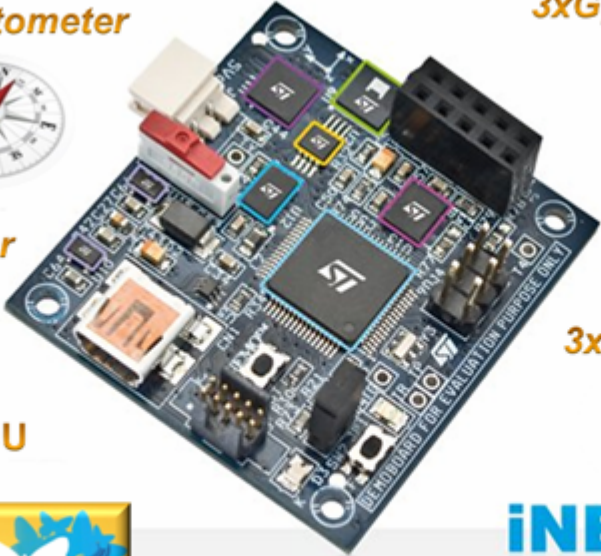


# iNEMO™

## Inertial module evaluation board



The image shows a blue printed circuit board (PCB) populated with various electronic components. A central microcontroller unit (MCU) is highlighted with a yellow box. Several other components are also highlighted with yellow boxes and labels. The board is shown at an angle, reflecting on a white surface below it.

**3xMagnetometer**

**3xGyroscope**

**Pressure Sensor**

**32-bit MCU**

**3xAccelerometer**

**iNEMO™**  
**10 Degrees of freedom**



April 2011

# NEMO™ platform concept



## 10 Degrees of freedom

3x Accelerometer



3x Gyroscope



Pressure Sensor

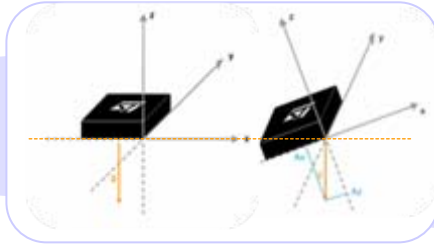


3x Magnetometer

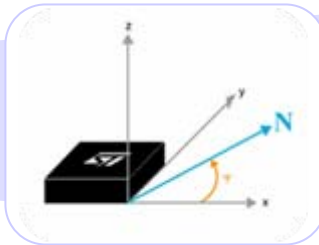


NEMO™ V2, the second version of ST inertial module, combines accelerometers, gyroscopes and magnetometers with pressure and temperature sensors. The system provides 3-axis sensing of linear, angular and magnetic motion, complemented with temperature and barometer/altitude readings, representing the new ST 10-degrees of freedom platform.

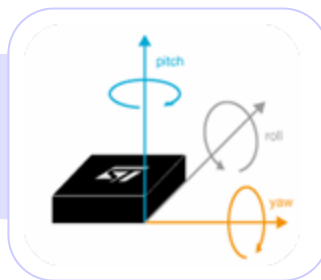
# ST MEMS – orientation made easy



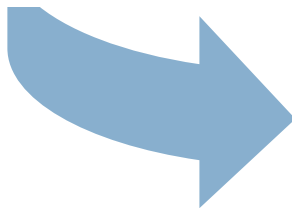
- The **accelerometers** sense the linear acceleration
- In **static** conditions, the projection of gravity on the 3 axes allows **tilt angles** to be computed



- The **magnetometer** senses the magnetic field
- In **static** conditions, the projection of geomagnetic field on the 3 axes allows the heading angle to be computed

