

MYONTEC



# KNOW YOUR MUSCLES

**MBODY for Sport**

**ERGOANALYSIS for Ergonomics**

The most comprehensive biofeedback solutions out there

Register to our community and get articles and case studies for free, as well as product campaign notification before public.

Go to our official website at [www.myontec.com](http://www.myontec.com)!

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# MBODY LEGS

**The most comprehensive  
biofeedback solution for lower body**

MShorts + MCell3 + Mbody Live App 939€

Know more by logging on to our website at [www.myontec.com](http://www.myontec.com)  
For inquiries, email [support@myontec.com](mailto:support@myontec.com)



# MSHORTS

**Smart shorts for Sport, Research,  
Rehabilitation and Ergonomics**

**Monitors:**

- Quadriceps
- Gluteus
- Hamstring muscles
- Motion sensors (IMU) in the hip



# MCELL3

MCell3 is a small, lightweight and easy to use device with EMC and inertial sensors. MCell3 can be attached to any of the latest generation Myontec smart clothes.

Know more by logging on to our website at [www.myontec.com](http://www.myontec.com).  
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# MBODY LIVE APP

## Real-time biofeedback and performance analysis

- Control loading patterns
- Improve technique
- Monitor the impact of intensity
- Improve activation order
- Optimize training with accurate muscle fatigue threshold



# **MBODY UPPER BODY**

**The most comprehensive biofeedback  
solution for upper body**

MShirt + MCell3 + Muscle Monitor 2490€

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For inquiries, email [support@myontec.com](mailto:support@myontec.com)

A close-up photograph of a person wearing a black, long-sleeved athletic shirt. A black, rectangular sensor is attached to the chest area of the shirt. The background is a blurred outdoor setting with trees and a person's face partially visible in the background.

# MSHIRT

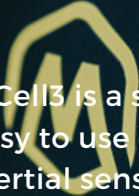


Myontec MShirt is capturing 8 channel EMG but also bending position with IMU sensors.





## MCELL3



MCell3 is a small, lightweight and easy to use device with EMG and inertial sensory. MCell3 can be attached to any of the latest generation Myontec smart clothes.



# MUSCLE MONITOR

**Software created and designed to suit the needs of professionals searching for deeper knowledge and accuracy**

- See INSIDE the movement
  - Movement quality
  - Muscle balance
  - Technique analysis
  - Muscle loading level
  - Activation - deactivation - cycle
  - Relaxation level
- Teach athletes
  - Correct movement techniques
- Monitor the effectiveness of training or rehabilitation protocol
- Notice overloading → avoid injuries

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# MUSCLE MONITOR

## Metrics

- Problem detection
  - Left-right balance
  - Muscle group balance
  - Relaxation
- Training load
  - Average muscle load (ML AVG) ( $\mu\text{V}$ ) = Sum of aEMG:s ( $\mu\text{V}$ ) of all measured muscle groups ( $\mu\text{V}$ )
    - Average muscle loading level
    - Independent of loading time
    - Compare e.g. exercises, techniques
    - Efficiency in running and cycling
  - Cumulative muscle load (mVs) = Area under the muscle load / time curve ("IEMG")
    - Total muscle loading level
    - Depends on loading time
    - Compare e.g. training sessions
    - Is easy training session easy and hard one hard?
  - aEMG of individual muscle groups also available
    - Compare e.g. exercises, techniques
    - Do you train the muscle group you think you are training?
    - How does you changing technique affect your muscle loading?

# MUSCLE MONITOR

## Features

- Problem detection
  - Prevent injuries early enough understanding muscle imbalance and relaxation levels
- Training load
  - Set your own threshold or use Muscle fatigue threshold
  - EMG indicates muscle loading level (training load) more accurate than lactate, and as accurate as ventilation tests
- Multiplayer monitoring
- Comparison
- Follow-up
- Recovery
  
- Integrate Heart rate and Power meters to see complete picture of your body load



# ERGOANALYSIS

## Optimized for ergonomic assessment

- Improve work processes, work safety, wellbeing and productivity.
- Reduce sick leaves and disability pensions.
- Provide better information to support decision making on work safety, occupational health, HR, product development and investments.
- Validate, compare and prioritize investments for hand tools, processes, aids and safety tools
- Patented and scientifically validated technology used by industrial companies

