

Using bioelectric signals and virtual reality to enable rehabilitation in the highly impaired

Morten B. Kristoffersen, Ph.D.

Postdoc,
Center for Bionics and Pain Research

Postdoc,
Department of Orthopaedics,
Gothenburg University

morten.bak.kristoffersen@gu.se

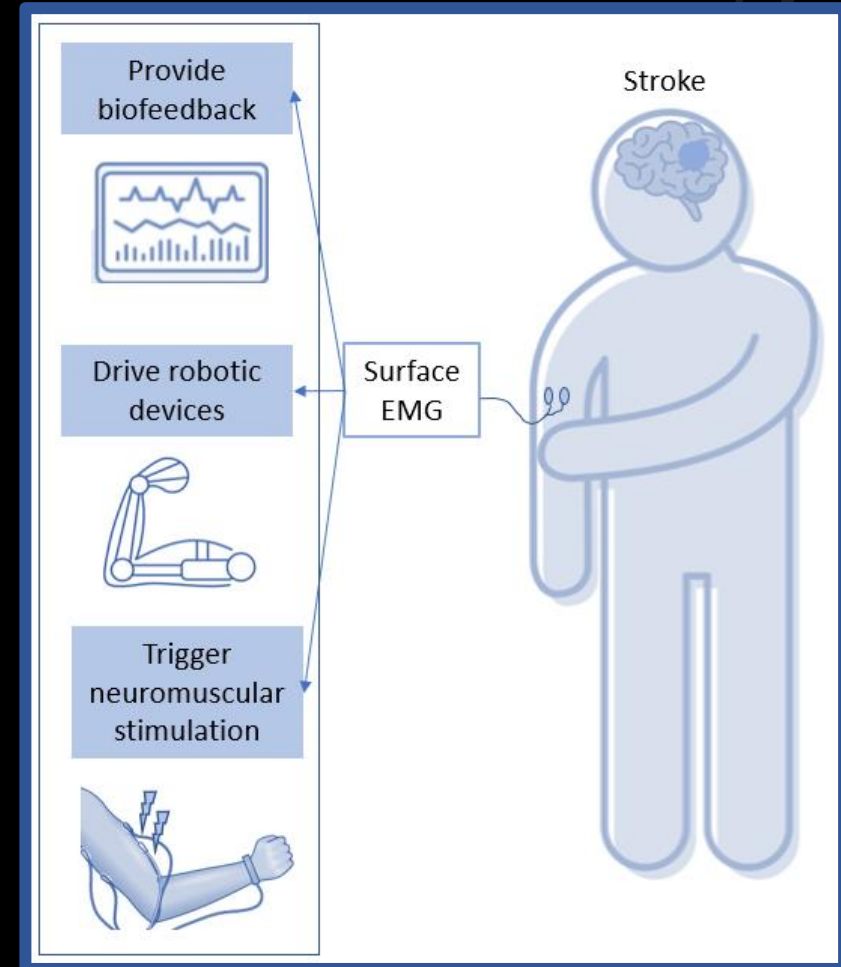


Stroke rehabilitation using Electromyography (EMG)



Maria
Munoz-Novoa

- Also known as myoelectric signals
- Use of EMG in stroke rehabilitation
- Systematic review and meta-analysis



Munoz-Novoa *et al.*, Front. In Hum. Neurosci., 2022

Myoelectric Pattern Recognition (MPR)

- Use of pattern recognition (AI) to decode the intended movement from the myoelectric signals
- Used for decades in prosthetics research

Works in the absence of movement

Kristoffersen, 2021



Myoelectric pattern recognition with virtual reality and serious gaming to improve upper limb functioning in chronic stroke: A single case design study

Six chronic stroke patients
Low upper limb function

Training:

- 18 sessions (A-B-A study design)
- 3 times per week
- 2 weeks assessments pre-post training



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Munoz-Novoa

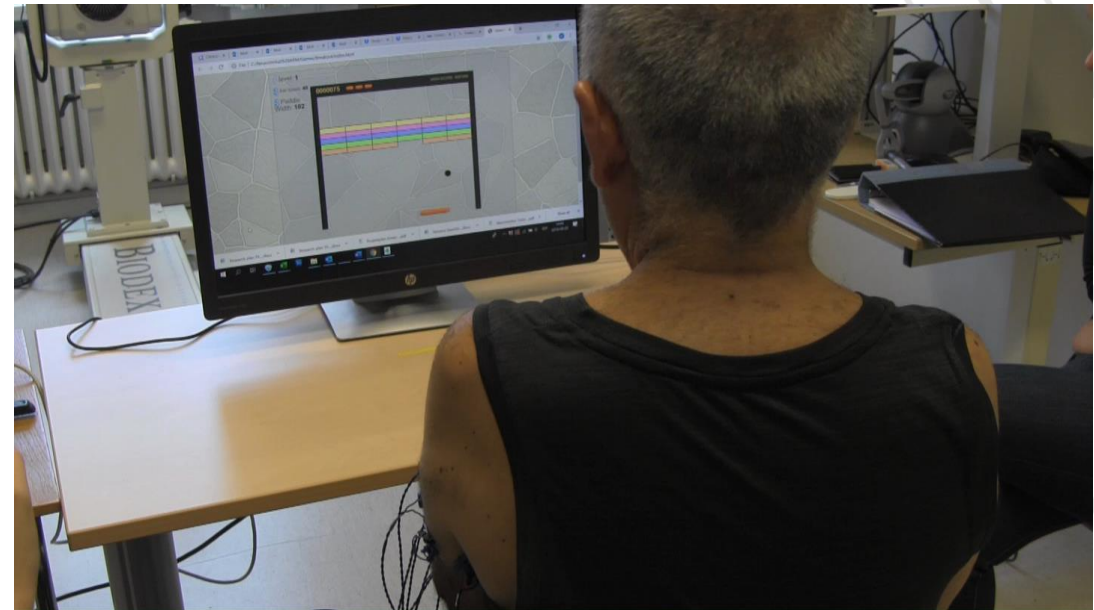
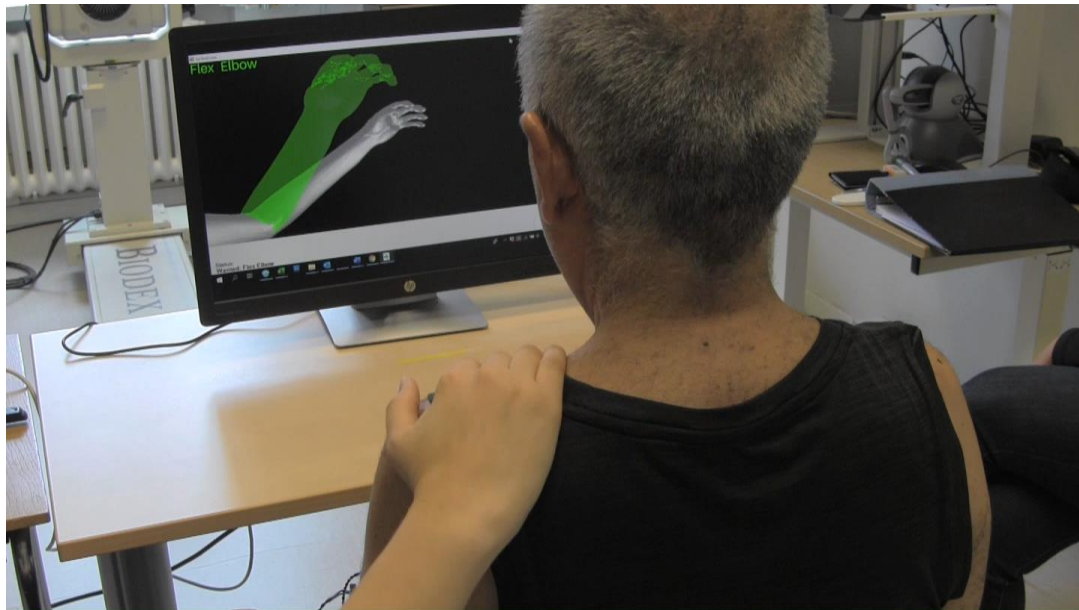
Munoz-Novoa *et al.*, in preparation



