MTi-G TECHNICAL SPECIFICATIONS

Attitude and heading
- Static accuracy (roll/pitch) <0.5 deg
- Static accuracy (heading) <1 deg
- Dynamic accuracy <1 deg RMS
- Angular resolution 0.05 deg
- Dynamic range:
  - Pitch ±90 deg
  - Roll/Heading ±180 deg
- Maximum update rate:
  - Onboard processing 120 Hz
  - External processing 512 Hz

Position
- Accuracy position:
  - SPS 2.5 m CEP
- Maximum update rate:
  - Onboard processing 120 Hz
  - External processing 512 Hz

Interfacing
- Digital interface: RS-232 (max 921k6 bps) and USB (extern. converter)
- GPS antenna: SyncOut, Antilogh (2x), SMA connector, active 1 ppm (GPS available)

Maximum operational limits
- Altitude: 18 km
- Velocity: 515 m/s (1854 km/h)
- Ambient temperature:
  - Operating range: -40...+85 °C
  - Specified performance: 0...+55 °C

HARDWARE SPECIFICATIONS

Housing
- Dimensions (WxLxH): 58x58x33 mm
- Weight: 68 g

Options
- Full scale acceleration: 5g (50 m/s²)
- 1g (180 m/s²)

Product code:
- Standard version: MTi-G-28 A53 G35

The MTi-G is RoHS compliant

Note: Specifications subject to change without notice.

1 depends on usage scenario. In case the Earth magnetic field is used, it must be homogeneous
2 under condition of a stabilized Xsens sensor fusion algorithm and good GPS availability
3 standard deviation of zero-mean angular random walk

INDIVIDUAL SENSOR SPECIFICATIONS

Sensor performance
- Rate of turn:
  - Full Scale (standard): ±300 deg/s
- Linearity: 0.1% of FS
- Bias stability: 0.02 deg/h
- Noise: 0.002 mV/√Hz
- Alignment error: 0.1 deg
- Max update rate: 512 Hz

Accuracy
- Pitch/Heading:
  - ±0.01 deg RMS
- ±0.02° FS
- ±0.1 deg
- ±0.2° FS
- ±0.5 deg

Acceleration
- ±50 m/s²
- ±100 m/s²

Magnetic field
- ±750 mGauss
- ±1500 mGauss

Static pressure
- ±30-120 kPa

GPS
- Receiver type: 50 channels L1 frequency, C/A code Galileo L1
- Timing accuracy: 50 ns RMS
- Start-up time cold start: 29 s
- Tracking sensitivity: -160 dBm
- GPS update rate: 4 Hz

Note: Specifications subject to change without notice.

1 depends on usage scenario. In case the Earth magnetic field is used, it must be homogeneous
2 under condition of a stabilized Xsens sensor fusion algorithm and good GPS availability

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ABOUT XSSENS TECHNOLOGIES

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

Since its inception in 2000, several thousands of motion sensors and motion capture solutions have successfully been deployed in areas such as 3D character animation, rehabilitation and sports science, and robust and camera calibration. Customers include Electronic Arts, Sony Computer Entertainment Europe, Electronic Arts, Sony Computer Entertainment Europe, Microsoft, Lucasfilm, Saab Underwater Systems, Kongsvinger Defence & Aerospace and many other companies and institutes throughout the world.

Xsens’ research department has created unique intellectual property in the field of multi-sensor data fusion algorithms, combining inertial sensors with aiding technologies such as GPS and RF positioning and biodynamics. The results of these activities have led to several patents, amongst which four consecutive entries in Deloitte’s ranking of fastest growing technology companies in Europe.

Xsens is headquartered in Enschede, The Netherlands and has a subsidiary, Xsens North America Inc. in Los Angeles, California, US.

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Xsens Technologies B.V.
phone +31 69 97367 00
fax +31 69 97367 01
e-mail info@xsens.com
internet www.xsens.com

Xsens North America Inc.
phone +1-866-973-6737 (toll-free)
fax +1-866-973-6701
e-mail info@xsens.com
internet www.xsens.com

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The MTi-G is a miniature size and low weight 6DOF Attitude and Heading Reference System (AHRS). The MTi-G contains accelerometers, gyroscopes, magnetometers in 3D, an integrated GPS receiver, a static pressure sensor, and temperature sensor. Its internal low-power signal processor provides real time and drift-free 3D orientation as well as calibrated 3D acceleration, 3D rate of turn, 3D earth-magnetic field, 3D position and 3D velocity data.

