AugmentX - Cognitive and Physical Assessment

Location: Brussels, Kortrijk, Leuven

Introduction

Description

The AugmentX infrastructure allows to assess physical augmentation solutions that enhance or augment the physical capabilities of a worker. Examples of augmentation devices include smart hoist, ergonomic tables, chairs, tools, cobots, exoskeletons and other peripherals. AugmentX provides the necessary tools to assess cognitive and physical load.

Scope

This document is intended as a **thematic information sheet** on infrastructure that covers all the elements that fit in the theme "**Cognitive and Physical assessment**".

There are devices that have a mixed use and are less focused on assessment. For instance, VR and AR goggles can be used as a means to augment the vision and/or as an eye tracking device. Also cobots can be used as and actuator and/or to measure position and force. **In this document we will treat the available AR goggles** as a separate class. However, cobots will be discussed in the thematic information sheet "robots and cobots".

For questions relating to the infrastructure presented on this fiche, please contact us via AugmentX@Flandersmake.be

Equipment and Specifications

The performed measurements (and equipment) can roughly be classified in four groups:

- A mocap system allow to track movement and posture in a 3D environment.
- Force sensing equipment allows to measure reaction forces (dynamometer, insoles, force plates etc.)
- Measurements of physiological variables allow to estimate the condition of a human operator.
- Other devices: AR goggles

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Fig1: left the Vicon, Kistler and German Bionics Exo skelet, right the Xsens, VO2-master, Cometa, Moticon (insoles) and German Bionics Exo

Mocap

Vicon optical Mocap system

The Vicon mocap system allows to monitor two spaces, the first offers a **capture volume of 5m by 8m by 2.5m** (extendible due to a removable wall) (equipped with the force plates), the second offers a **capture volume of 2.5.m by 1.5m by 2,5m** (equipped with the dual band treadmill). The combined system (over the two spaces) is composed of 4 Vue (RGB-cameras), 24 Vantage V5 (IR-cameras), 10 Vero V2.2 (IR-cameras), 2 64-channal ADC (Vicon lock-lab), 6 blue trident IMU's, two racks with patch-panels and switches allowing to allocate resources to three control desktops and 1 laptop.

The system **can be split** up into four separate systems distributing the resources according to the demand. This makes it possible to have several test campaigns running at the same time.

The setups can easily achieve **submillimeter accuracy (typically 0.3mm).** For the Vantage V5 cameras, the sample rate can reach up to **330 Hz.** (During commissioning, the accuracy was verified. i.e. at 100Hz, 16 V5 cameras and capture space of 5mx5mx2.5m. The system

demonstrated a position accuracy of 0.05 mm in the center of the capture space while the software estimated a space accuracy of 0.3mm)

The **Vicon system is more than just a mocap**. It is highly modular in nature and offers many possibilities to interconnect with other sensors.

The system with the large capture space (8m by 5m by 2,5m) and force plates is usually composed of:

- 24 Vantage V5 IR cameras
- 2 Vue RGB cameras
- 6 Vicon Blue trident IMUs
- The system comes with a 64 channel analog sampler (Vicon Lock lab) (1 channel at 192kHz or 64 channels at 3kHz).
- The connection to the Cometa sEMG is achieved via the Vicon lock Lab.
- The connection to the Kistler force plates is achieved with a software plugin but synchronized via the Vicon lock lab (i.e. the analogue channels remain available for other sources).
- A rack with three switches and patch panels
- Two control desktops

The system with the smaller capture space (2.5m by 1.5m by 2.5m) and the dual band treadmill is usually composed of:

- 10 Vero 2.2 IR cameras
- 2 Vue RGB cameras
- A 64 channel analog sampler (Vicon lock lab)
- The connection to the Cometa sEMG is achieved via the Vicon lock Lab.
- The connection to the dual band treadmill is achieved via the Vicon lock lab.

The Vicon Nexus software allows to define a skeleton template that can be fitted to a particular subject. **Joint angles** and other interesting metrics can be computed in automated pipelines and the collective data can be pushed in **real time** to other devices. (for instance over ROS in order to drive actuators, …).

An LSL client was developed for stream the RT data measure by the Vicon system (including Kistler force plates and Cometa EMG).

