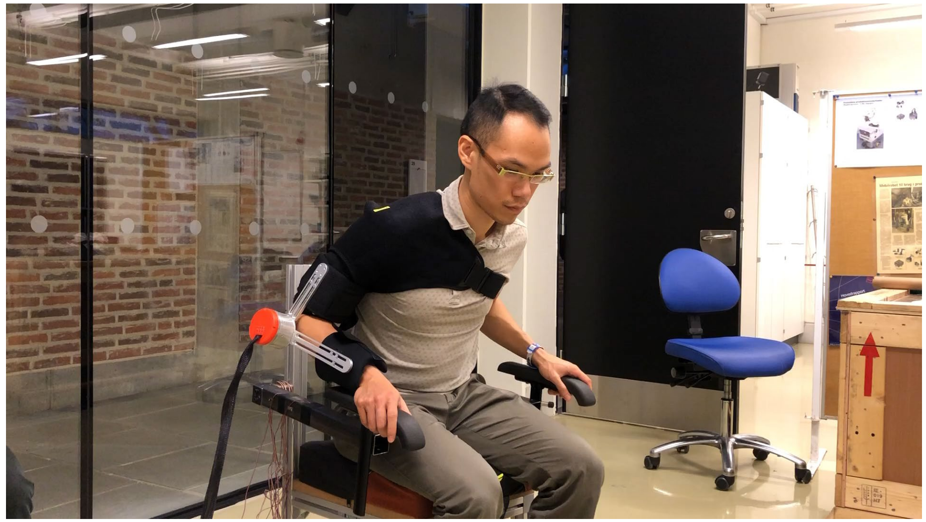
A most compact, lightweight yet powerful elbow joint exo
800 g of weight, 50 Nm aissitive torque





Sit-to-stand (STS) assistance

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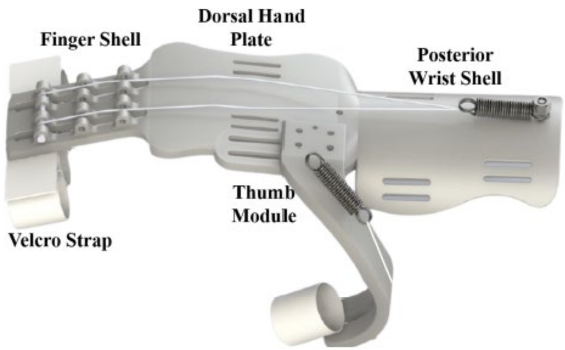
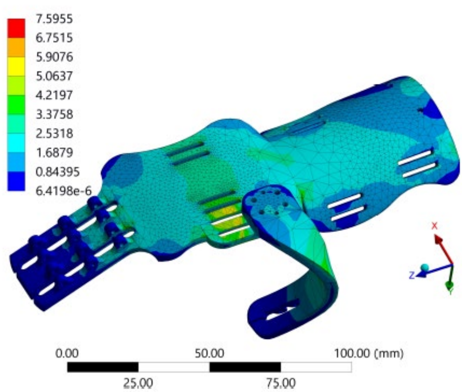
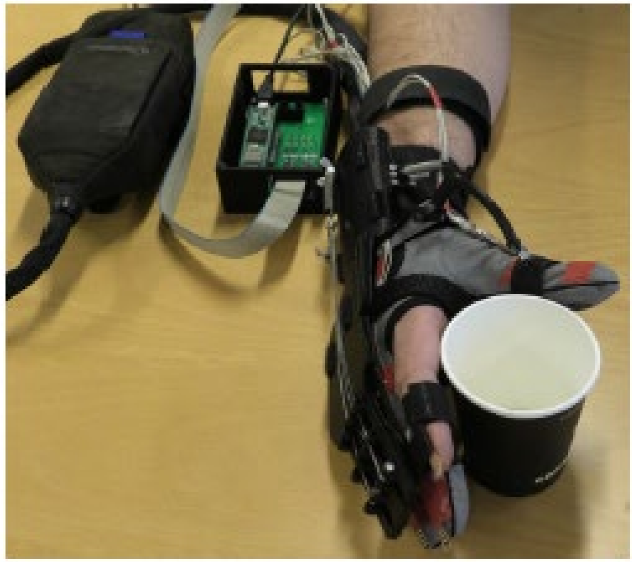
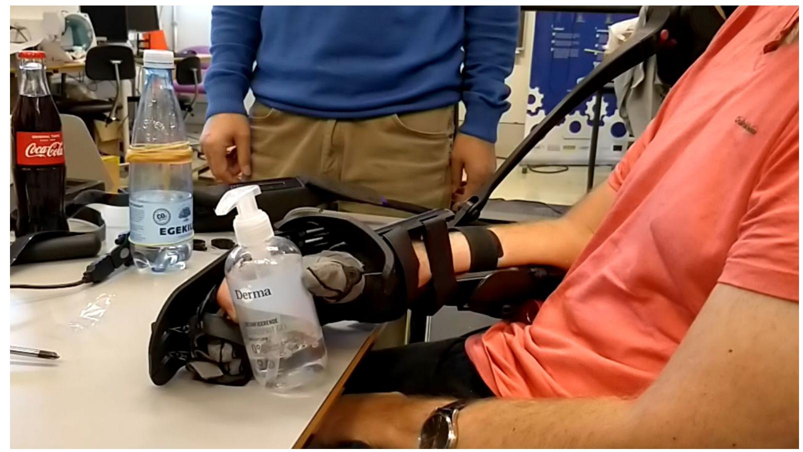
(2) 3D printed hand exoskeleton assisting both hand opening and closing