The MTi-G is an excellent measurement unit for stabilization and control of air and ground objects, even during situations of long term accelerations. During short periods, the MTi-G is able to calculate position and velocity even under dynamic conditions. Accurate position and orientation makes autonomous navigation possible for Unmanned Ground Vehicles (UGV’s), even in rough terrain or during short GPS outages. The MTi-G has been used in DARPA Grand Challenges for these purposes. These applications are typically out of reach for conventional MEMS IMUs.

The main functionality of the MTi-G in robotics applications is attitude control, even under dynamic conditions. Accurate position and orientation makes autonomous navigation possible for Unmanned Ground Vehicles (UGV’s), even in rough terrain or during short GPS outages. The MTi-G has been used in DARPA Grand Challenges for these purposes. These applications are typically out of reach for conventional MEMS IMUs.

User friendliness

The MTi-G is a sensor which can be used standalone or in combination with other sensor types. Because of the specific requirements for all these applications, the MTi-G uses different filter settings and configurations, implemented in software. Among others, there are scenarios for use in automotive and aerospace applications.

Features

- Low weight, ultra-low power consumption
- Easy integration in any system or application
- Complete and easy integration package
- Compact design
- High performance
- Suitable for any type of small to medium sized fixed-wing or rotary-wing aircraft.
- Autonomous attitude and navigation control
- Automatic control for driving and walking robots
- Camera and LIDAR stabilization and correction
- Suitable to test and analyze the dynamic behavior of e.g. automobiles.
- Suitable for high-level sports car or motorbike competitions.
- MT Manager Software
- MT SDK

User interface with possibilities to configure Xsens’ sensors, reading out, store and show data in real-time charts and visualizations.

MT SDK

The MT SDK contains the following:

- MT-G (any configuration)
- MT Manager Software
- MT Software Development Kit (MT SDK)
- MT COM-object API and DLL API

The MT COM-object API and DLL API for Windows

Integrating the MTi-G in Windows programs is made easy with the MT COM-object API and the DLL API. Use-modifiable example code for programs Matlab, C++ and Excel (VBA) is included.

C++ Class and binary communication for any RTOS

A C++ class is available for users who want to use the MTi-G on a binary level. Direct communication without using the C++ class is possible, following the fully documented communication protocol.

Magnetic Field Mapper plug-in
The Magnetic Field Mapper plug-in enables compensation for hard and soft iron effects.

MTi-G DEVELOPMENT KIT

The MTi-G DK contains the following:

- MT-G (any configuration)
- MT Manager Software
- MT Software Development Kit (MT SDK)
- MT COM-object API and DLL API

MTi-G DEVELOPMENT KIT

The MTi-G DK is an extensive set of tools for every level of hardware integration, allows for easy software/hardware interface making data processing possible. It also allows the user to extend user source code with the MTi-G communication, using commands and code examples provided.

The MT SDK contains:

- MT Manager Software
- MT SDK

A specialized developed, easy-to-use graphical user interface with possibilities to configure Xsens’ sensors, reading out and storing data and (re-)processing MTi-G data previously recorded.

The MTi-G is an excellent sensor for driving and walking robots. The main functionality of the MTi-G in robotics applications is attitude control, even under dynamic conditions. Accurate position and orientation makes autonomous navigation possible for Unmanned Ground Vehicles (UGV’s), even in rough terrain or during short GPS outages. The MTi-G has been used in DARPA Grand Challenges for these purposes. Three applications are typically out of reach for conventional MEMS IMUs.

Aerospace

- Autonomous attitude and navigation control
- Composites of (aerodynamic) planes
- Camera/LIDAR stabilization and correction
- No display

The MTi-G is ideal choice for control and stabilization for any type of small to medium size fixed-wing or rotary-wing aircraft. Because of the low latency, autonomous control can be designed in a simple and robust manner. The MTi-G provides a wide variety of dynamic data, suitable for dynamics analysis of (un)manned airplanes. An easy-to-use software/hardware interface makes data processing post-flight or even real-time. The MTi-G is easy to install and computes all the data required for e.g. an accurate artificial horizon or a digital map.