# ERGOANALYSIS

## BUY&TRY

5000 €

Including:

- One full EMG suite: ErgoShirt + MShorts measuring (sizes S-XL)
  - Forearm, biceps, deltoid and trapezius muscles in the upper body
  - Quadriceps, gluteus and hamstring muscle groups in the lower body
  - Arm angles and upper body forward bending angle
- 4 MCell3 dataloggers
- Nokia smart phone
- Smart watch
- Accessories: suspenders, washing bags, USB hub, charging cables, moisturizing gel
- 3 months free use of software;
  - ErgoMobile
  - ErgoLink
  - ErgoCloud

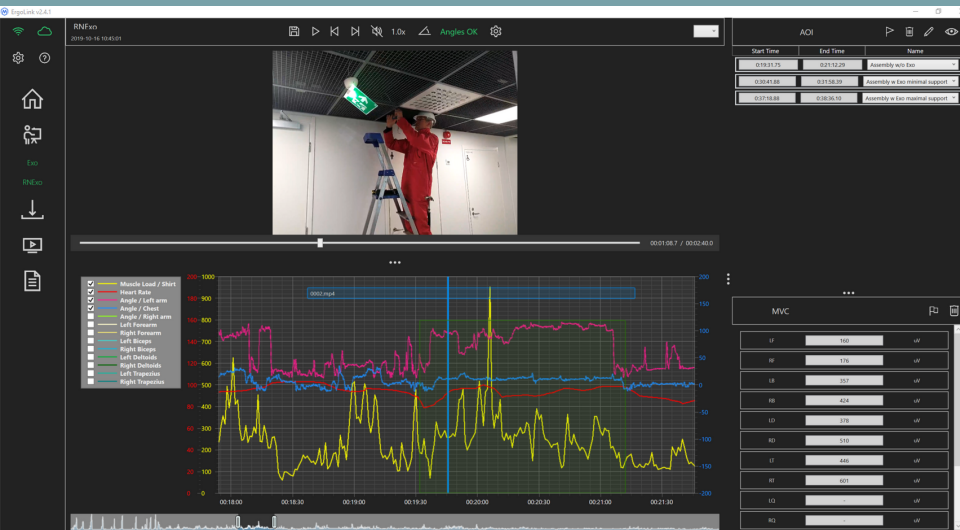
## ERGOMOBILE

- ...synchronizes EMG, IMU and heart rate with video.
- ...comes as pre-installed in mobile phone.
- ...has easy to use interface.



## ERGO LINK

- ....enables to
  1. define work task specific loads.
  2. analyze different data per work phase, subject or the load even for the whole working day.
  3. compare working techniques, tools, or subject specific loads.
- ...enables fast data analysis with synchronized data and video.



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# ERGO CLOUD

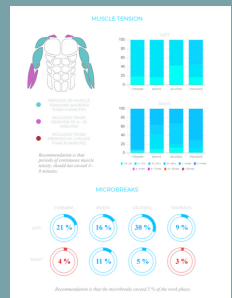
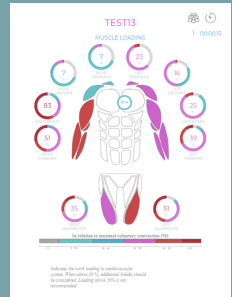
Keep your measurements safe and easily available. Share reports.

Reports are accurate: adjusts measured work load to personal maximum load (MVC), not to population based average values.

Reports show overload: report shows when loading levels increase scientifically validated recommendation levels.

By measuring muscle activity, we can evaluate:

- Muscle loading profiles (average vs. MVC)
- Cardiovascular loading level
- Sustained static loading periods
- Microbreaks (muscle relaxation periods)
- Upper arm elevation angles
- Upper body bending angles
- Group size and length of measured work phase



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# ERGOANALYSIS CERTIFICATE

500€

## Certificate of ERGONOMICAL DESIGN

This document certifies that the

### **Company Xxx Product Xxx**

has been measured and validated as  
ERGONOMIC in xxxxxxxx

by Myontec ErgoAnalysis on  
November 20th, 2020.  
Helsinki, Finland.