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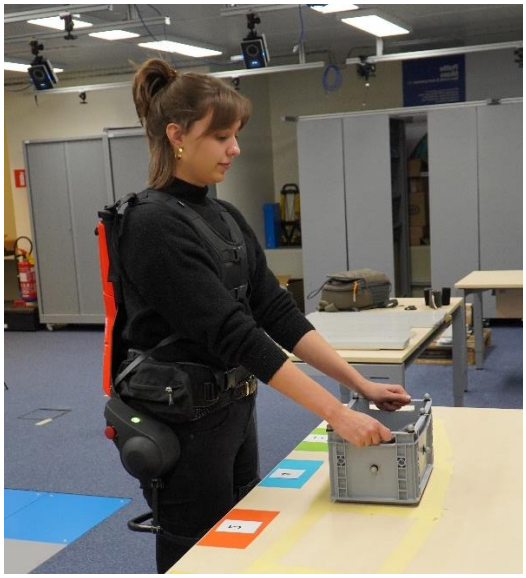
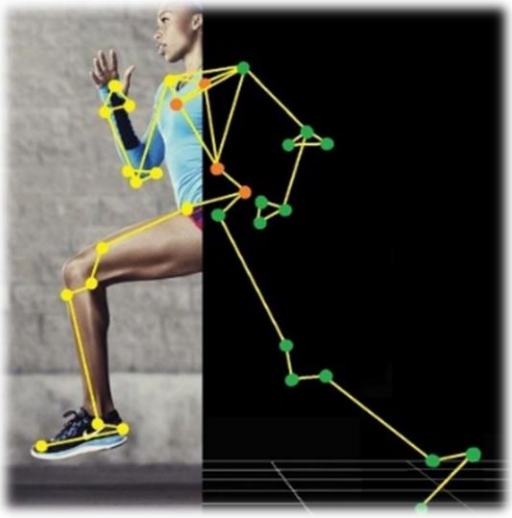


Qualisys optical Mocap system



Qualisys

Qualisys : Arqus A5 camera

The Qualisys system is comparable to the Vicon mocap system. The Qualisys Arqus A5 cameras are IR cameras (not visible light). They detect IR rays reflected by markers. Thus, they only 'see' dots representing each marker. The exact 3D position is then known from triangulation. As a camera system, they need line of sight to the markers. They are typically used for movies and animations.

After processing (in real-time), a wireframe skeleton of a subject can be measured based on the key positions of the markers. Positions of the limbs, and animation files can be extracted.

Useful details: Range: typically 2->15m from each camera. Frequency: 100 to 500Hz. Accuracy: 0.3mm/marker

Xsens / Movella - IMU based Mocap

(Movella recently took over Xsens.) The Xsens Awinda (50Hz) and the Xsens Link (200Hz) are mobile **IMU based Mocap systems**. They do not require cameras and are not limited by the space of the laboratory. The Xsens system measures the position and posture of human wearer.

In combination with Steam 2 tracking drift in position can be limited to 1 cm. The Xsens system has acceptable sensors but exceptional software. This software allows for convincing mocap sessions. In theory up to four subjects can be participate simultaneously in the same Mocap session and virtual Space (not tested).

R&MM disposes of an Awinda starter pack, an Awinda pack and one Link suit. We also have two MVN pro software licences. This is the software that combines all the data and that estimates a mocap based on a holistic assessment of sensor inputs. We can record, process and analyse data directly in the MVN software.

Because the Xsens is part of the mobile setup, we developed an application to push the data in Realtime to LSL. We can push the raw data or the corrected data (pre-processed (cleaned) by MVN).

Some of the important hardware specifications are listed in the following table.

Model	**Awinda**	**Link**
Sampling (Hz)	1000	1000
Output Signal (Hz)	60(#20) 80(10) 120(5)	240
Number of sensors	F.B. 17+1 up to 20	17
Batt endurance (h)	6	10
Buffer size (s)	10	Local storage mode
Accel. ±Range ±ac. (g)	±16±0.5%	±16±0.5%
Gyro ±Ran. ±ac. (°/s)	±2000±0.1%	±2000±0.1%
Mag. ±Range ±ac. (mT)	±0.19±0.1%	±0.19±0.1%
Connection to PC	2.4 GHz Awinda	Wifi
Latency (ms)	30	
Suits or straps	Wireless, straps	Wired/Wireless suit
Base station	Aw. station and dongle 50m(out) 20m(in)	150 m
Sensor weight (g)	16	
Sensor size (mm·)	47x30x13	

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Xsens – Movella - Awinda

Xsens – Movella - Link

Xsens Meta Gloves by Manus

With the Xsens meta gloves by Manus, submillimeter finger tracking is immediately within MVN the Xsens analyze software. The Metaglove batteries can last 3 hours during continuous use on a full charge. Additionally, the Metagloves can be powered by an external power source through the USB Type-C port.