TYPICAL USAGE APPLICATIONS

- Automotive
- Vehicle dynamics analysis
- Skidding cars and motorcycles
- On-board DSP, running sensor fusion algorithms
- 3D position and velocity data
- Autonomous attitude and navigation control
- Camera and LIDAR stabilization and correction
- Suitable to test and analyze the dynamic behavior of e.g. automobiles.
- Non-holonomic constraints can be used to further enhance accuracy.
- The roll and pitch remain accurate even during long term accelerations typical for this application.

- Marine
- In-composition optimization of racing yachts
- Static estimation of leisure yachts
- Backup system for high GPS systems

For racing yachts, the MTi-G provides orientations of several parts of the ship, such as the roll angle of the hull or the movement of the mast. This allows a sailing team to refine the ship’s performance during a race, or include the data in the autopilot. Another major application is stability estimation using the gyros, i.e. heeling. As heeling is important for container ships, cargo ships and surveying vessels. Installing the MTi-G together with high GPS systems is a logical choice to enhance accuracy and to reduce costs, especially in situations with limited GPS reception.

- Robotics
- Autonomous control for driving and walking robots
- Camera and LIDAR stabilization and correction
- Suitable to test and analyze the dynamic behavior of e.g. automobiles.
- Suitable for high-level sports car or motorbike competitions.
- MT Manager Software
- MT SDK

A specialized developed, easy-to-use graphical user interface with possibilities to configure Xsens’ sensors, reading out, store and show data in real-time charts and visualizations.

ACCESSORIES

- Cable options
- MT i-G DEVELOPMENT KIT
- MT COM-object API and DLL API for Windows

- USB cable
- Serial cable
- RS32, DB9 power adapter
- ANT

- MT COM-object API and DLL API

- Mounting kit

- CA-USB2G, CA-SERi-2, CA-MP

- MT COM-object API and DLL API

- Mounting kit

- CA-USB2G, CA-SERi-2, CA-MP

- Mounting kit

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- Mounting kit

- CA-USB2G, CA-SERi-2, CA-MP

- Mounting kit
The MTi-G is a miniature size and low weight 6DOF Attitude and Heading Reference System (AHRS). The MTi-G contains accelerometers, gyroscopes, magnetometers in 3D, an integrated GPS receiver, a static pressure sensor and temperature sensor. Its internal low-power signal processor provides real time and drift-free 3D orientation as well as calibrated 3D acceleration, 3D rate of turn, 3D earth-magnetic field, 3D position and 3D velocity data.

The MTi-G is an excellent measurement unit for stabilization and control of air and ground objects, even during situations of long term accelerations.

User friendliness
• Real-time computed GPS-enhanced position/velocity data
• GPS integration overcomes typical IMU challenges
• Integrated AHRS, GPS and static pressure sensor
• On-board DSP, sensing sensor fusion algorithm
• MP3 variable rate (120 Hz), inertial data
• Individually calibrated for temperature, 3D misalignment and sensor cross-sensitivity
• UTC referenced output

Compact design
• Compact and robust design
• Easy integration in any system or application
• Low weight, ultra-low power consumption

High performance
The MTi-G is a combination of a MEMS IMU, GPS and barometer. Yet, the MTi-G is more than just a sensor assembly. The IMU, GPS and barometric information is blending together in Xsens’ sensor fusion algorithm to provide 6DOF heading and position and position possible. Because of this fusion, the output is more accurate than the output from the IMU or GPS receiver only. For example, the IMUcorrects for the transient accelerations; a typical error source for any AHRS using the gravity as its reference estimating roll and pitch. The bore loop coupling works both sides: double-integrating the horizontal acceleration produces a drift, but the IMU is able to calculate position and velocity even during short GPS outages. There are some more corrections needed to aid the IMU functionality and to enhance the GPS measurements.

TYPICAL USAGE APPLICATIONS

Automotive
• Vehicle dynamics analysis
• Skidding cars and motorcycles
• Stability control

Maritime
• In-comparison optimization of racing yachts
• Static estimation of leisure yachts
• Backup system for high GPS systems

Unmanned ground vehicles and robotics
• Autonomous control for driving and walking robots
• Military and civil ground vehicles

Aerospace
• Autonomous control and navigation
• Composites of (aerodynamic) planes
• Camera/LIDAR stabilization and correction

Performance testing

• Reliability testing during a race, or include the data in the autopilot. Another major advantage of the fusion algorithm is that as heading is important for container ships, cargo ships and surveying vessels, installing the MTi-G together with high GPS systems is a logical choice to enhance accuracy and to reduce costs, especially in situations with blended GPS and IMU reception.

