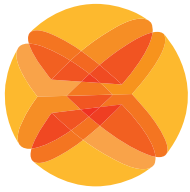


**xsens**



# MVN BIOMECH

**Ambulatory Measurement of Human Motion**



# Xsens

MVN BIOMECH is a camera-less 3D human motion measurement system. It is based on state-of-the-art MEMS inertial sensors, biomechanical models and sensor fusion algorithms. MVN BIOMECH is ambulatory, can be used indoors and outdoors regardless of lighting conditions. The results of MVN BIOMECH trials require minimal post-processing as there is no occlusion or lost markers. Results can easily be exported to other software applications. MVN BIOMECH is created by Xsens, a leading expert in inertial sensor technology.

## PRODUCT OVERVIEW

### MVN BIOMECH Hardware

- 17 MTx inertial motion trackers
- Extra backup/prop MTx
- Wireless transmission (subject to PC)
- Full-body elasticated Velcro straps
- Comfortable lycra suit with embedded cabling (optional)

### MVN BIOMECH Software

- Intuitive user interface
- Quick and easy set up
- Real-time visualization of:
  - 3D digital character (multi-plane view and user-adjustable)
  - Reference video
- Record 3D motion data with ease
- Output data of 23 segments and 22 joints
- Instant 3D kinematic graphs
- Access to inertial sensor data
- Export kinematic and sensor data

## APPLICATIONS

- Biomechanics
  - Research
  - Rehabilitation
  - Gait analysis
  - Sports science
  - Sports coaching
  - Ergonomics
- 3D character animation (game, film, TV, advertising)
- Training and simulation, live events

## FEATURES

### Freedom of movement

- Portable suitcase for easy transportation
- Wireless subject-PC connection: up to 150m (492ft) measurement range
- No occlusion or line-of-sight restrictions
- Use anywhere: outside, in the office, no lab or simulated environment required
- Use under any lighting condition

### Ease of use

- Very short setup time ( $\leq 15$  minutes)
- Short, pre-defined sensor-to-segment calibration
- No marker labeling required
- Export for further processing
- MATLAB example provided

### Subject comfort

- Minimal subject time needed
- Easy calibration
- Straps can be worn over normal clothing
- Suit can be worn under normal clothing

### Accurate data

- Highly sensitive MEMS inertial sensors capture subtle movements
- Sensor fusion algorithms ensures highly accurate output
- Sensors securely fastened to straps/suit
- Minimal skin motion artifact
- No sensitivity to EM-fields

### Easy sync with third party devices

- Using Awinda Station (necessary extra)
  - BNC connection
  - 2 input
  - 2 output
- TTL 0-3V
- Start/Stop recording

## TECHNICAL SPECIFICATIONS

### Possible motion trackers configurations

- Full-body 17 MTx (+1 prop/backup)
- Lower body 7MTx (+1 prop/backup)
- Upper body 10MTx (+1 prop/backup)

### On-body cabling

- For data communication and power
- Only 1 cable needed on each limb
- Trackers daisy-chained

### Full-body straps

- Strong elasticated straps, fastened using Velcro
- 12TPS Dryflex sensor holders
- Clips provided to streamline cables
- One size fits all

### Full-body suit

- Light weight revolutionary stretch fabric with cable guides
- 2 fabric sensor pockets
- 10 TPE Dryflex tracker holders
- Sizes: S, M, L (standard), XL, XXL

### Accessories (included)

- Gloves with tracker pockets
- 1 head band with Dryflex holder and pocket
- 2 foot mounts

### Power supply

2 Xbus Masters (XM) synchronize data from and supply power to all connected MTx's.

- Power/data control unit: 2 Xbus Masters (XM)
- Power (each XM)
  - Battery (incl.) 4 AA NiMH rechargeables (plus 4 spare)
  - Power adapter (incl.) EU/US/UK power adapter 110-240VAC/12VDC 1A
  - Input voltage range 4 - 14V
- Operating time (typical) 3 hours
- Battery charger (incl.) for 8 AA NiMH batteries



### Motion trackers Performance Specifications<sup>1</sup>

- 3D orientation accuracy<sup>2</sup> <0.5 deg
- Resolution 0.05 deg
- Accelerometer range ± 180 m/s<sup>2</sup> (18 g)
- Gyroscope range 1200 deg/s

### Communication

- Interface
  - Wireless or high-speed RS-232/USB
- Wireless range radius (up to)
  - Outdoor 150 meters (492 ft.)
  - Indoor open space 150 meters (492 ft.)
  - Indoor office 50 meters (164 ft.)