Training



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Results



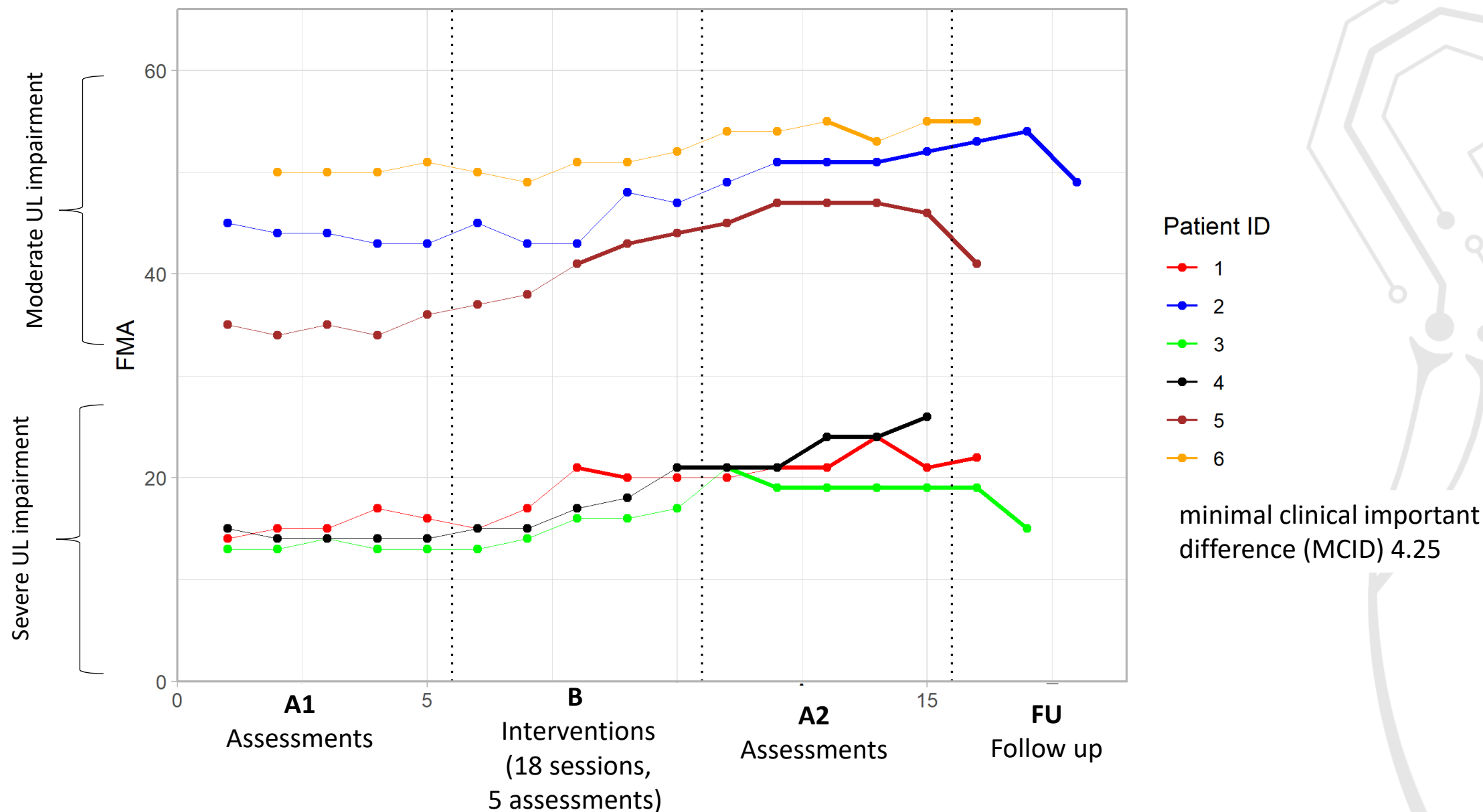
Before training



After training

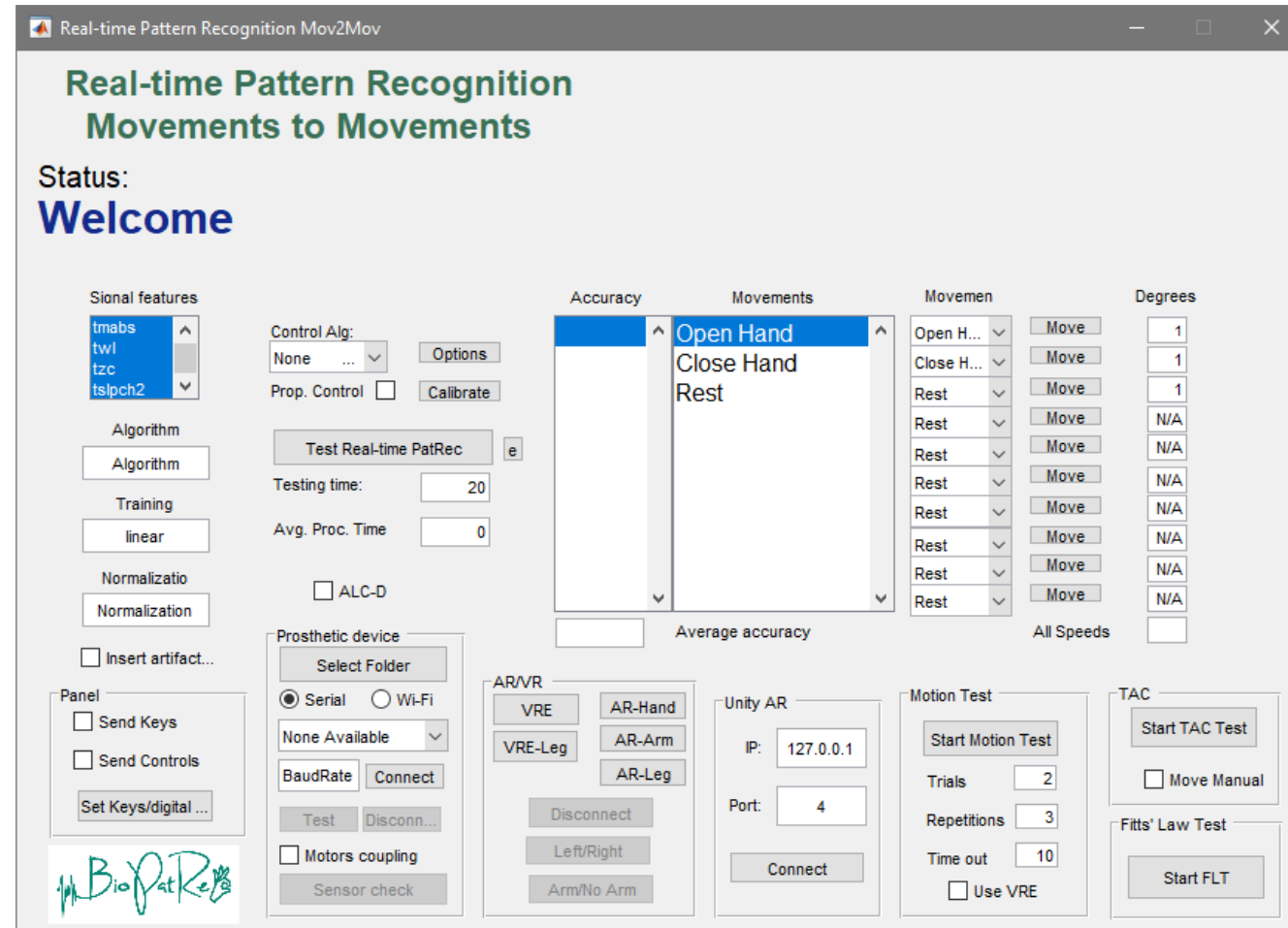


FMA-UE Score



Clinical translation

BioPatRec



Ortiz-Catalan *et al.*, Source Code Biol Med, 2013



MyoCognition

The screenshot displays the MyoCognition application interface. At the top, a progress bar shows four steps: 1 Settings (active), 2 Signal Check, 3 Record, and 4 Practice. On the left sidebar, there are two icons: a person lifting weights labeled 'PRACTICE' and a bar chart labeled 'ANALYZE'. At the bottom left of the sidebar is a 'LOGOUT' button. The main content area of the 'Settings' screen includes a 'No. Channels' dropdown set to '4'. Below this is a scrollable list of movement categories: 'ARM MOVEMENTS', 'HAND MOVEMENTS', 'FINGER MOVEMENTS', and 'RECORD AND MOVEMENT SETTINGS'. Under 'ARM MOVEMENTS', there are checkboxes for 'Supination/Pronation' (unchecked) and 'Flex Elbow/Extend Elbow' (checked). A 'Next' button with a right arrow is located at the bottom right of the settings panel.