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Xsens Meta gloves by Manus

Signal latency	· 7.5 ms
Finger sensor type	Absolute position, 3 axis rotation
Sensor sample rate	120 hz
Battery endurance	3h
Charging Time	2h
Weight	138 grams (incl. battery)
Wireless communication	Bluetooth 5 Low Energy
Wireless range	15 m
OS	Windows 10/11
Compatible with MVN	MVN 2022.3 Beta and up

Manus Prime X Haptic VR (finger tracking gloves)

Experience lifelike experience in the virtual environment with the Manus Prima X Haptic VR gloves. With the gloves you hold digital objects and you can press buttons and pull levers in the virtual environment. The Manus Prime X Haptic VR gloves are compatible with Unity and Unreal Engine. Further integrations can be built using the Manus Core SDK.

The Manus Prime X Haptic VR glove's built-in haptic module provides feedback to each individual finger. In addition to the Haptic feedback, the Manus glove has of a nine DoF IMU sensor for each finger to ensure high quality finger tracking. The Manus Prime X Haptic VR gloves contain a replaceable battery that lasts up to 5 hours. It is possible to swap batteries

while using the glove, so you do not run out of power. The Manus Prime X Haptic VR glove comes with a universal mounting system that allows different trackers and sensors to be placed on the glove. This includes: HTC VIVE Tracker 2.0 and 3.0.

Unfortunately these gloves are not recognized by the Xsens MVN analyze software. To provide integration into the mobile system, we are **currently writing** the necessary software to redirect the data stream and send the measured mocap data to LSL.

Manus Prime X Haptic VR

Stretch Sense fidelity glove (finger tracking gloves)

The Fidelity glove boasts unrivaled fidelity, equipped with 26 sensors that offer complete coverage and precise motion capture. Designed to provide a snug and comfortable fit, the Pro Fidelity glove allows performers to fully immerse themselves in motion capture sessions.

The fidelity gloves feature integration capabilities in VICON Shogun and Xsens. Thanks to local storage on an SD card a loss in connection does not cause data loss. Extra information can be found here.

Finger sensor type	26 Bending sensors
Sensor sample rate	Up to 120 hz
Battery endurance	8h
Weight	114 grams (incl. battery)
Wireless range	20 m
Unity	Yes
Compatible with MVN	Yes

We are planning to develop the LSL client in the near future.

Stretch sens Fidelity gloves

HTC VIVE Pro VR tracking

The VR tracking system consist of two beacons (called base stations) that are connected via BT to a PC. The beacons are able to track compatible VR headsets as well as VR controllers and trackers. The system is compatible with many third party devices and software. For instance it should allow to limit the drift in position to 1 cm when used with the Xsens Mocap solution (not yet verified).

The available system consists of a **Full HTC VIVE Pro 2 kit** (two Vive 2.0 base stations, two VR controllers and the HTC VIVE Pro 2 headset). Complete with 3 extra HTC VIVE 3.0 trackers. We also have the **Varjo XR3** headset and the **Microsoft HoloLens**. These AR headsets will be discussed separately further in this document.

HTC VIVE Pro 2 kit

HTC VIVE 3.0 tracker

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TEA CAPTIV imu based Mocap system

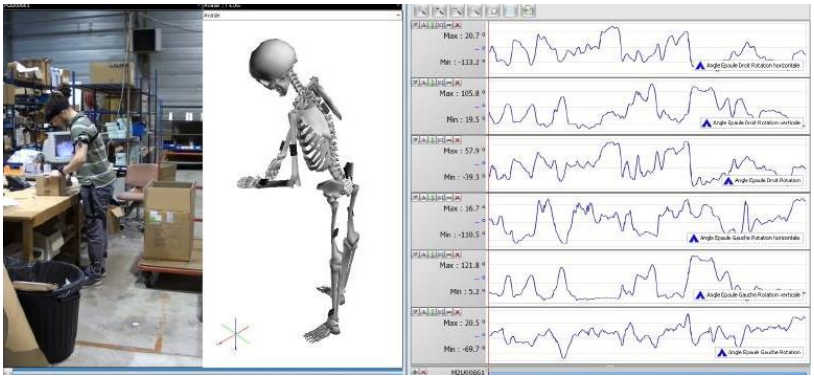
The Captive system is comparable to the Xsens IMU mocap system. The main difference are that the filtering and correction of the data is less performant leading to less performant Mocap system overall. On the other hand, the Captiv system comes withs an extensive collection of extras sensors (hart-rate, skin conductance, temperature,...). It also offers a malleable software that allows for an effective holistic assessment of physical load using the plethora of sensors part of the Captiv eco system.

Focussing on the Mocap part of the system, the Captiv mocap systems consist of 15 IMU sensors which attached on the body with straps. They each measure their orientation and acceleration and stream it to a computer. The software then creates an avatar (in real-time).

The accuracy mainly depends on the environment, and the given parameters. Line of sight is not needed.

Useful details: Range: 15m from station. Frequency: up to 128Hz. Accuracy: 0.5%/sensor. Battery: 2~3h.