### Wireless receiver units

- All configurations 2 Wireless Receivers (incl.)
- RF technology Bluetooth 2.0 (optimized, class 1)
- Interface USB 1.1 or 2.0

### Dimensions

- MTx inertial tracker 38 x 53 x 21 mm (1.5" x 2.1" x 0.8")
- Xbus Master 100 x 150 x 40 mm (3.9" x 5.9" x 1.6")
- MVN BIOMECH suitcase 559 x 351 x 229 mm (22" x 13" x 9")

### Weight

- MTx inertial tracker 30 g (1 oz.)
- Xbus Master 200 g (0.4 lbs)
- MVN BIOMECH straps (excl. trackers) 360 g (0.80 lbs)
- MVN BIOMECH Suit (excl. trackers) 360 g (0.80 lbs)
- Total on-body system (with batteries and cables) 1930 g (4.2 lbs)
- Shipping weight (incl. suitcase) 11 kg (24 lbs)

### Operation environment

- -20... +55 deg Celsius
- Avoid wet and humid conditions as condensation can damage the internal circuitry

Entire system conveniently packed and shipped in a suitcase:

Strong, durable & waterproof  
With wheels & extendable handle  
Suitable as hand-luggage

<sup>1</sup> Extra prop/backup sensor included

<sup>2</sup> Please refer to MTx leaflet for detailed specifications

<sup>3</sup> Static accuracy in homogenous magnetic field

## MVN FUSION ENGINE

### MVN BIOMECH human models

- MVN BIOMECH uses a 23 segment biomechanical model with 22 joints
- Each joint is specified by statistical parameters for 6DOF joint laxity
- An advanced spine and shoulder model is used to compute the kinematics of the spine and shoulder blades
- Anthropometric scaling or user-specified segment dimensions

### Sensor to segment calibration

Easy calibration, with animated instructions. Feedback of expected accuracy provided and advice for improvement (when necessary). Using preset delay, calibration can be carried out without assistance.

- Basic calibration
  - 10 seconds
  - Basic calibration needs only subject and foot length [cm or inches]
- Advanced calibration
  - 10 - 30 seconds per additional step
  - Advanced subject-specific calibration determines tracker alignment and/or subject specific dimensions
  - Calibration procedures for subjects with limited range of motion are possible.

### MVN Studio PRO

- Real time preview of:
  - 3D motion representation, user defined or multi-plane view
  - Synchronized video data
- Simultaneous recording/viewing
- Data replay: Video, digital character and graphical kinematics
- Joint angle vs time
- Joint angle vs joint angle (phase plots)

### Update rate

- Internal update rates 120, 100, 60 Hz
- Export frame rates 120, 100, 60, 50, 40, 30, 25, 24 Hz

### 3D translation

- Double integration of body segment accelerations allows for jumping/running (permanent floor contact is not needed)
- ~2% error in traveled distance
- Advanced external contact model detects body world contacts to enable crawling, sitting, cartwheels etc.
- Full control over external contact points

### Prop/object tracking

Supports up to three extra "prop sensors", for detecting movement of assistive devices e.g., walking aids, sports equipment.

### Magnetic environment

- Full immunity to temporary magnetic disturbances (~30 seconds)
- Visual warning of magnetically disturbed environment

### Patent Pending KiC algorithm

Provides accurate joint angles even in long-term magnetically disturbed environments.

### Local, permanent magnetic disturbances

The degree of immunity and performance will depend on motion and magnetic environment