Highlights
• 3D acceleration, 3D rate of turn
• 3D position and velocity (aided and unaided by inertial sensors)
• 3D orientation (360°)

MTi-G DEVELOPMENT KIT

The MTi-G is an excellent sensor for driving and walking robots. The main functionality of the MTi-G in robotics applications is attitude control, even under dynamic conditions. Accurate position and orientation makes autonomous navigation possible for Unmanned Ground Vehicles (UGV’s), even in rough terrain or during short GPS outages. The MTi-G has been used in DARPA Grand Challenges for these purposes. Three applications are actually out of reach for conventional MEMS IMU’s.

The MTi-G is the ideal choice for control and stabilization for any type of small to medium size ground and under- and over-ground vehicles.

Because of the low latency, autonomous control can be designed in a simple and robust manner. The MTi-G is an excellent sensor for driving and walking robots. The MTi-G has a wide variety of dynamic data, suitable for dynamics analysis of (un)aligned airframes.

An easy software/hardware interface makes data processing possible post-flight or even real-time. The MTi-G is easy to install and combines all the data required for e.g. an accurate artificial horizon or a digital map.

ACCESSORIES

Cable options
• CA-USB2G
• CA-SEN-2.5
• CA-DB8G

Antenna
• Optional: serial cabling

MT COM-object API and DLL API for Windows

Integrating the MTi-G in Windows programs, the MTi-G DLL can be used with the MT-COM object API and the DLL API. User modifiable code is possible, following the fully documented communication protocol.

Magnetic Field Mapper plug-in
The Magnetic Field Mapper plug in enables compensation for hard and soft iron effects.

MT Manager Software
A specially developed, easy-to-use graphical user interface with possibilities to configure Xsens’ sensors, reading out and storing data and reprocessing MTi-G data previously recorded. It also allows the user to extend own user source code with the MTi-G communication, using commands and code examples provided.

The MT SDK contains:

• MT Manager Software
• MT COM-object API and DLL API

Integration into applications is possible, following the fully documented communication protocol.
The MTi-G is an excellent measurement unit for stabilization and control of air and ground objects, even during situations of long term accelerations.

**Highlights**
- Real-time computed GPS-enhanced position/velocity data
- GPS integration overcomes typical IMU challenges
- Integrated AHRS, GPS and static pressure sensor
- On-board DSP, ranging sensor fusion algorithm
- PHR variable rate (120 Hz), inertial data
- Individually calibrated for temperature, 3D misalignment and sensor cross-sensitivity
- UTC referenced output

**Compact design**
- Compact and robust design
- Easy integration in any system or application
- Low weight, ultra-low power consumption

**High performance**
The MTi-G is a combination of a MEMS IMU, GPS and barometer. Yet, the MTi-G is more than just a sensor assembly. The IMU, GPS and barometric information is blending together in Xsens’ sensor fusion algorithm to provide an accurate position and velocity data. Because of this fusion, the output is more accurate than the output from the IMU or GPS receiver only. For example, the MTi-G copes with transient accelerations: a typical error source for any AHRS using the gravity as its reference (estimating roll and pitch). The loose coupling accelerations, a typical error source for any AHRS using the gravity as its reference (estimating roll and pitch) allows the MTi-G to operate without the need for additional sensors.

**Output**
- 3D orientation (0-360°)
- 3D position and velocity (axed and unaided by inertial sensors)
- 3D acceleration, 3D rate of turn
- 3D magnetic field

**User friendliness**
The MTi-G is a sensor which can be used in any 3D application requiring orientation estimation. Because of the specific requirements for all these applications, the MTi-G uses different filter settings and constraints, implemented in software. Among other things, these are constraints for use in automotive and aerospace applications.