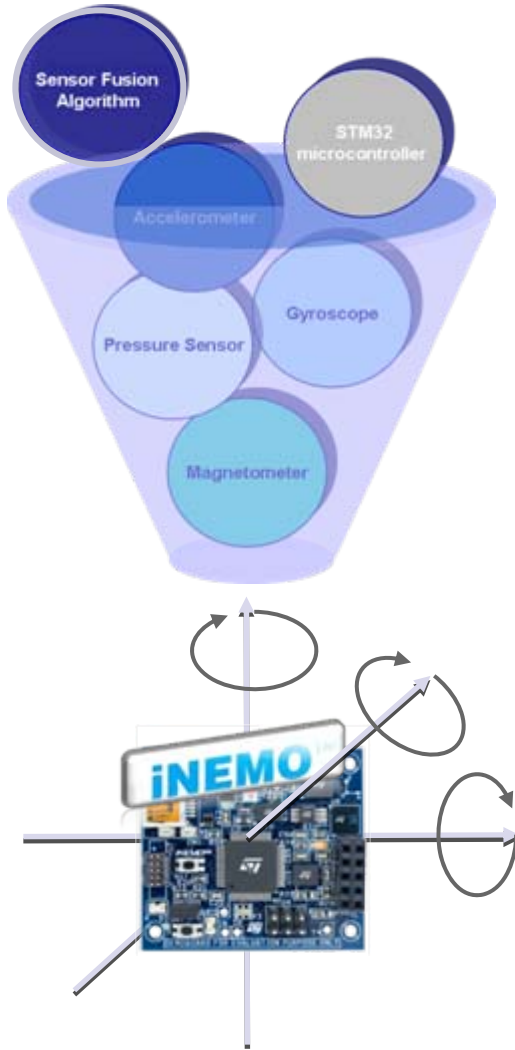


- The **gyroscope** measures the angular rate applied to the device
- In **dynamic** conditions, by integration of the 3-axis angular rate, the 3D orientation can be computed



The IMU (inertial measurement unit) allows sensor fusion and enables new applications

# iNEMO™ sensor fusion concept

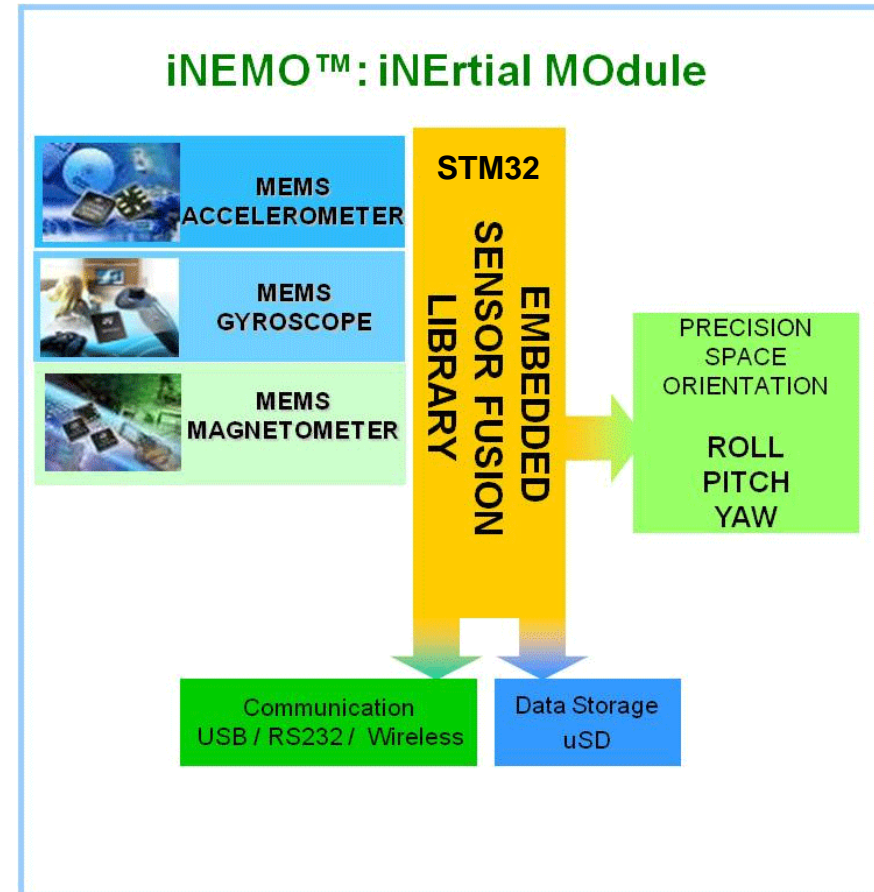


iNEMO™ is a smart combination of multiple MEMS sensors in a unique inertial measurement unit (IMU) completed by an embedded sensor fusion algorithm that provides 3D space orientation.

