TMSi
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SPIRE

A powerful, all-in-one solution for high-density EMG measurements

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TMSi – an Artinis Company
+31 481 378 650

Contact us
www.tmsi.artinis.com/spire

Zutphenstraat 57
7575 EJ Oldenzaal, NL

HD-EMG acquisition system

High-density electromyography (HD-EMG) is a powerful, non-invasive technique for measuring muscle activity on the skin's surface. Unlike the traditional bipolar EMG, which uses just two electrodes to capture a single voltage difference over a muscle, HD-EMG uses grids or arrays of many closely spaced electrodes to capture both the spatial and temporal patterns of muscle activation simultaneously. The result is a detailed, high-resolution map of muscle function across an entire muscle region.

HD-EMG enables the following capabilities:

- Motor unit decomposition – isolating and tracking individual motor units over time
- Muscle fiber conduction velocity estimation and innervation zone mapping
- High-resolution muscle activation topography
- Non-invasive assessment of neuromuscular coordination, fatigue, and adaptation
- Combination with other modalities such as near-infrared spectroscopy (NIRS) for simultaneous oxygenation and activity measurement

Key Features

Scalable Setup

Measure up to **64 HD-EMG channels** per SPIRE Recorder. Connect up to four Recorders to a single Hub Station for a total of 256 fully synchronized HD-EMG channels. One system, scalable to your study design.

Truly Portable & Wireless

The SPIRE Recorder is **compact and fully wireless**, making it ideal for dynamic and stationary research. Worn directly on the body via body straps or adhesive stickers, it streams data in real time via WiFi to the Hub Station.

High-Quality, Reliable Data

SPIRE delivers exceptional HD-EMG signal quality: **24-bit resolution**, sampling rates up to **2048 Hz**, and RMS noise below **1.8 µVrms**. Shielded reference electrode further suppresses noise in real-world environments.

Long-duration Recordings

The integrated battery supports up to **5 hours** of continuous data acquisition per charge. The SPIRE Recorder charges wirelessly via the included charging pad.

Innovative Textile HD-EMG Grids

SPIRE is designed to work with our next-generation Textile HD-EMG Grids, stretchable electrode arrays made from flexible fabric with Ag/AgCl electrodes. Unlike rigid PCB-based grids, the textile material conforms perfectly to curved and dynamic body surfaces, minimizing movement artefacts and electrode detachment even during demanding tasks like walking, running, or jumping.

Available grid configurations for SPIRE:
- 64 channels, 8×8 layout, Small inter-electrode distance (4 mm), 2 mm electrode diameter
- 64 channels, 8×8 layout, Large inter-electrode distance (8.74 mm), 4 mm electrode diameter
- 64 channels, 4×16 layout, Large inter-electrode distance (8.74 mm), 4 mm electrode diameter

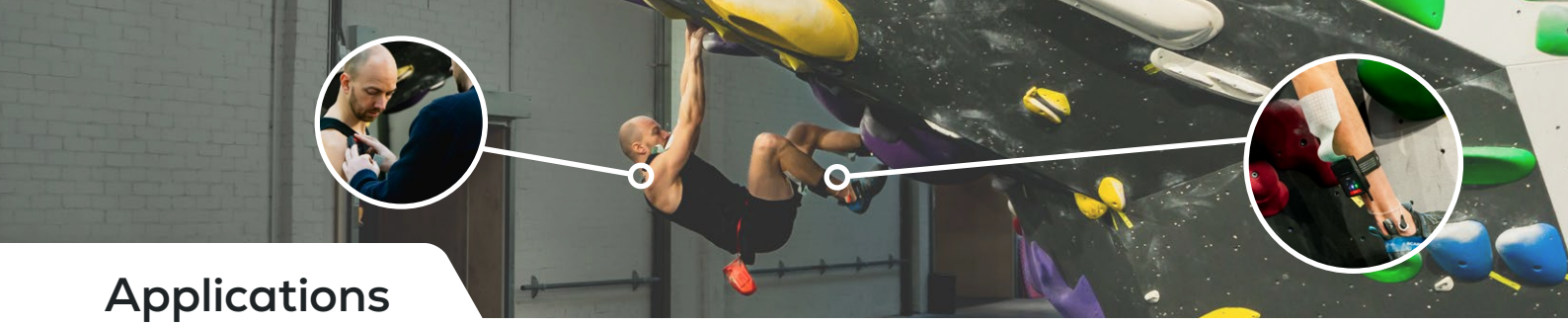
Additional configurations (4–16-M, 6–11-S) available on request.
Optionally, it is possible to combine two grids in different orientations to create an extended configuration, either by placing them side by side to increase width or end to end to increase length.