### Soft tissue artifacts

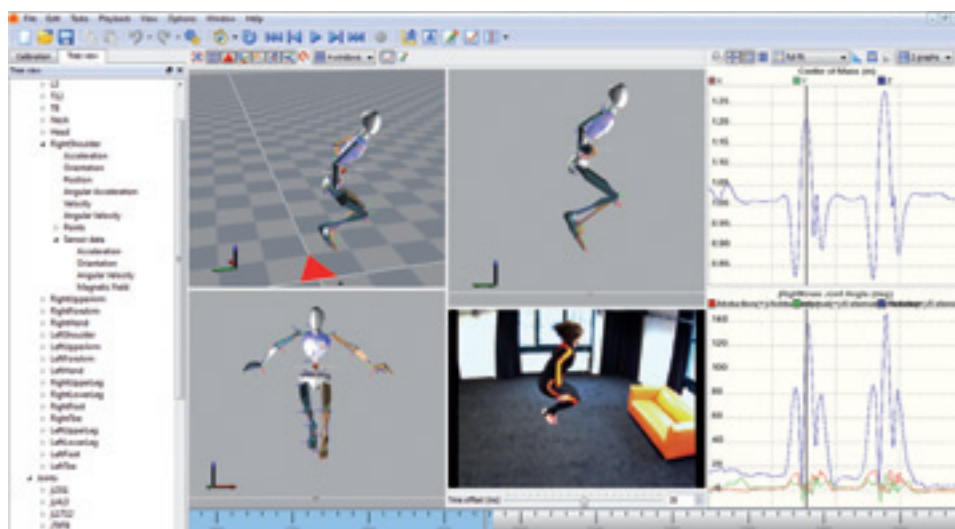
- Minimized to ~2 degrees RMS using redundancy in measurement and biomechanical constraints

### Multiple person measurement

Up to four systems simultaneously on one PC

Warranty 2 year

Support & software updates 1 year



## Parameter Output

- 3D MVN BIOMECH character
- Synchronized video
- 3D Segment orientation and position

## User selected

- 3D joint angles
- 3D segment acceleration, velocity, angular rate and angular acceleration
- Body centre of mass
- 3D sensor
  - Angular velocity
  - Acceleration
  - Orientation

## Supported export formats

- .C3D (Coordinate 3D)
- .MVNX (MVN Open XML format)
- .BVH (Biovision Hierarchical Data)
- .FBX (FiLMBOX)

## EXTRAS

### Siemens Tecnomatix Plugin

- Real-time streaming to Siemens PLM software
  - Jack
  - Process Simulate Human

### Streaming motion data

- Streaming motion data on local area network (UDP)
- MotionBuilder 2012-2013 compatible client plug-in available
- Client network monitor support in MVN Studio PRO

### MVN BIOMECH Software Development Kit

- Easy integration with custom application software
- Provides real-time joint angles and orientation and position data of body segments using C++
- Provides interfaces to calibration routines and character definition routines
- Handles pre-recorded MVN files for post-processing
- MVN Studio Fusion Engine handles 3D position aiding input, in real-time

### Data rate

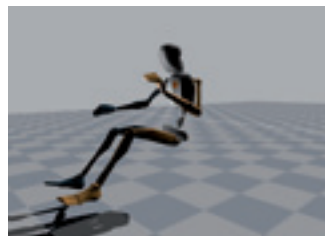
39 MB/min @ 60 Hz

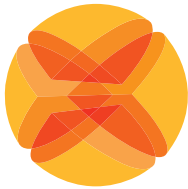
66 MB/min @ 100 Hz

79 MB/min @ 120 Hz

## COMPUTER SYSTEM REQUIREMENTS

Operating System	Windows 7
Processor	Dual core or higher (2.5 GHz or faster) 4 GB RAM
Graphics Card	Any graphics card with hardware acceleration for DirectX 9
USB Ports	2x USB or hub per system





# XSENS

## ABOUT XSENS

Xsens is a leading developer and global supplier of 3D motion tracking products based upon miniature (MEMS) inertial sensor technology.

Since its foundation in 2000, thousands of motion sensors and motion capture solutions have successfully been deployed for 3D character animation, movement science, control of autonomous vehicles and stabilization. Clients of Xsens include Electronic Arts, NBC Universal, INAIL Prosthesis Centre, Daimler, Saab, Kongsberg Defence Systems and many other companies and institutes throughout the world. Xsens is working with several industry partners, including Autodesk, Sagem (Safran Group) and Siemens.

Xsens' research department has created unique intellectual property in the field of multi-sensor data fusion algorithms, combining inertial sensors with GPS and RF positioning and biomechanical modelling. Xsens and its products have received several awards and five consecutive entries in Deloitte's ranking of fastest growing technology companies in Europe.

Xsens is a privately held company with its headquarters in Enschede, the Netherlands and a US subsidiary in Los Angeles, California.

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