# iNEMO™ AHRS algorithm



- Key features
  - Embedded extended Kalman filter to provide drift-free 3D space orientation
  - Outputs: Euler angles, quaternion, acceleration, angular rate and magnetic field
  - Firmware architecture based on FreeRTOS
  - EKF frequency up to 100 Hz
  - Dynamic range:
    - Pitch:  $\pm 90^\circ$
    - Roll/heading:  $\pm 180^\circ$



# iNEMO™ platform concept



## STLM75DS2F

Digital temperature sensor  
& thermal watchdog

## LSM303DLH

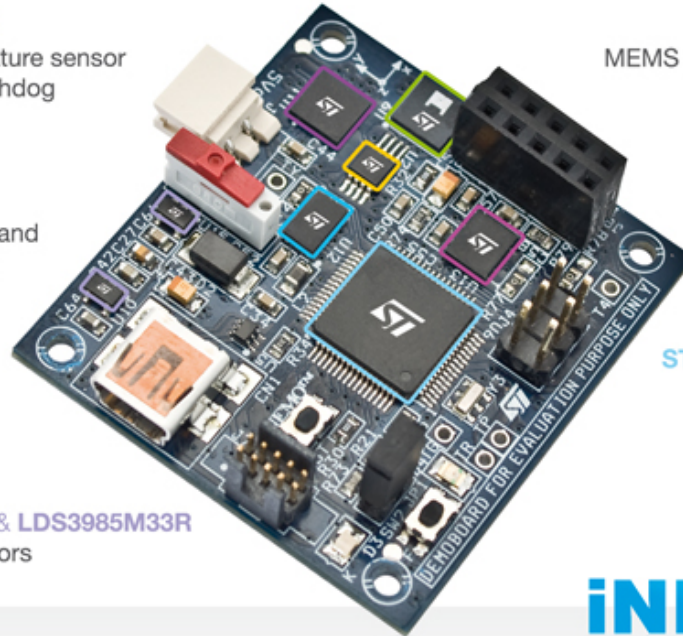
6-axis module:  
accelerometer and  
magnetometer