1 Settings 2 Signal Check 3 Record 4 Practice

PRACTICE

ANALYZE

LOGOUT

No. Channels 4

ARM MOVEMENTS

- ☐ Supination
Pronation
- ☒ Flex Elbow
Extend Elbow

HAND MOVEMENTS

FINGER MOVEMENTS

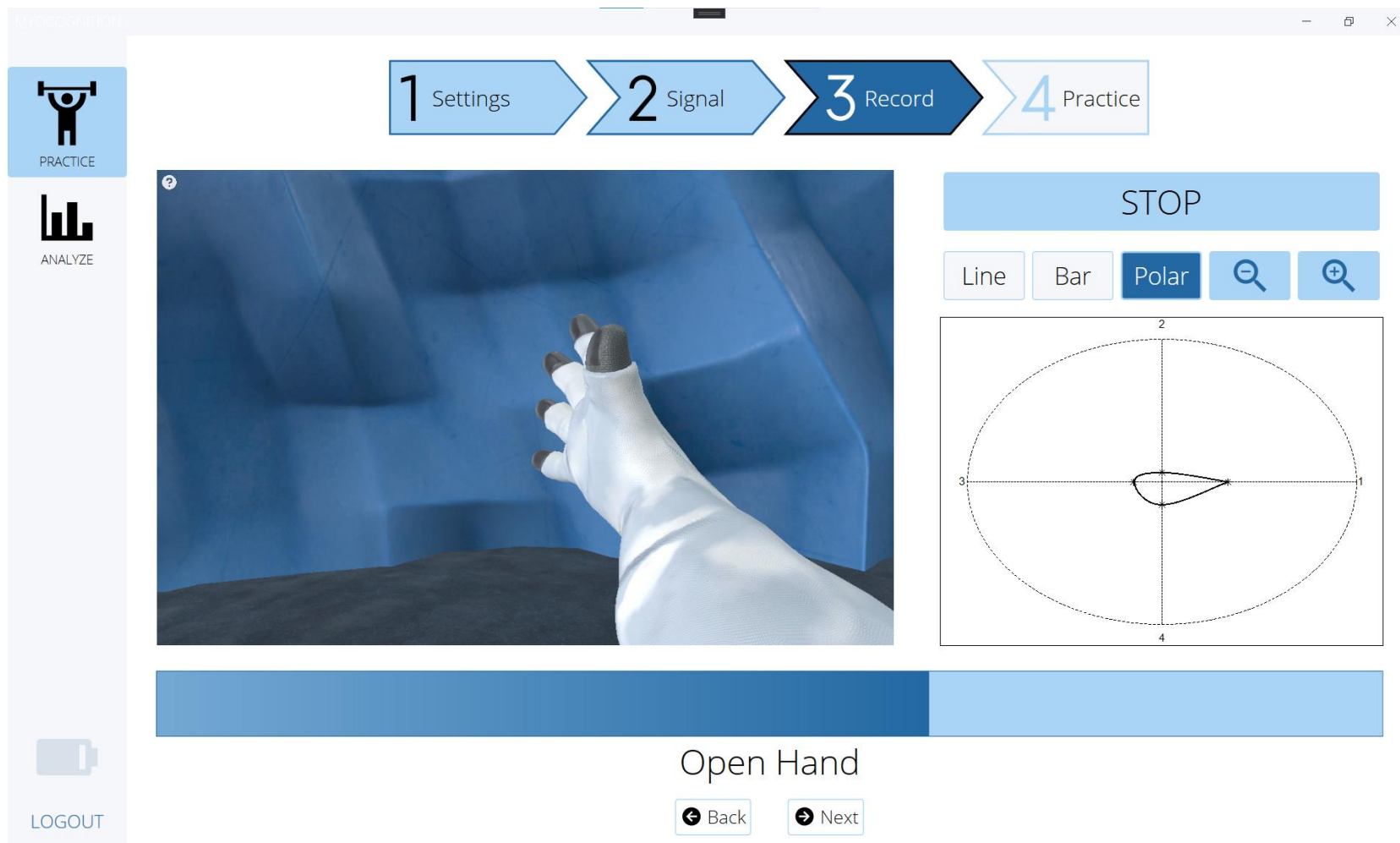
RECORD AND MOVEMENT SETTINGS

Next

Kristoffersen *et al.*, Rehabweek (ISVR), 2022



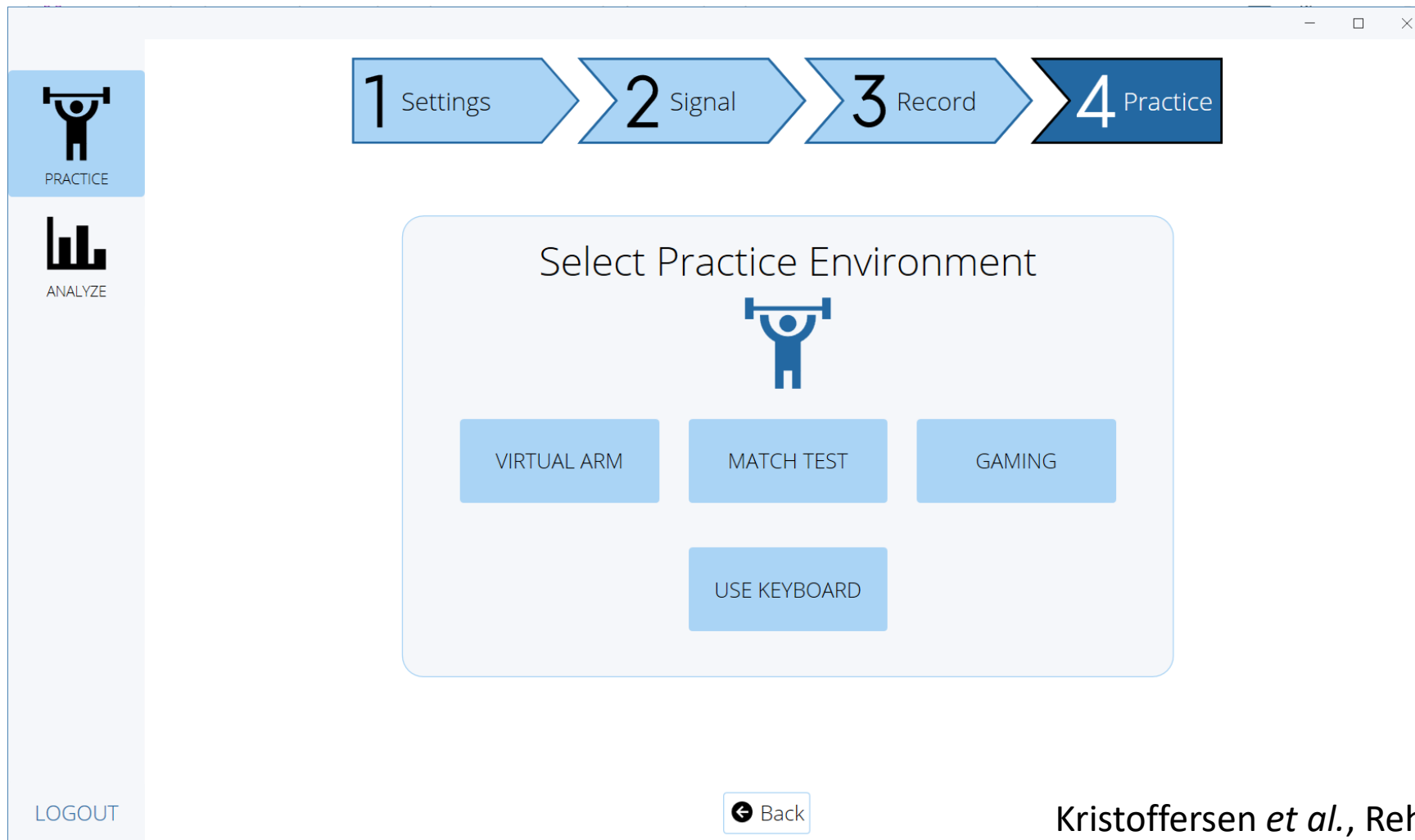
MyoCognition