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Janne Pylväs  
Myontec, CEO

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Xxx Xxxx  
Senior Ergonomic  
Specialist



Certified by Myontec  
ErgoAnalysis™

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# ERGOSLEEVE

**BUY&TRY, 2500€**

Including:

- ErgoSleeve, S-M or L-XL size. For right or left hand
  - Forearm extensors and flexors
  - Wrist and shoulder angles
  - Wrist velocity
- MCell3 and 2 Xsens DOT sensor
- Nokia smart phone with High Res video
- Accessories: washing bag, USB hub, charging cables, moisturizing gel
- 3 months free use of software;
  - ErgoMobile
  - ErgoLink
  - ErgoCloud



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For inquiries, email [support@myontec.com](mailto:support@myontec.com)



# MBELT

2490€

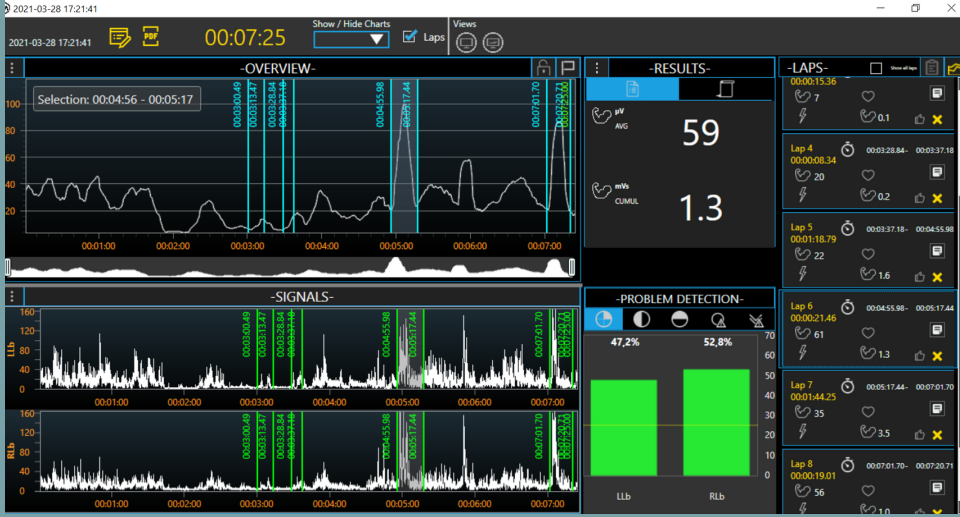
Including:

- MBelt, adjustable size with adapter parts and straps, measuring
  - Multifidus & Erector Spinae muscles
- MCell3
- Accessories: washing bag, charging cable, moisturizing gel
- Muscle Monitor Software license (also compatible with ErgoLink Software)



Know more by logging on to our website at [www.myontec.com](http://www.myontec.com).

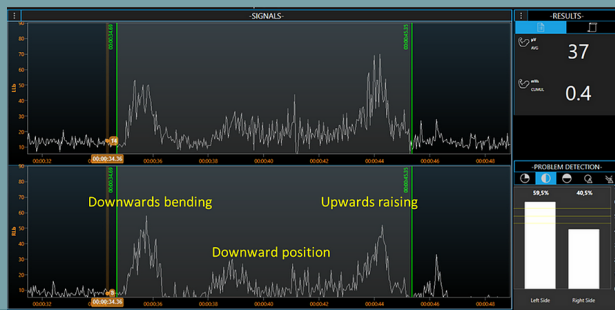
For inquiries, email [support@myontec.com](mailto:support@myontec.com)



# MBELT & MUSCLE MONITOR

Software created and designed to suit the needs of professionals searching for deeper knowledge and accuracy

- Run quickly and easily low back screening test protocols like flexion-relaxation, 90 sec fatigue test etc.
- Problem detection
- Comparison
- Follow-up



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For inquiries, email [support@myontec.com](mailto:support@myontec.com)



# MSLEEVE

2390€

Including

2 x MSleeve measuring:

- Tibialis
- Gastrocnemius
- Soleus muscles

2 x MCells with IMU sensors

Muscle Monitor Software  
license



## TAILORED SOLUTIONS

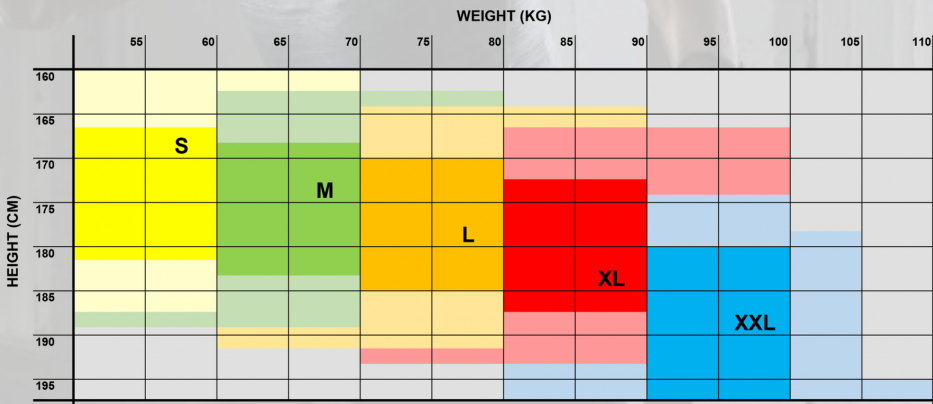
### Examples:

- High waist 8 ch MShorts measuring additionally lower back muscles
- 8ch Long pants measuring hamstrings, quadriceps, soleus and tibialis anterior muscles
- Long pants for kids
- Extended shorts for basketball players OR MShorts with zipper
- 8 ch T-Shirt measuring triceps, biceps, deltoid, pectoralis and latissimus dorsi muscles
- 8 ch Shirt measuring tailored combination of triceps, trapezius and abdominal muscles
- 5 ch Sleeve measuring triceps, biceps, deltoid, pectoralis and trapezius muscles
- 4 ch Collar measuring neck muscles etc.
- String underwear for MShorts

Ask for quotation and pricing

# SIZE CHART

## MShorts



The sensors inside the Mbody shorts need to stay firmly straight next to skin. To make sure of the correct fit, please use the size-chart below. We recommend You start with your regular size. Measure horizontally hip circumference from widest part of your hip and thigh circumference from widest part of your thigh.

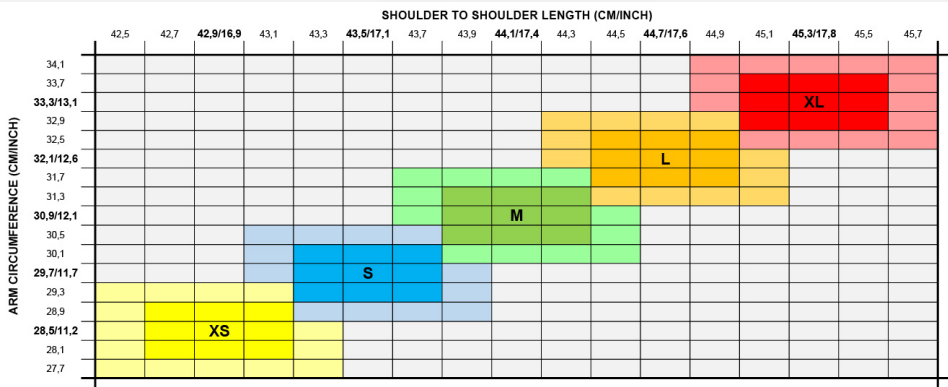
If your measurements fit either light or grey area, please contact us to find the solution together.

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For inquiries, email [support@myontec.com](mailto:support@myontec.com)

# SIZE CHART

## Shirts

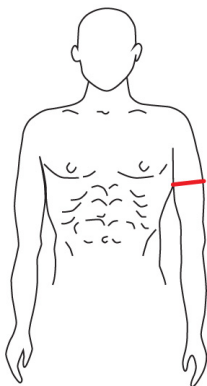


The sensors inside the Mbody Ergo-shirt need to stay firmly straight next to skin. To make sure of the correct fit, please use the size-chart above.