Multimodality

HD-EMG and Near-Infrared Spectroscopy (NIRS) are highly complementary techniques: HD-EMG captures the fast temporal and spatial patterns of muscle activity, while NIRS measures local muscle oxygenation by tracking changes in oxygenated and deoxygenated hemoglobin. Both are portable, lightweight, and non-invasive, making them well suited for combination in research settings.

Together, they provide a complete picture of the functional, neuromuscular, and metabolic state of a muscle. When studying fatigue, HD-EMG reveals changes in motor unit recruitment, firing rates, and conduction velocity, while NIRS captures oxygen desaturation and recovery dynamics. The combination exposes both the neural (central) and metabolic (peripheral) components of fatigue simultaneously.

This combination is made easy with the PortaMon MKIII (muscle NIRS) and SPIRE (HD-EMG). The NIRS sensor can be positioned directly on the HD-EMG grid, enabling measurements from the same muscle region within a fully wearable setup.



Applications

HD-EMG has become an established technique for investigating muscle function across a wide range of research fields. By revealing the spatial and temporal complexity of muscle activation, SPIRE enables deeper insights into how muscles are controlled, coordinated, and fatigued during different tasks.

Sport Science & Performance
Monitor muscle activation patterns to evaluate athletic performance, optimize training protocols, and reduce injury risk. Assess how muscles adapt to sustained or repetitive loading, quantify fatigue and recovery, and study muscle coordination and endurance in elite and recreational athletes.

Body Mechanics & Motor Control
Study the coordinated effort of muscles, bones, and the nervous system during movement tasks such as walking, lifting, and posture control. HD-EMG maps muscle activation with high precision, enabling detailed assessment of efficiency, coordination, and neuromuscular strategy during functional tasks.

Neuromuscular Research & Rehabilitation
Investigate motor unit behaviour, muscle fiber properties such as conduction velocity and innervation zones, and neuromuscular coordination in both healthy and patient populations. HD-EMG provides detailed data to support research into conditions affecting the peripheral nervous system and skeletal muscles, and to monitor rehabilitation progress.

Human–Computer Interaction & Robotics
Decode muscle signals to enable intuitive gesture-based control of computers, prosthetics, exoskeletons, and robotic systems. HD-EMG captures the full complexity of natural movement, supporting the development of advanced human–machine interfaces.

Ergonomics
Assess muscle strain, fatigue, and posture during occupational or repetitive tasks. HD-EMG provides quantitative, spatially resolved data to guide workspace and tool design, reducing musculoskeletal injury risk and improving worker wellbeing and productivity.

Software

SPIRE Connect
SPIRE Connect provides an intuitive graphical interface to configure recording sessions, verify electrode impedance across all channels simultaneously, and control data acquisition from up to four Recorders. All device-related functionality is embedded in one application.

WaveView
WaveView allows you to open, inspect, and export any recording made with the SPIRE into a variety of file formats for downstream analysis in your preferred analysis environment.

SPIRE Hub Station

The SPIRE Hub Station connects to your PC via USB-C and wirelessly orchestrates up to four SPIRE Recorders simultaneously. It also provides a range of additional time-synchronized input channels, bringing external signals directly into the SPIRE data stream:

1 Analogue Auxiliary Input (AUX)
Connect an external sensor via the analogue AUX input to measure additional signals.

2 Force / Load Cell Inputs
Dedicated 1D load cell inputs allow direct measurement of external force during muscle contractions. Particularly useful for force feedback in motor unit decomposition studies, and for normalizing HD-EMG data to maximum voluntary contractions.