CAPTIV



Ultra-Wide Band position tracking

UWB position tracking: It is a small sensor measuring distances between each other via Ultrawideband. It is highly scalable and each sensor can cover around 20m, so the range only depends on the size of the grid built, and the amount of available sensors. Typically, at least 4 are used as bases for reference and need to reach the subject sensor to perform triangulation.

It measures the 2D position (3D is also possible) of the sensors relative to each other.

Useful details: Range: 20m from closest 4 bases. Frequency: 10 to 20Hz. Accuracy: ~10 to 15 cm. Battery: at least a day

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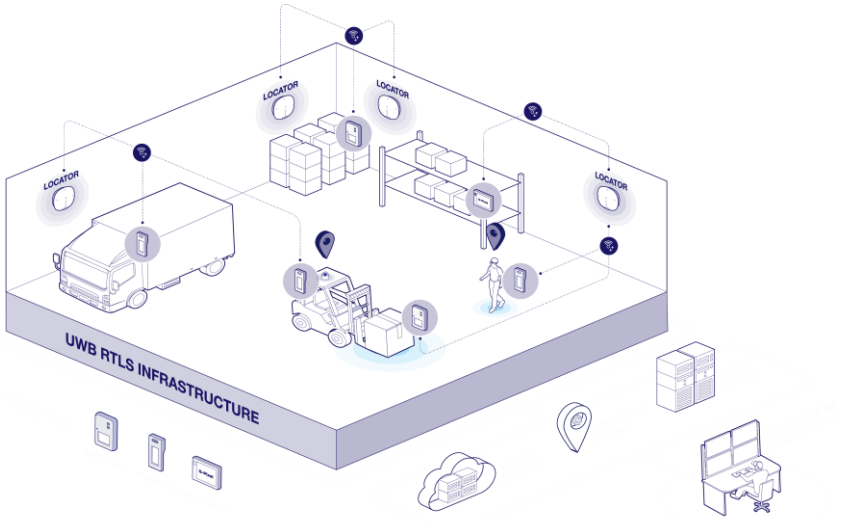
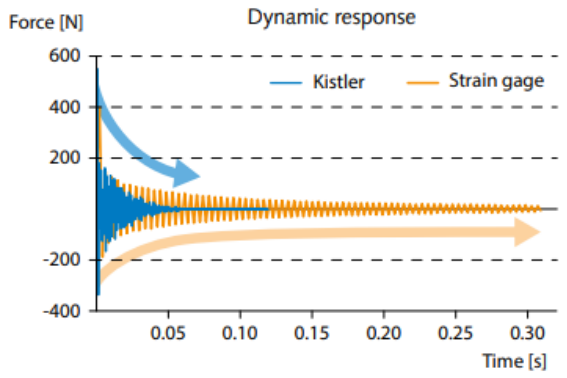


UWB

Force Sensing

Kistler force plates

Four 50cm by 60cm **Kistler force plates** measure ground reaction forces (impact up to 5kN). They offer an unattenuated bandwidth up to 70Hz which makes them the most reactive force plates available today (2022). Do notice that the natural frequency of a mass spring system greatly relates to the mass. The natural frequency and therefore bandwidth of this sensor greatly reduces when mass is added to the force plate. The force plates are fully integrated within the Vicon mocap system. This combination allows to visualize de ground reaction force vector.



Kistler Force plates

Force sensing treadmill – (Qty 1) – (Static)

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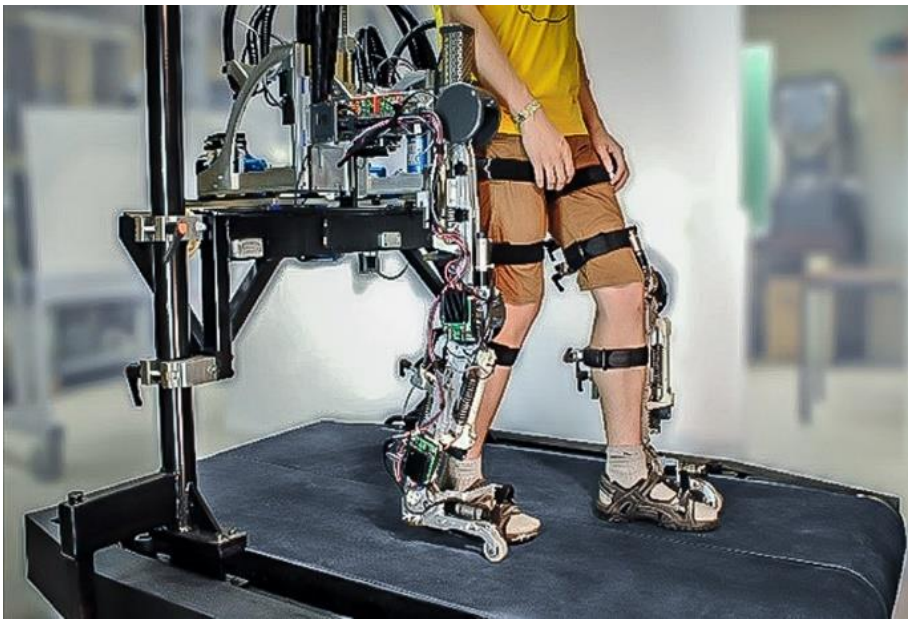
For longer term development and optimization of artificial prosthetics, gait rehabilitation robots or legged robots, a continues testing regime is valuable for instance to fine tune control parameters.