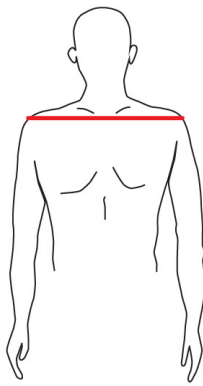
We recommend You start with Your regular size. Please check instruction for measuring from pictures below.

If Your measurements fit either light or grey area, please contact us to find the solution together.

When You take the measurements relax Your muscles and stand up straight



**ARM CIRCUMFERENCE**  
Take the measurement from the widest point of Your arm (biceps)



**SHOULDER TO SHOULDER**  
Take the measurement from left shoulder line tip point to right.

Know more by logging on to our website at [www.myontec.com](http://www.myontec.com).

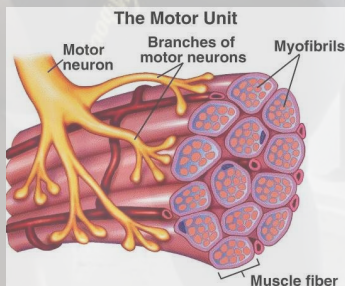
For inquiries, email [support@myontec.com](mailto:support@myontec.com)



# WHAT DOES MBODY MEASURE?

Our smart clothes measure surface EMG (sEMG), which is processed further. Electromyography (EMG) is a technique for recording and evaluating myoelectric signals produced by skeletal muscles. The scientific background is briefly explained in this section.

The process begins in the motor cortex of the brain. These signals are triggered and sent to the motor neurons. Via these motor neurons the information about the movement is conveyed to the relevant muscles. The motor neurons transmit these "messages" by exchanging ions across the muscle membranes which cause the muscle fibres to contract. The muscle fibres are combined in groups, which contract together by one motor neuron. These groups are called motor units. As this process involves depolarization (a change in the electrochemical gradient), a potential difference can be measured.



Simplified representation of motor unit

Surface EMG measures all these small  $\mu$ Volt-level "messages" summarized on the skin. The resulting signal provides information about timing and intensity of the muscle activation.

In summary, EMG measures messages from the nervous system to the muscles and this represents muscle activity.

## HOW IS THE SIGNAL COLLECTED?

The signal is collected from technical electrodes with a sampling frequency of 1000 Hz. For MCell3 the frequency is further filtered with 40 Hz - 200 Hz (-3dB) band-pass filters and digitalized with 24-bit A/D converter and a Gain of 0.

With standard configured MCell3 models the 1000Hz Raw EMG signal is rectified and averaged at intervals of 25 samples/sec (25Hz). With tailored products we can also configure the averaging to 10, 50 or 100Hz and add a special configuration for motion data (IMU).

Myontec's wearable EMG technology is based on following key elements:

- textile electrodes are sized according to the actual size of muscle or muscle group to cover sufficiently large area from which the EMG signal is reliably obtained (covers large amount of motor units)
- the electrodes are shaped and positioned anatomically so that they collect a representative sample of muscle's or muscle groups' loading data
- the electrodes, which are embedded into tight-fitting clothing, are "automatically" repositioned in the same places and the distances between the electrodes remains the same when put on
- absorption in tissue between muscle belly and electrode surface is minimized because large electrode surface finds minimum resistance spot from muscle through the skin
- need for special skin preparation is minimized due to large electrode size over skin surface (even with skin hair)
- signal wiring and all connections are mechanically moving together with skin and thus are secured and protected against external artefact sources

# DATA EVALUATION

## COMPARE DATA

Myontec's measurement philosophy is mainly to measure functional muscle groups instead of single muscles. The muscle groups are selected so that individual muscles, which are working synchronically together are combined into one measurement channel. Typical synchronized muscles are the ones which extend or flex a limb, which are called agonist and antagonist muscles.