Kristoffersen *et al.*, Rehabweek (ISVR), 2022



MyoCognition



Kristoffersen *et al.*, Rehabweek (ISVR), 2022

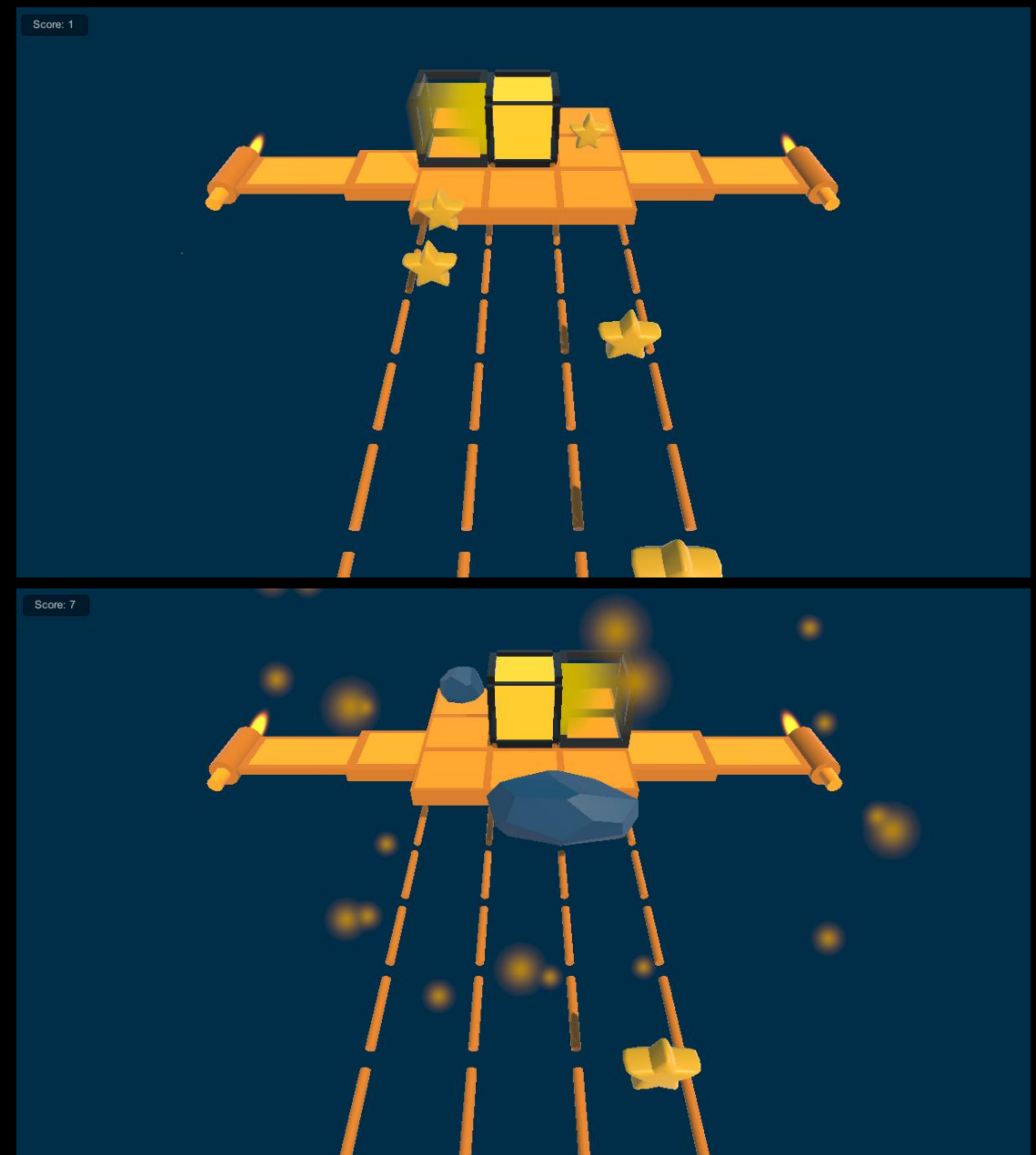


Serious games

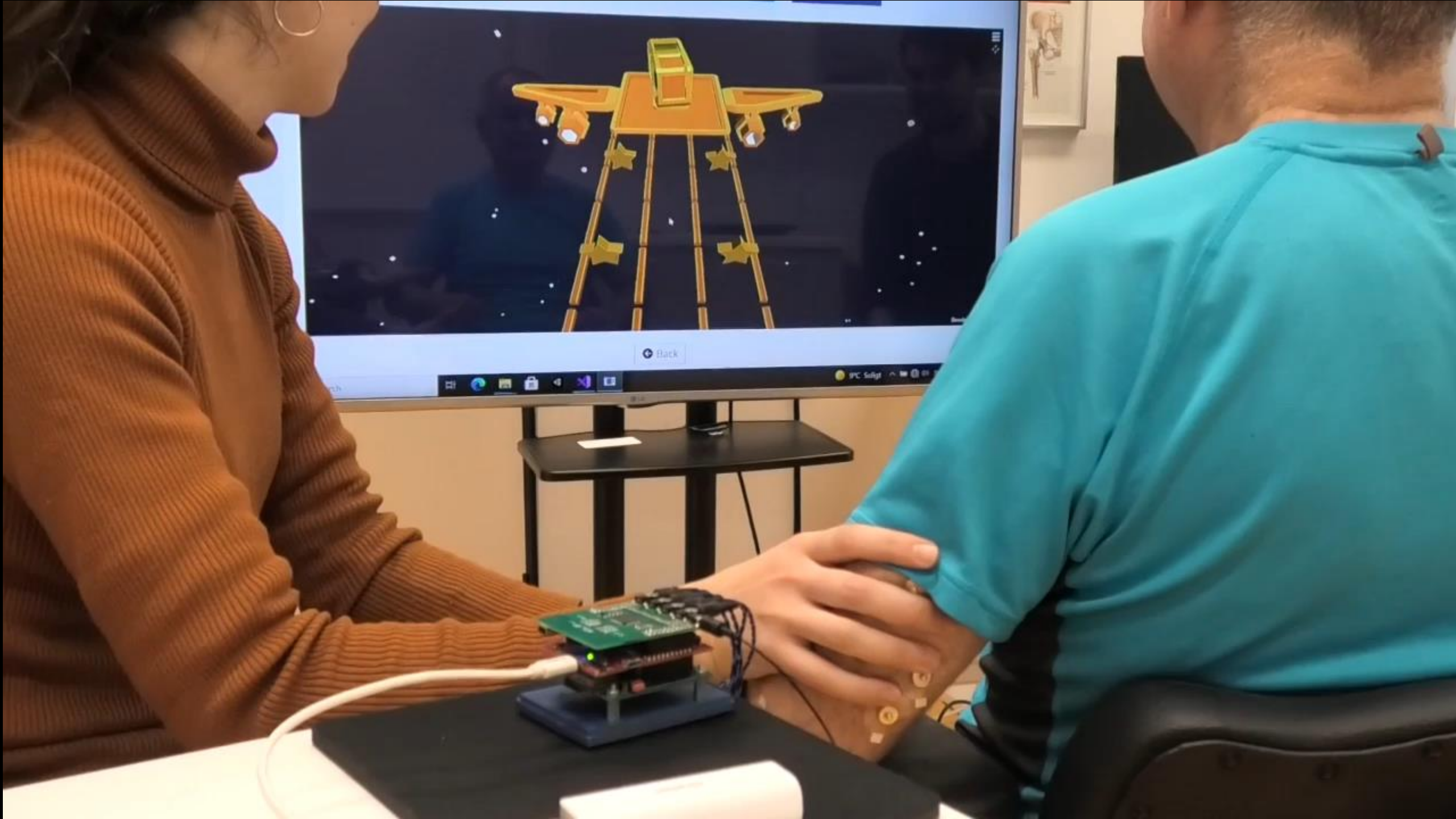