Hand exo assisting both hand closing and opening



M. Ahsan Gull and S. Bai, et al, ASME J. Medical Devices, 2021, 15(4): 041007

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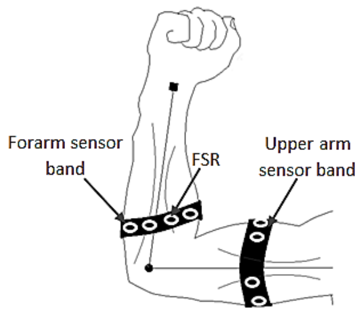
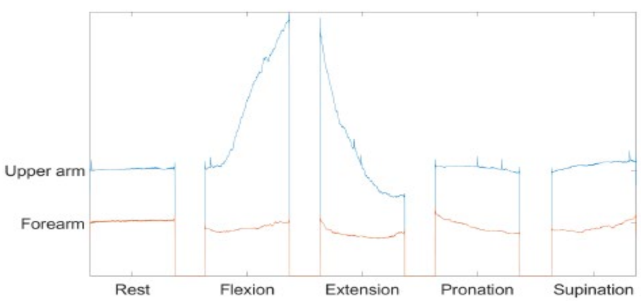
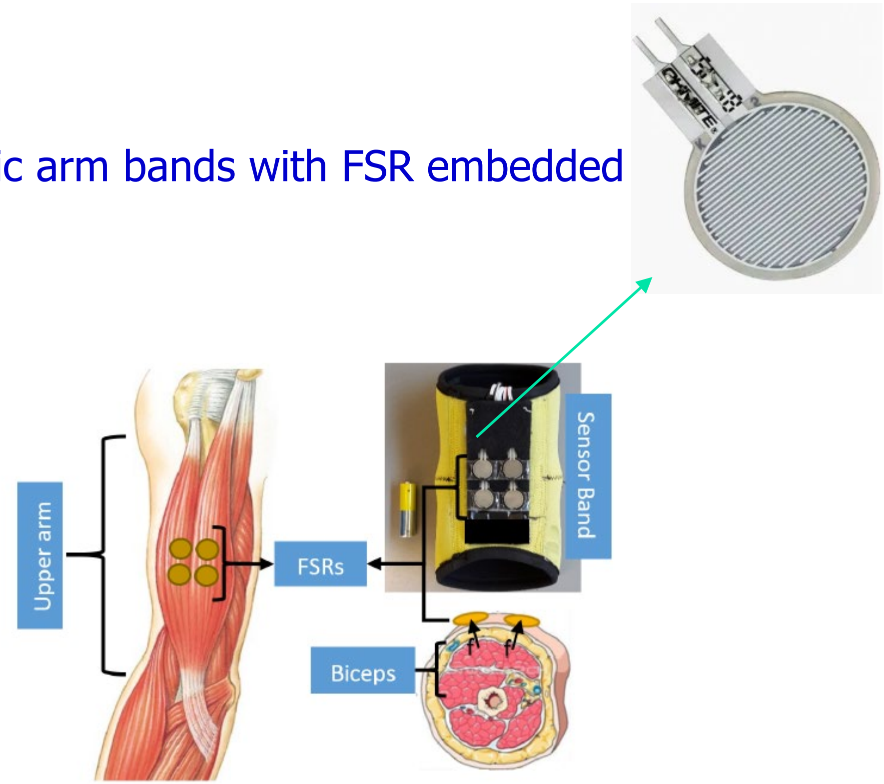
A sensing method based on FMG