The EMG-signals in clothing are measured via large-area conductive textile electrodes, which are positioned on to the muscle groups or large single muscles. The electrodes are shaped so that they acquire a relatively sufficient data sample of muscle activity, which ensures better signal quality and repeatability to compare results over time. Therefore, the measurement results are - for the same person-comparable at different times. Unlike with traditional EMG-measurements, there is no need to normalize the signals every time when new electrodes are attached to the skin.

Because of high repeatability, our principle enables easy monitoring over time of parameters showing muscular performance factors like balance, relaxation, fatigue etc. Muscle Monitor and Mbody Live App 3 offer specific features, which are based on the repeatability. These features are e.g. Muscular Fatigue Threshold (MFT) test and Threshold to set reference levels for signals. For details see Muscle Monitor User Guide and Moby Live 3 User Guide.

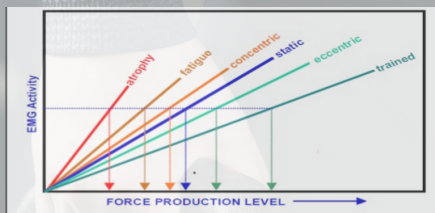
However, comparison between different persons can't be done without specific measures to obtain references for comparison. Due to individual physiology and anatomy, personal parameters like maximum heart rate or maximum muscle activity, do not as such reflect maximum personal performance or capacity. EMG's amplitude-based muscle loading values calculated in Muscle Monitor and Mbody Live App 3 can't be compared between individuals, because they are influenced by a variety of factors. Such factors are:

- anatomical differences in muscular sizes and motor unit distribution (slow and fast motor units in clusters) in muscle
- amount of fat tissue between the surface of the muscle and the electrode
- even though using the same size of EMG cloth, the placement of electrodes may differ between users because of their anatomical differences (height, length of limbs etc.)

Myontec ErgoAnalysis software offers a way of comparing muscle load parameters between individuals by performing a special Muscular Voluntary Contract (MVC) - test before the measurement.

# EMG VS. FORCE

Neuromuscular EMG is a signal, which basically represents how many so called motoric units are recruited at a time of muscle contraction. In practice it's the "internal" power output of a muscle. However, that's not the same as "external" power output, because the force is a transmitted power from muscle-ligaments-bone-joint-joint angle etc. chain of organs and mechanisms against the force sensor. It's commonly known that EMG/Force relation depends on several factors as shown below:



Schematic EMG/force relationship in ramp contractions. Depending on the muscle condition and training status the ratio can alter. Trained muscles need less EMG for a given force output than atrophic or fatigued muscles.  
Reference: ABC of EMG - A Practical Introduction to Kinesiological Electromyography, page 43

As very rough assumption EMG to some extent is linear with force during submaximal contractions, because the contraction is made using endurance "muscle cells". But then when approaching to maximum contraction level, the linearity is lost due to the fact that more and more "fast cells" must be recruited. Also, when muscle starts to fatigue, the force output is getting weakened even though the EMG is still rising. It's important to bear in mind that EMG and force output are two different parameters. On the other hand, EMG vs. Force ratio is excellent parameter to show efficiency and performance economy, but only when the EMG is measured using Novel wearable EMG, which is reproducible and thus useful with force data.

# NORMALIZATION

In case EMG-signal normalization is necessary, the used method depends on target of the study. Normalization of EMG signals is usually performed by dividing the EMG signals during a task by a reference EMG value obtained from the same muscle. The choice of reference value should allow comparisons between individuals and between muscles. To be able to do so, the reference value should have similar meaning between individuals and between muscles. The choice of normalization method is critical in the interpretation of the EMG signals as it will influence the amplitude and pattern of the EMG signals.

A variety of methods are used to obtain normalization reference values:

- Maximum (peak) activation levels during maximum contractions
- Peak or mean activation levels obtained during the task under investigation
- Activation levels during submaximal isometric contractions

In each of the methods sufficient repeatability requires proper guidance of the subjects to perform the tests identically with each repetition, familiarity of the subjects with the production of maximum effort and the avoidance of fatigue and possible motion artifacts. Also, one important element is proper warm-up and muscular adaptation to contract efficiently during the test. When defining the exact numerical value as normalized reference, the signal needs to be processed in order to avoid overestimating the reference. Typically the Raw EMG signal is first rectified and averaged and then the final value is calculated as average within a "calculation window" (e.g. 1 second length) around the selected signal peak area.