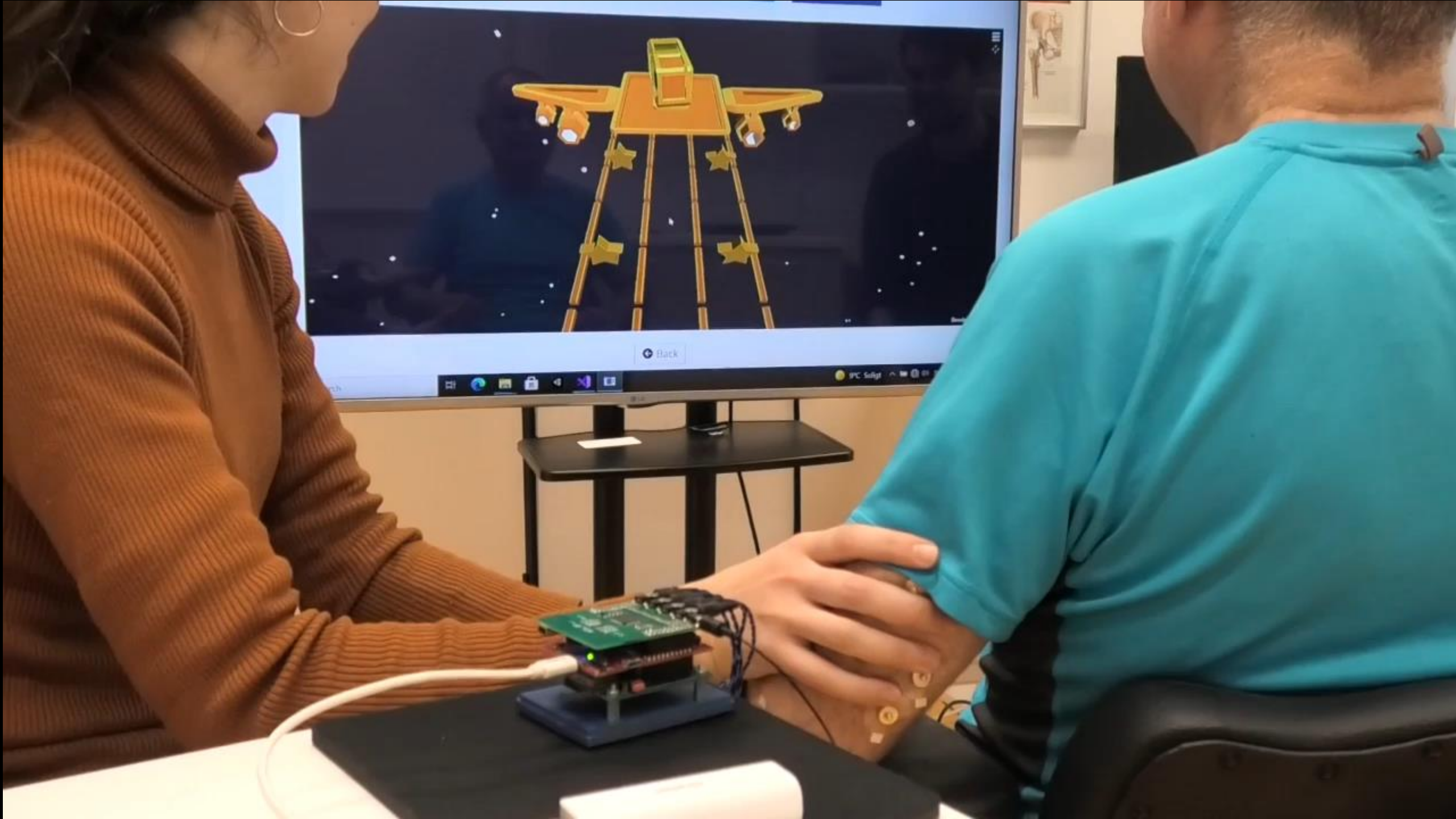
Niklas Möller

@CBPR.se



Kristoffersen *et al.*, Rehabweek (ISVR), 2022





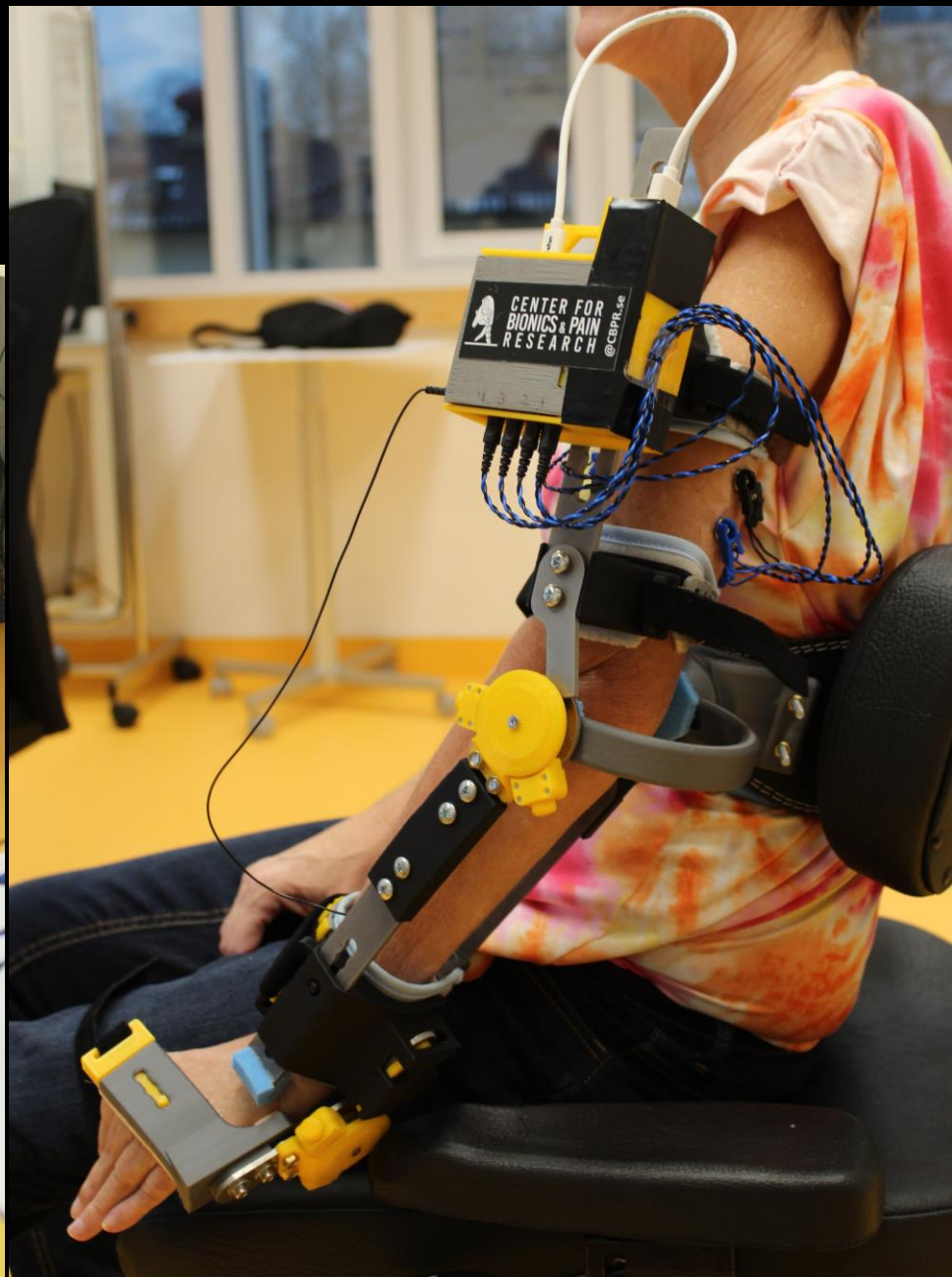
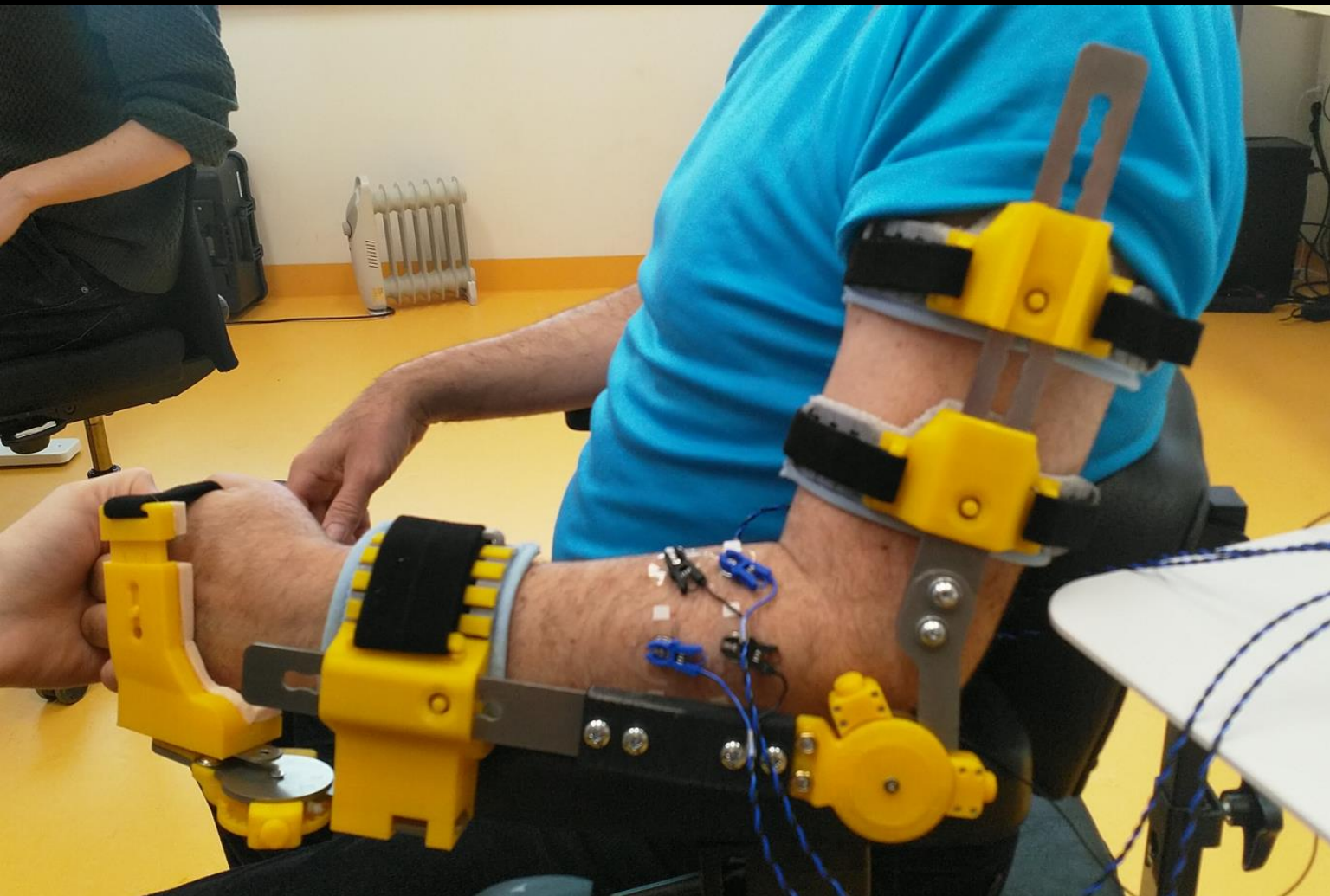