**TYPICAL USAGE APPLICATIONS**
- Automotive
  - Vehicle dynamics analysis
  - Skidding cars and motorbikes
  - Telematics
  - Full access to valuable data is available for engineers working at any level of sports car or motorbike competitions. The MTi-G outputs are compatible to test and analyze the dynamic behavior of e.g. automobiles. Non-holonomic constraints can be used to further enhance accuracy. The roll and pitch remain accurate even during long term accelerations typical for this application.
- Marine
  - In-comparison optimization of racing yachts
  - Static estimation of leisure yachts
  - Backup system for high GPS systems
  - For racing yachts, the MTi-G provides orientations of several parts of the ship, such as the roll angle of the hull or the movement of the mast. This allows a sailing team to refine the ship’s performance during a race, or include the data in the autopilot. Another major application of the MTi-G in marine robotics is heave compensation as heading is important for container ships, cargo ships and surveying vessels. Installing the MTi-G together with high GPS systems is a logical choice to enhance accuracy and to reduce costs, especially in small to medium vessel applications.
- Unmanned ground vehicles and robotics
  - Autonomous control for driving and walking robots
  - Military and civil ground vehicles
  - Unmanned Ground Vehicles (UGVs), even in rough terrain or during short GPS outages. The MTi-G has been used in DARPA Grand Challenges for these purposes. Three applications are typically out of reach for conventional MEMS IMU’s.
- Aerospace
  - Autonomous altitude and navigation control
  - Composites (of aerobatic planes)
  - Camera/LIDAR stabilization and correction
  - Real-time computing and navigation
  - The MTi-G is an excellent sensor for driving and walking robots. The main functionality of the MTi-G in robotics applications is attitude control, even under dynamic conditions. Accurate position and orientation makes autonomous navigation possible for Unmanned Ground Vehicles (UGVs), even in rough terrain or during short GPS outages. The MTi-G has been used in DARPA Grand Challenges for these purposes. These applications are typically out of reach for conventional MEMS IMU’s.

**MTI-G DEVELOPMENT KIT**
- The MTi-G DK contains the following:
  - MTi-G (any configuration)
  - A USB2G cable is used to make sure with the MTi-GDK application and the DLL API. Use-read-only code copies for program Matlab, C++, and Excel (VBA) is included.
  - C++ Class and binary communication for any RTOS
  - A C++ class is available for users who want to use the MTi-G on a binary level. Direct communication with the MTi-G is possible, following the fully documented communication protocol.

**ACCESSORIES**
- A magnetic Field Mapper plug-in
  - The Magnetic Field Mapper plug-in enables compensation for hard and soft iron effects.

**MT COM-object API and DLL API for Windows**
- Integrating the MTi-G in Windows programs, the MTi-G SDK can be used with the MTi-G DK application and the DLL API. Use-read-only code copies for program Matlab, C++, and Excel (VBA) is included.
MTi-G TECHNICAL SPECIFICATIONS

Attitude and heading
- Static accuracy (roll/pitch) <0.5 deg
- Static accuracy (heading) <1 deg
- Dynamic accuracy 1 deg RMS

Angular resolution
- Pitch: 0.05 deg
- Roll/Heading: 0.05 deg

Dynamic range:
- Pitch: ±90 deg
- Roll/Heading: ±180 deg

Maximum update rate:
- Onboard processing: 120 Hz
- External processing: 512 Hz

Position
- Accuracy position:
  - SPS: 2.5 m CEP
- Maximum update rate:
  - Onboard processing: 120 Hz
  - External processing: 512 Hz

Interfacing
- Digital interface: RS-232 (max 921K6 bps) and USB (ext. converter)
- Power consumption: 650-690 mW (typical) - 910 mW (max)
- GPS antenna: SyncOut, Analogniq (2x), UART connector, active 1 ppm (GPS available)

Maximum operational limits
- Altitude: 18 km
- Velocity: 515 m/s (1854 km/h)
- Ambient temperature:
  - Operating range: -40...+85 °C
  - Specified performance: 0...+55 °C
- Linearity:
  - Pitch: ±0.1 deg
  - Roll/Heading: ±0.1 deg

MTi-G MINIATURE AHRS WITH INTEGRATED GPS

HARDWARE SPECIFICATIONS

Housing
- Dimensions (WxLxH): 58x58x33 mm
- Weight: 68 g

Options
- Full scale acceleration:
  - 5g (90 m/s²)
  - 10g (180 m/s²)

Product code:
- MTi-G 28 A53 G35

The MTi-G is RoHS compliant

Individual sensor specifications

Sensor performance
- Rate of turn: ±300 deg/s
- Acceleration: ±50 m/s²
- Magnetic field: ±750 mGauss
- Static pressure: 30-120 kPa

Linearity:
- ±0.1% of FS

Bias stability:
- ±0.02 m/s²/√Hz

Scale Factor Stability:
- ±0.03% 

Noise:
- ±0.05 deg/s/√Hz

Alignment error:
- ±0.1 deg

Bandwidth:
- 40 Hz

Max update rate:
- 512 Hz

GPS
- Receiver type: 50 channels L1 frequency, C/A code Galileo L1
- GPS update rate: 4 Hz
- Start-up time: cold start 29 s
- Tracking sensitivity: -160 dBm
- Timing accuracy: 50 ns RMS

Note: Specifications subject to change without notice.