With Myontec's ErgoAnalysis system we provide with instructions to perform the isometric MVC-tests for upper and lower body muscles. The ErgoLink software includes as standard area selection tool and MVC-calculation feature to define the reference values for normalization. The ErgoAnalysis reporting tool automatically takes the normalized signals into account when calculating and presenting the results. Therefore, with the ErgoAnalysis concept the work loading levels from different test persons are compared to each other reliably and accurately.

Myontec's Muscle Monitor software and Mbody Life 3 app feature Muscular Fatigue Threshold (MFT) Tests, which use a method of mean activation level of summarized leg muscles obtained during endurance exercise like running, cycling etc. The basic test includes 20 min warm-up period followed by a 10 min test phase, during which the loading is instructed to be kept as steady as possible. In Muscle Monitor software there are also tests for running or cycling in incremental effort to enable more precise threshold definition.

Muscle Monitor software does not provide with signal normalization to separate EMG channels. However, the normalization tests can be performed and all data are exportable in CSV format to Excel or MatLab for post analysis including the normalization.

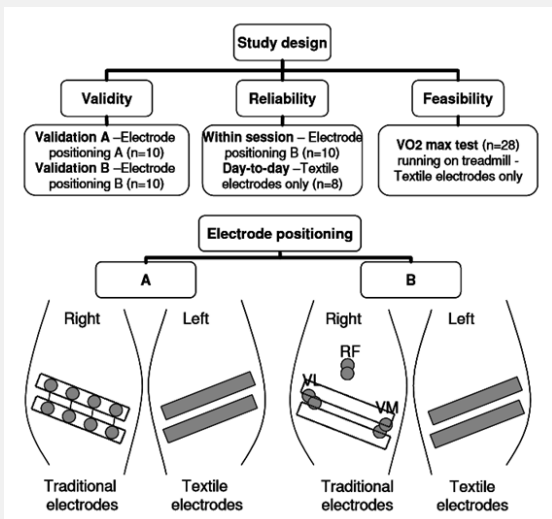
# VALIDATION STUDIES

Summary of major validation studies of Wearable EMG measurement principle and technology by Myontec Oy

## 1.

Measurement of EMG activity with textile electrodes embedded into clothing, by Taija Finni, Min Hu, Pasi Kettunen, Toivo Vilavuo, Sulin Cheng: Neuromuscular Research Center, Department of Biology of Physical Activity, University of Jyväskylä, Finland

- Published in Journal Physiological Measurement 2007
- Scope:
  - The purpose of this study was to evaluate the validity, reliability and feasibility of this new product to measure averaged rectified EMG.
- Conclusions:
  - "This study indicates that the textile electrodes embedded into shorts is a valid and feasible method for assessing the average rectified value of EMG."



# VALIDATION STUDIES

## 2.

Ventilatory threshold during incremental running can be estimated using EMC shorts by Olli Tikkanen<sup>1</sup>, MinHu, Toivo Vilavuo, Pekka Tolvanen, Sulin Cheng and Taija Finni, Neuromuscular Research Center, Department of Biology of Physical Activity, University of Jyväskylä, Finland:

- Published in Journal Physiological Measurement 2012
- Scope:
  - The study examined whether shorts with textile electromyographic (EMG) electrodes can be used to detect second ventilatory threshold (VT2) during incremental treadmill running
- Conclusions:
  - "In practice, experienced runners could use online feedback from EMC garments to monitor whether their running intensity is near VT2."

## 3.

Textile Electrodes Embedded in Clothing: A Practical Alternative to Traditional Surface Electromyography when Assessing Muscle Excitation during Functional Movements by Steffi L. Colyer, Polly M. McGuigan. Department for Health, University of Bath, Bath, UK

- Published in Journal of Sports Science and Medicine 2018
- Scope:
  - To quantify the validity and reliability of textile electrodes, 16 recreationally active males completed two identical testing sessions, within which three functional movements (run, cycle and squat) were performed twice: once wearing EMG shorts (measuring quadriceps, hamstrings and gluteals myoelectric activity) and once with surface EMG electrodes attached to the vastus lateralis, biceps femoris and gluteus maximus.
- Conclusions:
  - "Generally, textile EMG electrodes appear to be capable of providing comparable muscle excitation information and reproducibility to surface EMG during dynamic tasks. Textile EMG shorts could therefore be a practical alternative to traditional laboratory-based methods allowing muscle excitation information to be collected in more externally-valid training environments."