## LY330ALH

MEMS Yaw  
gyroscope

## LD3985M18R & LDS3985M33R

Voltage regulators



## LPS001DL

MEMS pressure sensor

## LPR430AL

MEMS Pitch &  
Roll gyroscope

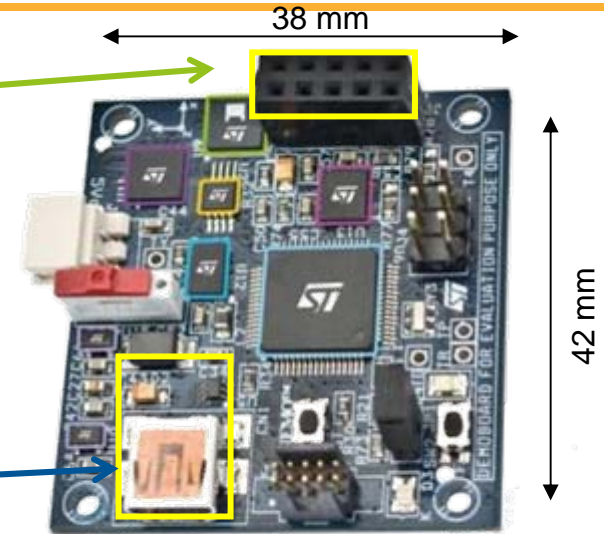
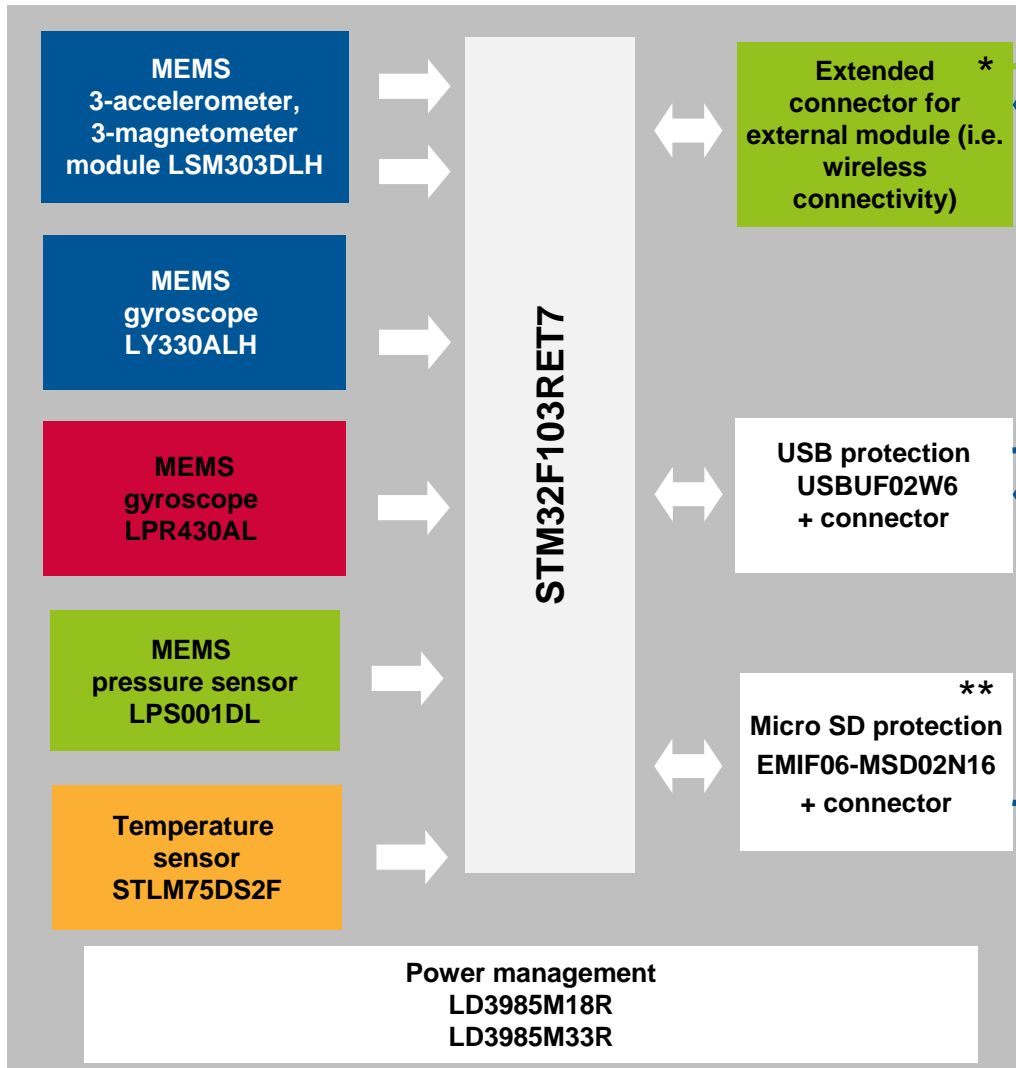
## STM32F103RET7

32-bit MCU

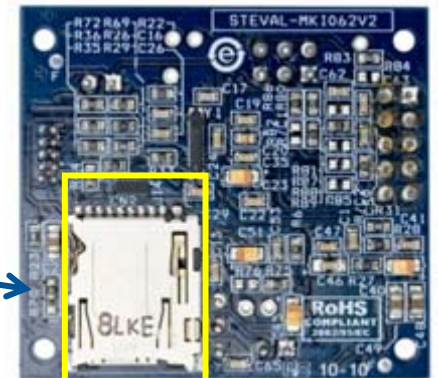
# iNEMO™

Based on the previous version, the STEVALMKI062V2 represents another step forward in miniaturization, integrating five ST sensors: a 2-axis roll-and-pitch gyroscope, a 1-axis yaw gyroscope, a 6-axis geomagnetic module, a pressure sensor and a temperature sensor. The platform is completed by a 32-bit ARM based MCU, and two ultra-low-drop voltage regulators.

# NEMO™ V2: block diagram



Top



Bottom

\* Supporting only HW connector  
 \*\* Supporting only HW micro SD card connector  
 Any firmware for data logging available

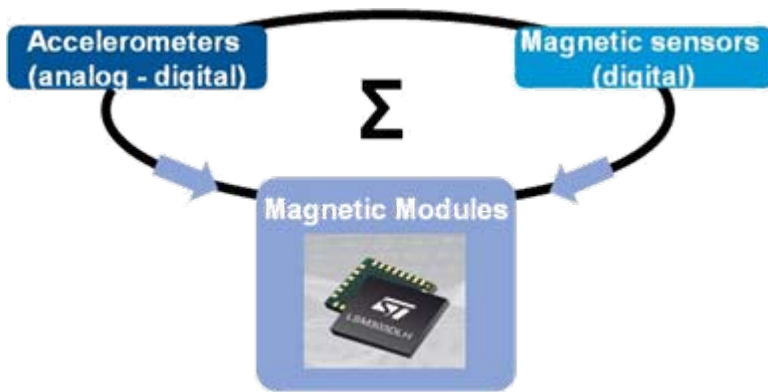
# MEMS compass and gyroscope



**Compass LSM303DLH:** digital module  
3 accelerometers + 3 magnetometers

## Features

- 3-axis accelerometer: 2 ÷ 8 g
- 3-axis magnetic sensor: up to 8.1 gauss
- Independent sensing power management
- I<sup>2</sup>C interface