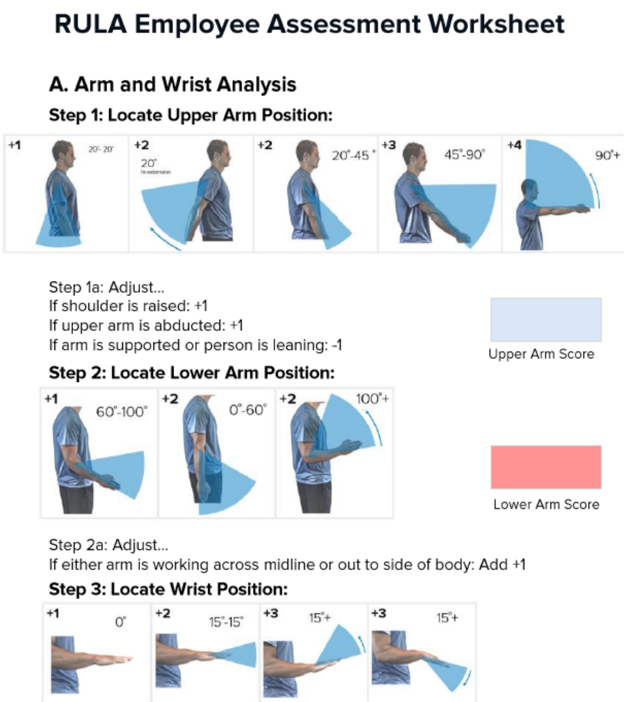
- A new sensorband of FMG
  - Force sensing resistor (FSR)
  - Sensorbands are built with elastic arm bands with FSR embedded







(4) Digital and Automatic Rapid Upper-Limb Assessment (RULA)



RULA Employee Assessment Worksheet

A. Arm and Wrist Analysis

Step 1: Locate Upper Arm Position:

Step 1a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

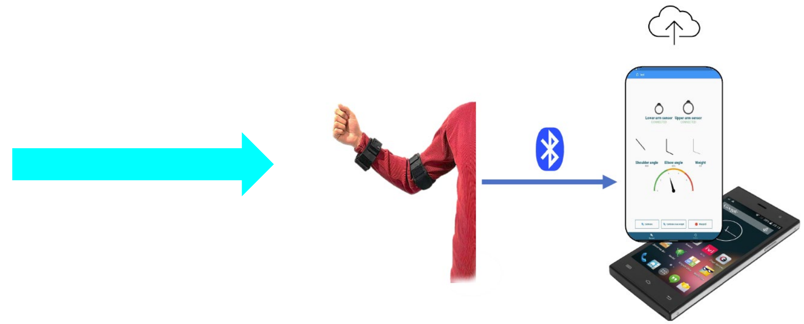
Upper Arm Score

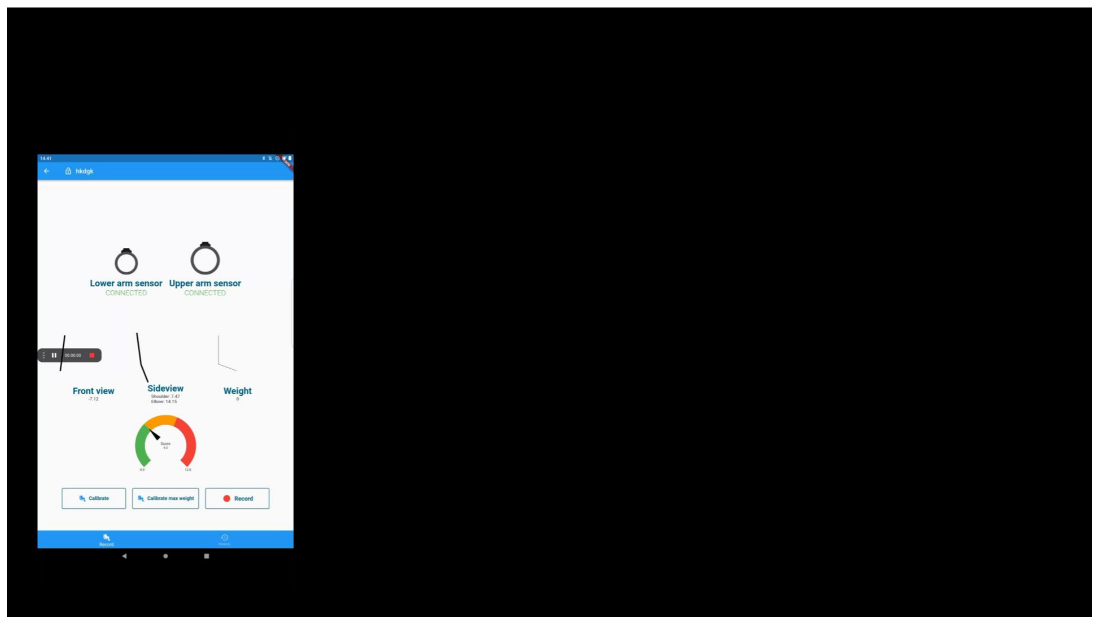
Step 2: Locate Lower Arm Position:

Lower Arm Score

Step 2a: Adjust...
If either arm is working across midline or out to side of body: Add +1

Step 3: Locate Wrist Position:





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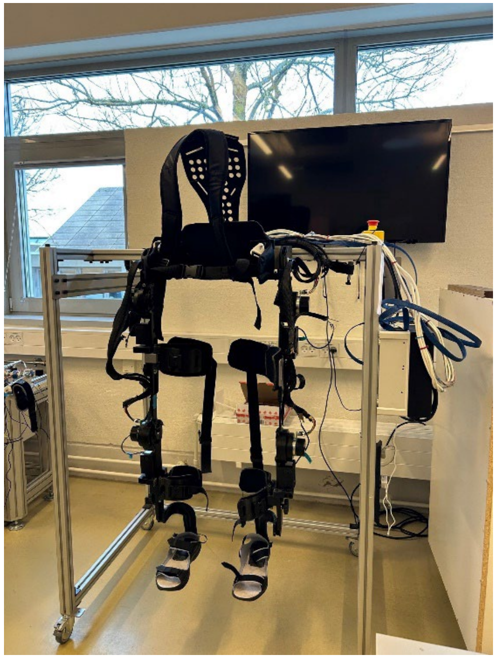
Lower-limb exoskeleton---ALEXO project

Frode V. Nyegaard og Hustrus Fond



- Fully powered at hip and knee joints
- Natural and comfortable interface
- Adaptive gait control built on ROS2