# VALIDATION STUDIES

## 4.

Reliability of Measuring Lower-Limb Muscle EMG Activity Ratio in Activities of Daily Living With Electrodes Embedded in the Clothing by Dagny Bengs, Ira Jeglinsky, Jukka Surakka, Thomas Hellsten, Joachim Ring, Jyrki Kettunen. Applied University of Arcada, Helsinki, Finland

- Published in Journal of Sport Rehabilitation 2017
- Scope:
  - The aim of the study was to investigate the reliability of measuring lower-limb left-right electromyography (EMG) activity ratio with smart shorts during stair descent, stair ascent, and repeated unloaded squats among healthy working-aged subjects.
- Conclusions:
  - "Our study among healthy subjects showed that the left-right EMG activity ratio in activities of daily living can be reliably measured with smart shorts. In future the feasibility of technical clothes as a follow-up method in rehabilitation should be investigated in greater detail."

## 5.

Functional Movement Screen – Aspekte der Validität (Functional Movement Screen – Aspects of Validity). Attachment 2 "Reliability of Textile Electromyography Sensors" by Kornelius Kraus. Fakultät für Humanwissenschaften der Universität der Bundeswehr München, Germany

- Published as Ph.D thesis at University of Munich, Germany 2018
- Scope:
  - The aim of this reliability study was to examine the interday-reliability of textile electromyography sensors in a strength context.
- Conclusions:
  - "The analysis suggests that the textile sensors produce reliable muscle activity data. In order to determine asymmetries, the balance item might be the most reliable item. The coefficients of variations are comparable to the results of traditional EMG and might be suitable for the utilization in general movement screening and biofeedback applications."



# GENERAL QUESTIONS

## Are the shorts waterproof? Can I swim with the shorts?

- The shorts are waterproof and won't be damaged from the water, however the measurement device is not, so measuring in water is not possible. However, the MCell product is splash proof so you can run in the rain, for example.

## Can I wear any underwear when wearing the shorts?

- Especially with the gluteus sensors, you should be careful to not have any fabric between the skin and the sensors. Try wearing very slim or string type of underwear. Special Myontec underwear is available upon order.

## If I hold the shorts in the air and start the measurement, I'm getting very high signal but no one is actually using the shorts?

- The shorts recognize very low  $\mu$ -Voltage level changes from the muscles caused by the muscle activity. If the sensors have no skin contact, they pick up various interferences from the air, which are shown in the results as "noise".

## In which units can I display the measured signals?

- Units  $\mu$ V and mVs ("microVolts" & "milliVoltseconds")
  - Microvolt is mostly used in scientific reports and publications. Momentary EMG signals are shown in  $\mu$ V units. Cumulative work/loading results are presented in mVs units e.g. like total muscle load.
- Unit MA/min and MA ("Muscle Activity/min" & Muscle Activity")
  - It is a more practical unit and often used together with other variables such as heart rate, speed, distance, cadence or power. The unit "MA/min" describes the momentary average muscle load per minute; similar to heart rate "beats/min" and shares the same range like the other variables. In Mbody Live 3, the numerical value of the variable is calculated from the 4 channels of quadriceps and hamstring with a conversion factor of 0.6. Cumulative work/loading results are presented in MA units (average MA/min value \* time).
- In Muscle Monitor you have the option to choose between both units, while Mbody Live App 3 is only using MA/min.

## What material are the Mbody electrodes made of?

- They consist of silver-coated yarns sewn into a form of fabric.

## Can I use Muscle Monitor with Mac?

- Unfortunately, no. You need Windows 7 SP 2 (Service Pack 2) or newer version of Windows.
- However, if your MAC is equipped with collateral Windows installation, you should be able to use Muscle Monitor normally.