This two band treadmill is equipped with three dimensional force gauges at the four corners or each band. The effectively adds force plate capability to each of the treadmill bands.



Ground reaction force sensing dual band treadmill

Moticon insoles

Insoles can be placed inside shoes. They measure normal pressure distribution which allows to compute the normal ground reaction force. In a certain way insoles can therefore be compared to force plates:

- A big advantage of insoles compared to force plates is the ease of use. Unlike with force plates, the operator does not have to perform an unnatural choreography in order to have a pair of ground reactions forces (one for each foot).
- The insoles allow to cover vast distances in or outside the lab (limited by the wifi connectivity).
- Today we are limited to the vertical ground reaction force component. However, further development should make estimation for the horizontal components possible.

We poses the **Moticon science** insoles. These come equipped with an **IMU** in each insole.

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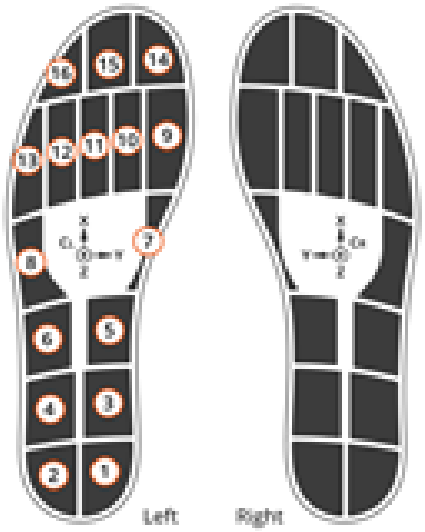

Moticon insoles

We poses the following sizes (@Brussel):

- Qty:1 S4 38/39
- Qty:1 S5 40/41
- Qty:1 S6 42/43
- Qty:1 S7 44/45
- Qty:1 S8 46/47
- Qty:1 S9 48/49

We poses the following sizes (@Kortrijk):

- Qty:1 S3 36/37
- Qty:1 S4 38/39
- Qty:1 S5 40/41
- Qty:1 S6 42/43
- Qty:1 S7 44/45
- Qty:1 S8 46/47

The most important specifications are listed below.

Frequency (Hz)	10 -> 100
Pressure range /acc (N/cm^2) / (m/s^2)	50 / 0.25
Zones/insole	16
Battery life (h)	8 -> 20 LiPo
Communication	BT5 - Wifi

Computed outputs	Fz - COP
Output format	.csv .xlsx
Endurance (km)	100 walking

Because the Moticon insole is part of the mobile setup, we developed an application to push the data in **Realtime to LSL**.

Hoggan ergo Glove

This 'glove' consists of a set of 8 resistive resistive disk sensors that can be placed on your fingers tips and hand palm. This allows more freedom on the placement, but makes it very easy to move during the measurement. Such sensor type is also prone to deviations based on temperature. Thus, it is not very practical.

It measures the pressure on its surface, which is turned in a force based on the calibration.

Useful details: Range: 15m from station(BLE). Frequency: 100Hz. Accuracy: >3%. Battery: 2h

Hoggan Ergo Glove

TEA CAPTIV- Force transducer

TEA CAPTIV force transducer

Another sensor from the CAPTIV system (see section Mocap). This load cell can be attached with a thread to measure push forces. It is calibrated to 2000N. Uplink characteristics are the same as the rest of the CAPTIV system.

Because the CAPTIV system is part of the mobile setup, we have developed an application to push the data in **Realtime to LSL**.

Force gauge Mark 10

The Mark10 force gauges can measure compression and tensile forces. These sensors can be used in many applications. We have three sensors available; **1kg, 25kg, 300kg.**

The force gauges can only work in tandem with an indicator or a testing rig. We have both.

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The testing rig keeps track of position and force and can be programmed to apply a particular loading profile that can be influenced by the force of position measurements. The testing rig has several advanced features such as cyclic loads, statistical analysis of multiple tests etc.