Stefan
Schuurbiers



Marnick
Joosen

Orthosis

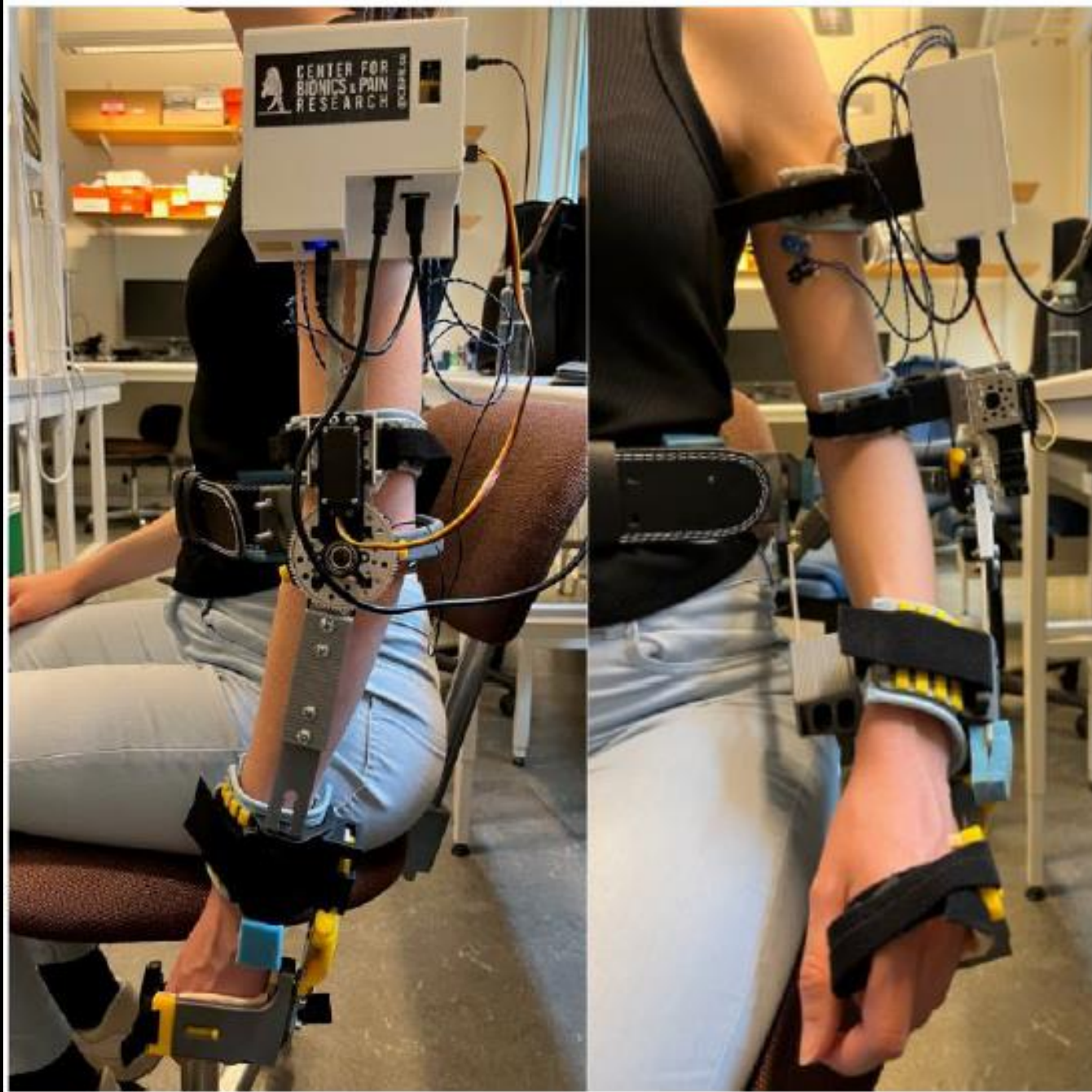




Rebecka
Lövgren



Rebecka
Lövgren



Sensory training



Sensory Training

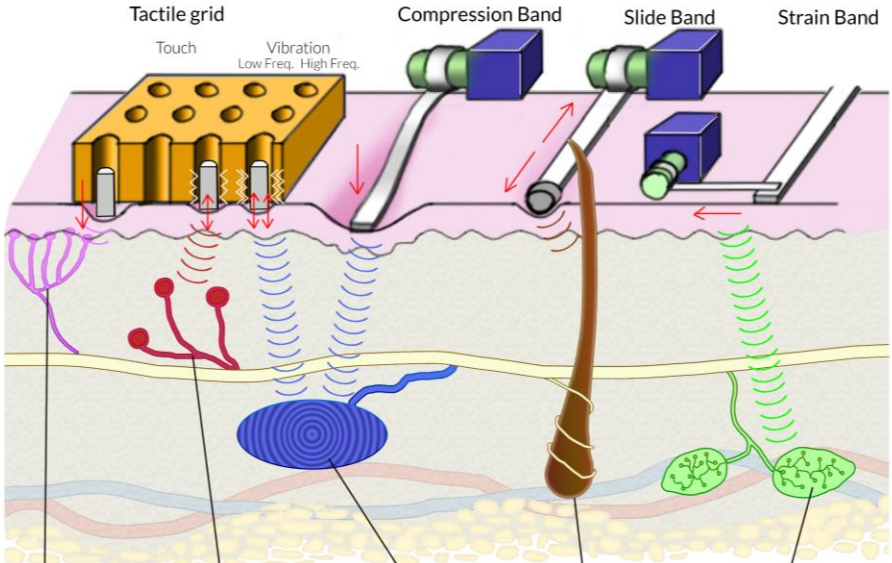


Mirka Buist



Training Software

Sensory Device
Tactile Grid
Sliders
Strain Band



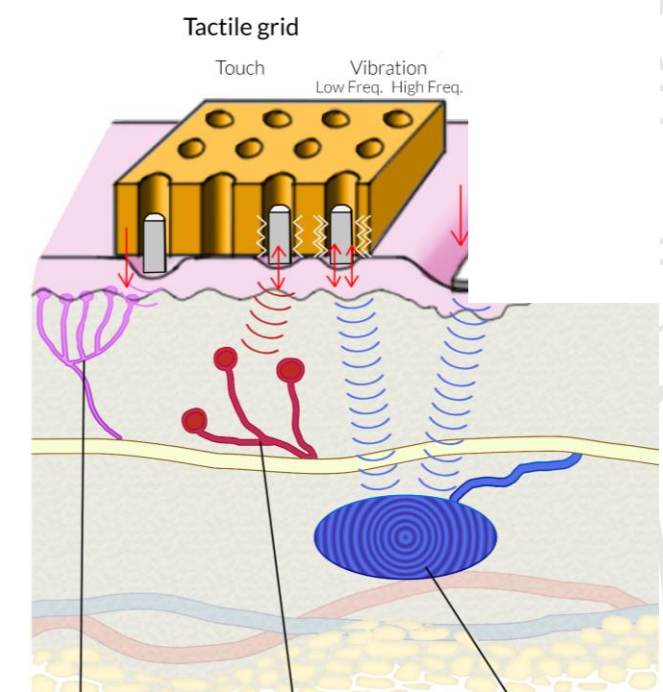
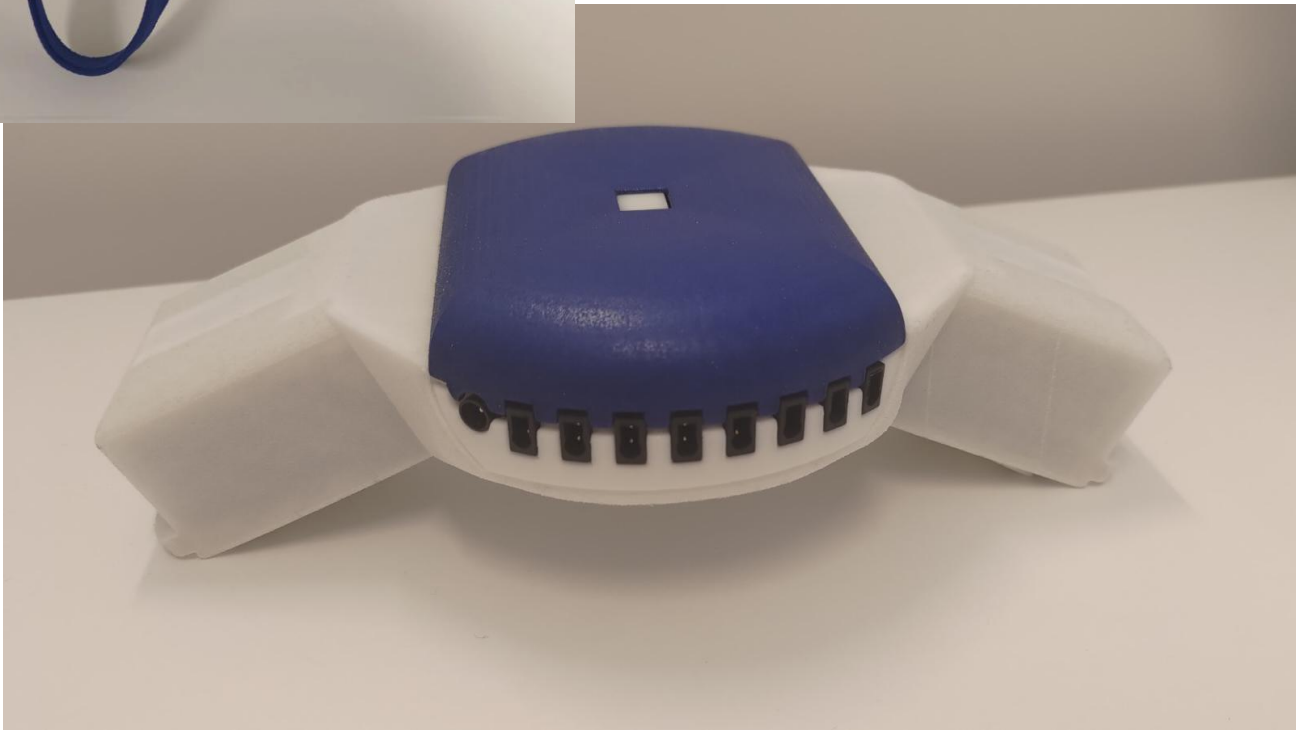
	Merkels Disks	Meisners Corpuscles	Pacinian Corpuscles	Hair Follicle Plexus	Ruffini's Endings
Type	Slow Adapting	Rapid Adapting	Rapid Adapting	Rapid Adapting	Slow Adapting
Response					
Density [cm2]	High 500	Medium 100	Low 20	Medium 200	Low 10
Fundtion	Light touch and tactile discrimination	Low frequency vibrations and skin motion	High frequency vibrations and deep pressure	Hair movements	Skin Stretch





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Myohaptic



	Merkels Disks	Meisners Corpuscles	Pacinian Corpuscles
Type	Slow Adapting	Rapid Adapting	Rapid Adapting
Response			
Density [cm2]	High 500	Medium 100	Low 20
Fundtion	Light touch and tactile discrimination	Low frequency vibrations and skin motion	High frequency vibrations and deep pressure