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**MTi-G TECHNICAL SPECIFICATIONS**

**Attitude and heading**
- Static accuracy roll/pitch: <0.5 deg
- Static accuracy heading: <1 deg
- Dynamic accuracy: 1 deg RMS
  - Pitch: <90 deg
  - Roll/Heading: <180 deg
- Maximum update rate:
  - Onboard processing: 120 Hz
  - External processing: 512 Hz

**Position**
- Accuracy position:
  - SPS: 2.5 m CEP
- Maximum update rate:
  - Onboard processing: 120 Hz
  - External processing: 512 Hz

**Interfacing**
- Digital interface: RS-232 (max 921k6 bps) and USB (ext. converter)
- GPS antenna: SyncOut, Antilogh (2x), SRAA connector, active
  - 1 ppm (GPS available)

**Maximum operational limits**
- Altitude: ±18 km
- Velocity: 515 m/s (1854 km/h)
- Ambient temperature:
  - Operating range: -40...+85 °C
  - Specified performance: 4...+55 °C

**GFR SPECIFICATIONS**

**Housing**
- Dimensions (WxLxH): 58x58x33 mm
- Weight: 68 g

**Options**
- Full scale acceleration: 5g (50 m/s²)
- 1g (180 m/s²)
- Full scale rate of turn: 1200 deg/s

**GPS**
- Receiver type: 50 channels L1 frequency, C/A code Galileo L1
- GPS update rate: 4 Hz
- Start-up time cold start: 29 s
- Tracking sensitivity: -160 dBm
- Timing accuracy: 50 ns RMS

**INDIVIDUAL SENSOR SPECIFICATIONS**

**Sensor performance**
- Full scale (standard):
  - 3 axes: ±300 deg/s
  - 3 axes: ±50 m/s²
  - 3 axes: ±750 mGauss
- Linearity: 0.1% of FS
- Bias stability: 20 deg/h
- Scale Factor stability:
  - ±0.02 m/s²/√Hz
  - ±0.1 mGauss
- Noise:
  - ±0.05 deg/s/√Hz
  - ±0.02 m/s²/√Hz
  - ±1.5 mGauss
  - ±4 Pa/√Hz (0.3 m/√Hz)
- Alignment error:
  - ±0.1 deg
- Bandwidth:
  - ±0.1 deg
- Max update rate:
  - ±512 Hz

**Acceleration**
- Full scale rate of turn: 1200 deg/s

**Magnetic field**
- Full scale: ±1750 mGauss

**Static pressure**
- Full scale: ±30-120 kPa
- Linearity: 0.5% of FS
- Bias stability: 100 Pa/yr

**Specifications subject to change without notice.**

**ABOUT XSENS TECHNOLOGIES**

Xsens is a leading global supplier of 3D motion tracking products based upon miniature MAMIS inertial sensor technology.

Since its inception in 2000, several thousands of motion sensors and motion capture systems have successfully been deployed in areas such as 3D character animation, rehabilitation and sports science, and robot and camera stabilization. Customers include Electronic Arts, Sony Pictures Imageworks, Electronic Arts, public transport operator Saarbrücken, Saab Underwater Systems, Kongsberg Defence & Aerospace and many other companies and institutions throughout the world.

Xsens’ research department has created unique intellectual property in the field of multi-sensor data fusion algorithms, combining inertial sensors with aiding technologies such as GPS and RF positioning and biometric sensors such as accelerometers, gyroscopes and microphones. These products have secured several patents, among which four consecutive times in Deloitte’s ranking of fastest growing technology companies in Europe.

Xsens is headquartered in Enschede, The Netherlands and has a subsidiary, Xsens North America Inc. in Los Angeles, California, US.