A typical application is the testing of components like springs or the analysis of material properties or even calibrate custom made strain gauges, testing of linear actuators etc.

The indicator amplifies, the signal of the load cell and makes it available on the display but also as an analogue or digital signal that can be used in an integrated setup.

Testing Rig model	F755
Travel	813mm
Position Accuracy	0.05mm (under load)
Speed range	0.02 – 1.525mm/s
Max Force	3.4kN
Data acquisition rate	1kHz
Accuracy force ADC sampler	+-0.1%
Indicator model	(Series 5) M5I
Indicator Sampling Frequency	7kHz
Protocols	Analog, USB, RS-232
Accuracy ADC sampler	+-0.1%
Loadcell models	MR01-50, MR01-500
Load cells maximal force rating	1kg, 25kg, 375kg
Accuracy load cells	+-0.1% of full scale

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Mark 10 indicator and testing rig

Force gauge Ergo FET

The Ergo FET is a hand held device that allows to measure forces up to 1335 N or **136kg** . the sample rate is approximatively **100Hz**. The device can measure **compression and tensile** force and stream the signal over Bluetooth to a PC.

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Hoggan Ergo fet

Because the Ergo FET is part of the mobile setup, we developed an application to push the data in **Realtime to LSL**.

In the future we hope to integrate these force measurements (along with the ground reaction forces) directly in the unity powered visualisation that is part of the mobile set up.

Collision measurement PRMS set Pilz

Force measurement:

The force measurement device is equipped with springs and sensors to measure the forces exerted on the human body.

The nine different springs have different spring force constants and are used in force measurement to recreate the various body regions.

Pressure measurement:

Pressure indicating films are used to measure the local pressure and compare it with the limit values specified in the standard.

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Pilz collision measurement set

PRMS helps you work towards a safe robot application thanks to:

- Standard-compliant measurement of force and pressure
- Standardised measurement procedure
- Software with protocol tools – for simple evaluation, visualisation and documentation

Physiological

Cometa

Cometa sEMGs are a type of surface electromyography device that offer several benefits compared to other sEMG devices:

- High-quality signal: Cometa sEMGs use high-quality electrodes and advanced signal processing algorithms to produce accurate and reliable measurements of muscle activity.
- Wireless connectivity: Cometa sEMGs can transmit data wirelessly to a computer or mobile device, allowing for real-time monitoring and analysis of muscle activity.
- Ease of use: Cometa sEMGs have a user-friendly interface that requires minimal training, making them easy to set up and use.
- Versatility: Cometa sEMGs can be used for a wide range of applications, including sports performance monitoring, rehabilitation, and research.
- Cost-effectiveness: Cometa sEMGs are competitively priced compared to other high-quality sEMG devices, making them an attractive option for researchers and healthcare professionals.

Overall, the high-quality signal, wireless connectivity, ease of use, versatility, and cost-effectiveness make Cometa sEMGs a top choice for measuring muscle activity.

We have **two sets that each count eight sEMG's**. One set are the infinity water resist and the second one are the picos.

Specification	Infinity Water Resist	Pico
Electrodes	2	2
Sampling rate	Up to 2000 Hz	Up to 2000 Hz
Bandwidth	20-500 Hz	20-500 Hz
Battery life	Up to 8 hours	Up to 10 hours
Connectivity	Bluetooth 4.0	Bluetooth 4.2 (30m indoor)
Water resistance	Yes, up to 1 m depth	No
Size	63 x 18 x 12 mm	32 x15 x 12 mm
Weight	26 g	7 g
3D Gyroscope	yes	yes

Note: The specifications listed are based on information available on the official websites of the products as of April 16, 2023, and are subject to change.

Cometa Infinity WR

Cometa Pico

Because the Cometa sEMG is part of the mobile setup, we developed an application to push the data in **Realtime to LSL**.

TMSI SAGA64+

The SAGA 64+ is the most advanced and versatile high density amplifier and recorder on the market. Recording human electrophysiological signals with quality and ease. The SAGA64+ can be used for EEG and HD-EMG.

The SAGA 64+ can be used for electrophysiological research in numerous fields such as: mental workload, cognitive performance, social interaction, body mechanics and robotic control.

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SAGA 64+ used in an EEG application

TMSI SAGA64+ with HD EMG

Below some of the most important parameters of the SAGA64+.

Model	SAGA 64+
Inputs	64 x unipolar 2 x dual bipolar 3 x triple auxiliary 1 x digital
RMS noise	< 1uV
Common mode rejection ratio	100 dB at 50/60Hz
Maximum Sampling Rate	4kHz
Input range	-0.15V -> 0.15V
Bandwidth	Up to 800Hz
Resolution	24 bits
Input impedance	> 1GOhm
Storage	32 GB
Battery endurance	6 h
Dimensions	Recorder: (w: 179mm x h: 41 mm) Dock: (w: 179mm x h: 47 mm)
Weight	Recorder: (700 g + batteries) + dock 700 g

The TMSI is considered part of the mobile setup. A RT Lsl uplink is so welcome that TMSI made one available for us. We have tried two configurations:

- Docked, the LSL uplink holds 64 channels at 4kHz.