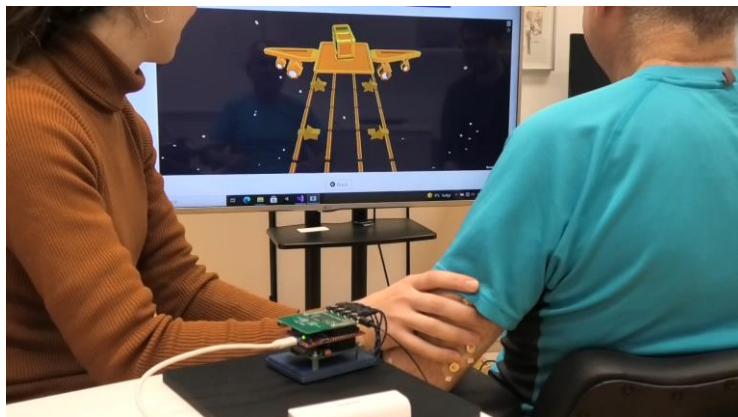


Mirka Buist



Niklas Möller

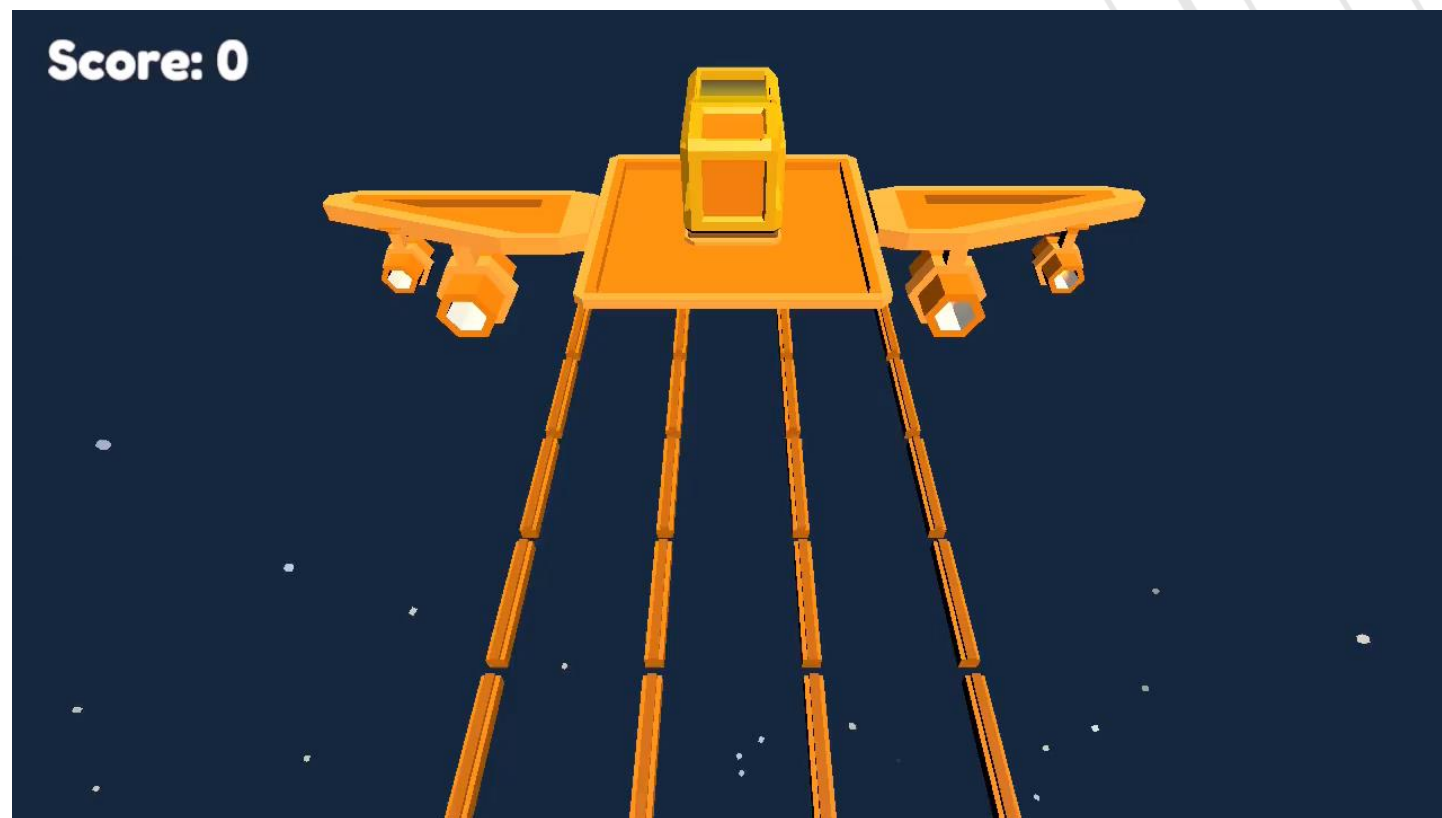
Sensorimotor training



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Maria Munoz



Mona Emaldeldin

Case study with minor (chronic case) Pre-assessment (ARAT)





Maria Munoz



Mona Emaldeldin

Case study with minor (chronic case) Midterm-assessment (ARAT)





Li Guo

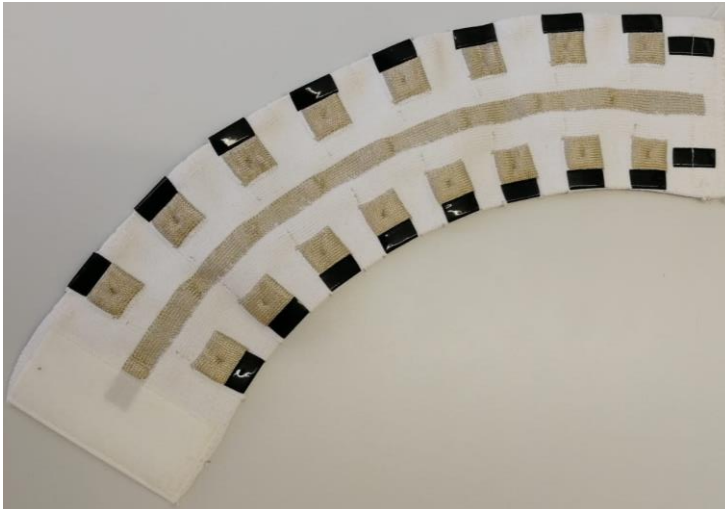


UNIVERSITY
OF BORÅS

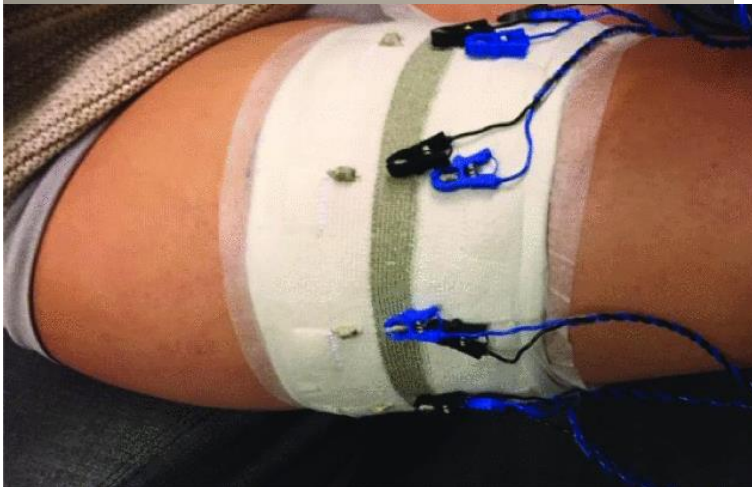
Next steps



Prof. Asplund



Textrode band



Laser Induced Graphene (LIG)
electrodes





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Questions?

Morten.bak.kristoffersen@gu.se



@CBPR.se

<http://www.cbpr.se>

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