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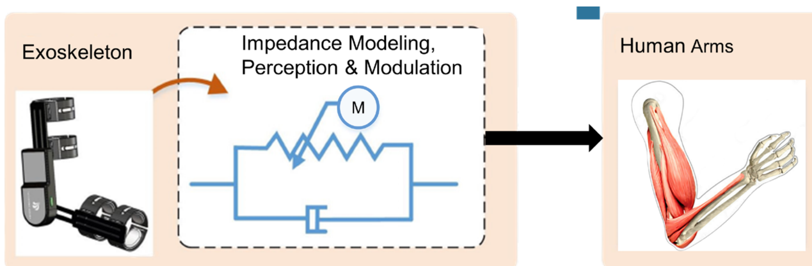
A DFF project on active upper-body exoskeleton

VIEXO (2022 -2025)
Variable impedance exoskeleton

DANMARKS FRIE FORSKNINGSFOND
INDEPENDENT RESEARCH FUND DENMARK

To develop advanced exoskeleton technologies for improvement of working conditions of physical demanding jobs to mitigate occupational injuries, such as musculoskeletal disorders (MSD), among others.



Human-exoskeleton interaction system of variable impedance

The project proposes a new bionic approach of exoskeleton development through variable impedance analogy to human limbs, which will lead to smart, safe and comfortable human-exoskeleton interaction (HEI) to meet situation-dependent requirements.

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EXKALLERATE project

- To imrove industrial exoekeleton technologies and
- to accelerate deployment of exoskeletons in SMEs

- Pilot sites at SMEs
- Seven pilot sites
- Contact us for pilot test at your company

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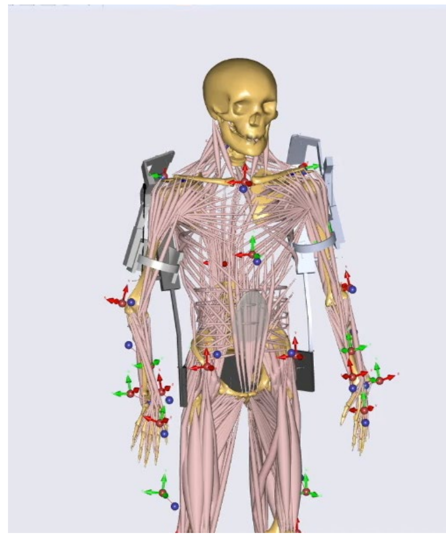
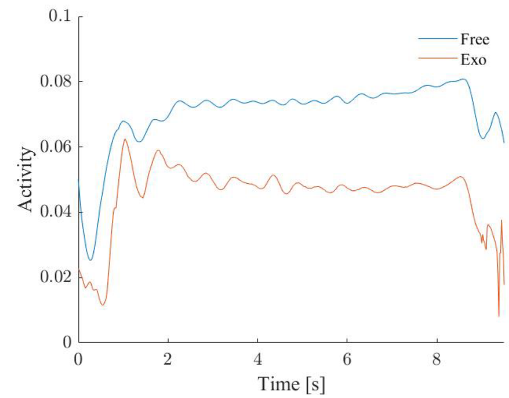
Effect of Biomechanics --- AnyBody modeling and simulation

- Modeling of Skelex exosketon in overhead tasks





reduction of 41.91% (SD 12.17%) in the Antero-Posterior force

M. Musso, A, Oliveira, S.Bai, Non-Rigid Passive Exoskeleton-Mathematical Description and Musculoskeletal Simulations , Robotics 2022, 11, 147

- Contact for pilot site test on either exoskeleton or RULA accessment:
  - Shaoping Bai
  - Email: shb@mp.aau.dk
  - Tel: 21359697

Interreg North Sea Region
European Regional Development Fund
EUROPEAN UNION

Innovation Fund Denmark
RESEARCH, TECHNOLOGY & GROWTH

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