- Undocked but wirelessly connected the LSL uplink holds 64 channels at 1024 Hz.

VO2 Master

Breathing sensors such as the VO2 Master can be used in the context of industrial labor to assess the aerobic fitness and respiratory function of workers. This can help to identify individuals who may be at increased risk of developing respiratory or cardiovascular diseases due to the physical demands of their job, and to develop interventions to improve their health and safety.

For example, the VO2 Master can be used to measure the oxygen uptake and carbon dioxide production of workers during tasks such as heavy lifting, climbing, and carrying loads. This information can be used to identify individuals who may be at risk of developing fatigue, heat stress, or other health problems due to their job demands.

In addition, the VO2 Master can be used to evaluate the effectiveness of interventions such as ergonomic improvements, work-rest schedules, and training programs on the aerobic fitness and respiratory function of workers. This can help to optimize the health and safety of workers and improve productivity.

Here is a table with the most important specifications of the VO2 Master:

Specification	**VO2 Master**
Oxygen accuracy	Galvanic fuel cell +- 1 %
Flow accuracy	Diff pressure +-3%
Sampling rate	Approx 1Hz
Battery life	Up to 8 hours
Weight	320 g
Size	124mm x 88mm x 47mm
Communication	Bluetooth Low Energy (BLE)
Life Oxigen sensor	12 months
Tidal Volume	0.25 – 10 liters
Ventilation	2-250 liters per minute
Respiratory rate	3-80 breaths per minute

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VO2 master

Equivital Life Monitor

Note: The specifications listed are based on information available on the official website of the VO2 Master as of April 16, 2023, and are subject to change.

The VO2 master is equipped with a **hart rate** sensor allowing to measure the electrocardiogram.

Because the VO2 Master is part of the mobile setup, we are developing an application to push the data in **Realtime to LSL**.

Equivital Life monitor

The Equivital Life Monitor is an easy to use sensor that is fixed to a subject with the help of a harness with electrodes. This sensor with belt contains an ECG (sampled at 256Hz), a respiratory sensor, a skin temperature sensor, a skin conductance sensor, and an IMU.

All the data is streamed to a computer that processes it to output BPM, R-R, ...

Useful details: Range: 15m from station (BLE). Frequency: 5Hz (streamed). Accuracy: a confidence index is calculated. Battery: >8h

Because the Equivital is part of the mobile setup, we have developed an application to push the data in **Realtime to LSL**.

Empatica

The Empatica E4 is a bracelet that measures the heart rate (via PPG/BVP) and skin conductance. It is worn like any watch. It stream the measurements to a computer who can then stores it.

Useful details: Range: 15m (BLE). Frequency: 4Hz. Accuracy: depends on placement, and activity intensity. Battery: >8h

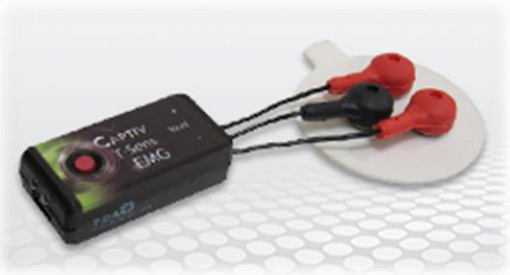
Empatica

CAPTIV Skin conductance

Because the Empatica is part of the mobile setup, we have developed an application to push the data in **Realtime to LSL**.

CAPTIV Physiological sensors

The CAPTIV system (see section Mocap) comes with an extensive collection of physiological sensors. These sensors include: ECG ((electro cardio gram (hart)) sampled at 2kHz), some EMGs ('electro myography (muscles)) at 2kHz), a GSR sensor (skin conductance), a respiration belt, a skin temperature sensor. The uplink characteristics are the same as the rest of the CAPTIV system.



CAPTIV EMG

CAPTIV EEG

Because the CAPTIV system is part of the mobile setup, we have developed an application to push the data in **Realtime to LSL**.

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TELEMED ArtUs EXT 2H

ArtUs is Telemed's very compact and highly powerful application-based ultrasound device. Featured with high-speed USB3.0 interface it allows increase scanning speed without compromising image quality and provides real-time transfer RF ultrasound data to a PC. New "WideView" imaging mode maximizes viewing area for linear, convex and endocavity transducers. Other features includes improved spatial compound available for linear and convex transducers, parallel beamforming, harmonics, B-steer imaging. The system is capable to drive high-density and high-frequency transducers delivering detailed, rich and wide dynamic range images. Software features include Echo Wave II with Speckle noise reduction as a standard package and optional research package: SDK library and advanced data processing and visualization procedures for MATLAB environment.