Synchronization & Triggering
- A TTL Trigger input provides a general interface to log digital events either via BNC or DB25 cable.
- A 2-level Sync input is designed for direct compatibility with the Artinis PortaSync device, receiving 2.5 or 5V trigger signals from its output port.

For more information on synchronization possibilities, please consult askforinfo@artinis.com

What's in the Box?

- SPIRE Recorder(s)
- SPIRE Hub Station
- Quick Start Guide, User Manual, and Certificates in English
- USB-C to USB-A Cable
- Set of Body Straps (Size S, M, and L)
- Set of Body Stickers
- Wireless Charger
- HD-EMG Starter Kit (NuPrep, gel, syringe, applicator card, tape measure)
- Set of Textile HD-EMG Grids (of choice)
- Ground and Common Reference Cable
- Software: SPIRE Connect and WaveView
- SPIRE Suitcase

Technical Specifications

RECORDER CHANNEL SPECIFICATIONS	
RESOLUTION (BITS, VOLTAGE)	24 bits, <20 nV
RMS NOISE	< 1.8 µVrms
INPUT RANGE (DIFFERENTIAL MODE)	-150 mV to +150 mV (@ 0 V common)
INPUT RANGE (COMMON MODE)	-1 V to +1 V (@ 0 V differential)
INPUT IMPEDANCE	> 1 GΩ and input capacitance < 10 pF
CMRR (@50/60 HZ)	>90 dB
SUPPORTED SAMPLING RATES	2048 / 2000 Hz
ANALOGUE BANDWIDTH	DC to 500 Hz
CHANNEL CONFIGURATION	
UNIPOLAR	64 Unipolar
AUXILIARY	1x 6-Analog Input (for 6 component dynamometer or other)
SYNC	2-Level Sync Input, PortaSync compatible
TRIGGER	4-bit Trigger Input, TTL
FORCE	2x 1D-Input for Loadcell
PROPERTIES	
SPIRE RECORDER	
DIMENSIONS	91 x 65.5 x 21 mm
WEIGHT	120 grams
POWER SUPPLY	Battery powered, wireless charger
HUB STATION	
DIMENSIONS	125 x 108 x 25mm (including ports) 125 x 85 x 25mm (excluding ports)
WEIGHT	147 grams
POWER SUPPLY	USB power (USB-C)
BATTERY LIFE	Up to 5 hours
OTHER FEATURES	
IMPEDANCE MEASUREMENT	Yes
SYNCHRONIZATION OUTPUT	Yes
TRIGGER INPUT	Yes
REFERENCE TYPE	Common Reference
DATA TRANSFER	Wireless via WiFi (Spire Recorder <> Hub Station), USB (Hub Station <> PC)
SCALABLE SETUP	Measure wireless with up to 4 SPIRE recorders (256 channels)
SOFTWARE	
DATA ACQUISITION SOFTWARE	SPIRE Connect
DATA VISUALIZATION SOFTWARE	WaveView
OPERATING SYSTEM	Windows 11
COMPATIBILITY WITH OTHER SYSTEMS	NIRS, EEG

References

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APEX
Our wearable and user-friendly device that measures 24 or 32 channels of high-quality EEG signals. It has a compact & lightweight design, giving you the freedom to record measurements anywhere.

SAGA
Our all-in-one device for EEG/ HD-EMG measurements. SAGA can measure 32 or 64 channels of high-quality EEG signals along with EOG and physiological sensors. With SAGA, everything is possible.

ACCESSORIES
We provide various EEG/HD-EMG solutions for every research need: from clinical-grade gel headcaps & convenient water-based systems to discreet cEEGrid ear electrodes and advanced textile EMG grids.

HD-EMG - mNIRS
Have a complete picture of muscle activation with a fully integrated, wearable, and compact, HD-EMG and mNIRS package.