Our Art Us system is equipped with the optional hardware expansions:

- I/O module; hardware modification, provides up to 6 trigger signals to/from external equipment through additional connectors;
- RF module; ArtUs scanner modification, provides access to beamformed RF data via Telemed's SDK and MATLAB utilities

The complete the system we have one LF9-5N60-A3 ultrasonic linear transducer. The LF9-5N60-A3, is equipped with 128 elements, has a bandwidth of 5.0 to 9.0 Mhz and has a linear field of view of 60mm. It is typically used to visualize muscular contraction.

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LF9-5N60-A3 transducer ArtUs EXT- 2H – driver

Other devices

AR headsets

The headsets below are typically **part of a mocap system**. Their main use is of course to display an augmented vision to the user. In that sense they are quite different from the previously described mocap systems. However Besides being part of Mocap systems, they offer remarkable sensor output. They can **scan the environment and make a 3D map** of the surrounding. They offer special **eye monitoring capabilities** (gaze fixation, pupil dilatation etc.) that can help investigate cognitive variables during particular tasks.

Here a comparison of the key features and specifications of the Microsoft HoloLens 2, HTC Vive Pro, and the Varjo XR3 which we have available in the lab:

Feature	**Microsoft HoloLens 2**	**HTC Vive Pro**	**Varjo XR3**
Display Technology	Waveguide-based AR display technology 2kPixel (3:2)	Duo AMO led 3.5" each with a resolution of 1440 x 1600 pixels	Bionic Display with a resolution of 1080 x 1920 pixels per eye and a micro OLED display with a resolution of 2560 x 2560 pixels per eye
AR Tech	Holographic display	Feed through camera	2x 12MP low latency Feed through
Battery endurance	2-3h (gesture control)	Wired (6h for controllers)	Wired (gesture control or depending on controllers)
Field of View	52 degrees diagonal	110 degrees diagonal	115 degrees diagonal
Audio	Speakers	Speakers	Output jack 3.5
Refresh Rate	60 Hz	90 Hz	90 Hz

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Sensors	Inside-out tracking (4 cameras), IMU, 1 depth sensor, 8MP photo camera / 1080p30 HD video camera	SteamVR Tracking, IMU, proximity sensor, IPD sensor	LiDAR (0.4 ->5m), IMU, RGB video pass-through, 6DoF, inside-out tracking
Connectivity	Wi-Fi, Bluetooth, USB-C	DisplayPort 1.2, USB-3.0	2x DisplayPort 1.4, 2x USB-C
Weight	566 grams	823 gram	980 grams (well balanced)
Eye Tracking Capabilities	Built-in eye tracking technology using IR cameras	No eye tracking	Built-in eye tracking technology using IR cameras (200Hz, sub degree accuracy)
Eye Tracking Example to Assess Concentration	Measuring gaze duration and fixation during a task requiring visual attention.		Measuring gaze fixation, detecting changes in pupil dilation.

Overall, the Microsoft HoloLens 2 is designed primarily for Augmented Reality (AR) applications, while the HTC Vive Pro and Varjo XR3 are both Virtual Reality (VR) headsets.

The MS HoloLens, uses a wave guide technology embedded in a glass visor. This allows the HoloLens to be transparent. Even if a pixel is black, the wearer can still see through. This could be important as it allows for increased safety. Competing technology uses VR goggles with a pair of feed through cameras. The disadvantages of the HoloLens are a small field of view and poor contrast. The Varjo XR3 has a very high resolution display and great contrast.

HTC Vive Pro 2


Ms Hololens


Varjo XR3

The HTC Vive Pro and Varjo XR3 both use infrared cameras and LEDs to provide high-accuracy eye tracking with low latency. The Varjo XR3 supports foveated rendering, which dynamically adjusts the resolution of the virtual environment based on the user's gaze. The

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Microsoft HoloLens, on the other hand, uses IR sensors, which provide limited eye tracking mainly for gaze detection.

The choice between these devices ultimately depends on the specific use case and application requirements.

Sony camera – (Qty - 3) – (Mobile)

In the field of ergonomic and biomechanical assessment, being able to make semi-professional pictures and video is a necessity. For this reason, we dispose of multiple tripods (more than 10), two SONY ZV-E10 cameras, one Sony Alpha 6100, several lenses, and several types of microphones (wireless, directional, omnidirectional) .

Sony ZV-E10

Interested?

Contact AugmentX@flandersmake.be for more information.