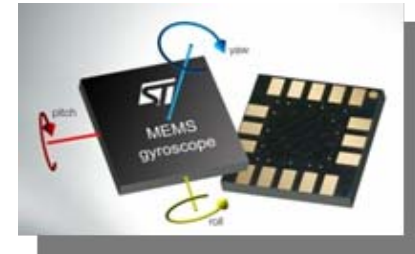


[LSM303DLH datasheet](#)

**Gyroscope:** high-performance  $\pm 300$  dps analog  
dual-axis LPR430AL (pitch and roll)  
and LY330ALH (yaw)

## Features

- Analog absolute angular-rate outputs
- Two separate outputs for each axis
- Integrated low-pass filters
- High shock and vibration survivability



[LPR430AL datasheet](#)

[LY330ALH datasheet](#)

More about MEMS at [www.st.com/mems](http://www.st.com/mems)

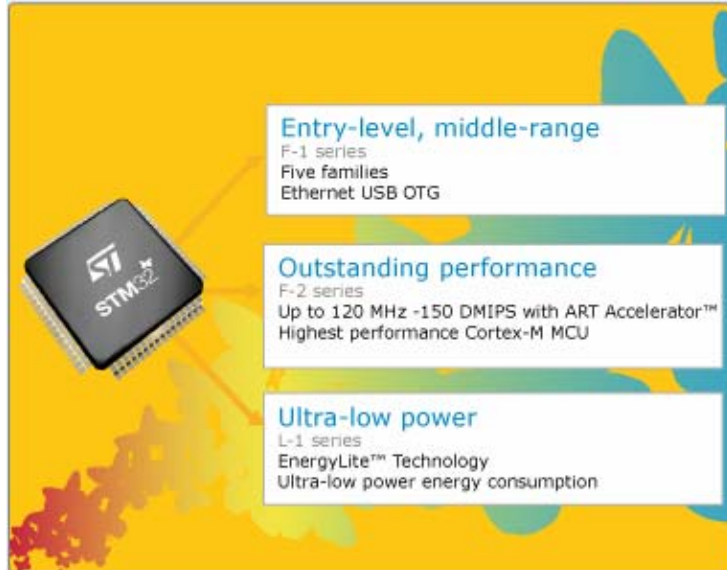
# STM32F103RET7



High-density performance line ARM-based 32-bit MCU

## Features

- Core: ARM 32-bit Cortex™-M3 CPU
- 72 MHz maximum frequency
- 256 Kbytes of Flash memory and 64 Kbytes of SRAM
- 3x 12-bit ADCs
- 13 communication interfaces, 11 timers



[Datasheet](#)

More at [www.st.com/stm32](http://www.st.com/stm32)

# More products

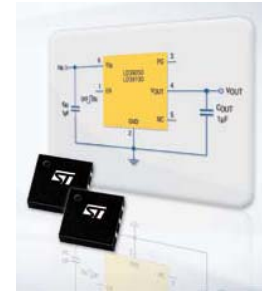


**STLM75DS2F** – digital temperature sensor and thermal watchdog



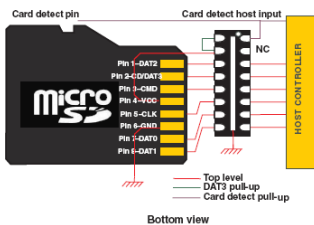
[Datasheet](#)

**LD3985M18R/M33R** – ultra-low drop, low-noise BiCMOS voltage regulators



[Datasheet](#)

**EMIF06-MSD02N16** – 6-line IPAD™, EMI filter and ESD protection



[Datasheet](#)

**USBUF02W6** – EMI filter and line termination for USB upstream ports



[Datasheet](#)



# The iNEMO's 10-degrees of freedom frees creativity in applications



**iNEMO™**



*Pressure Sensor*



*3xAccelerometer*



*3xMagnetometer*

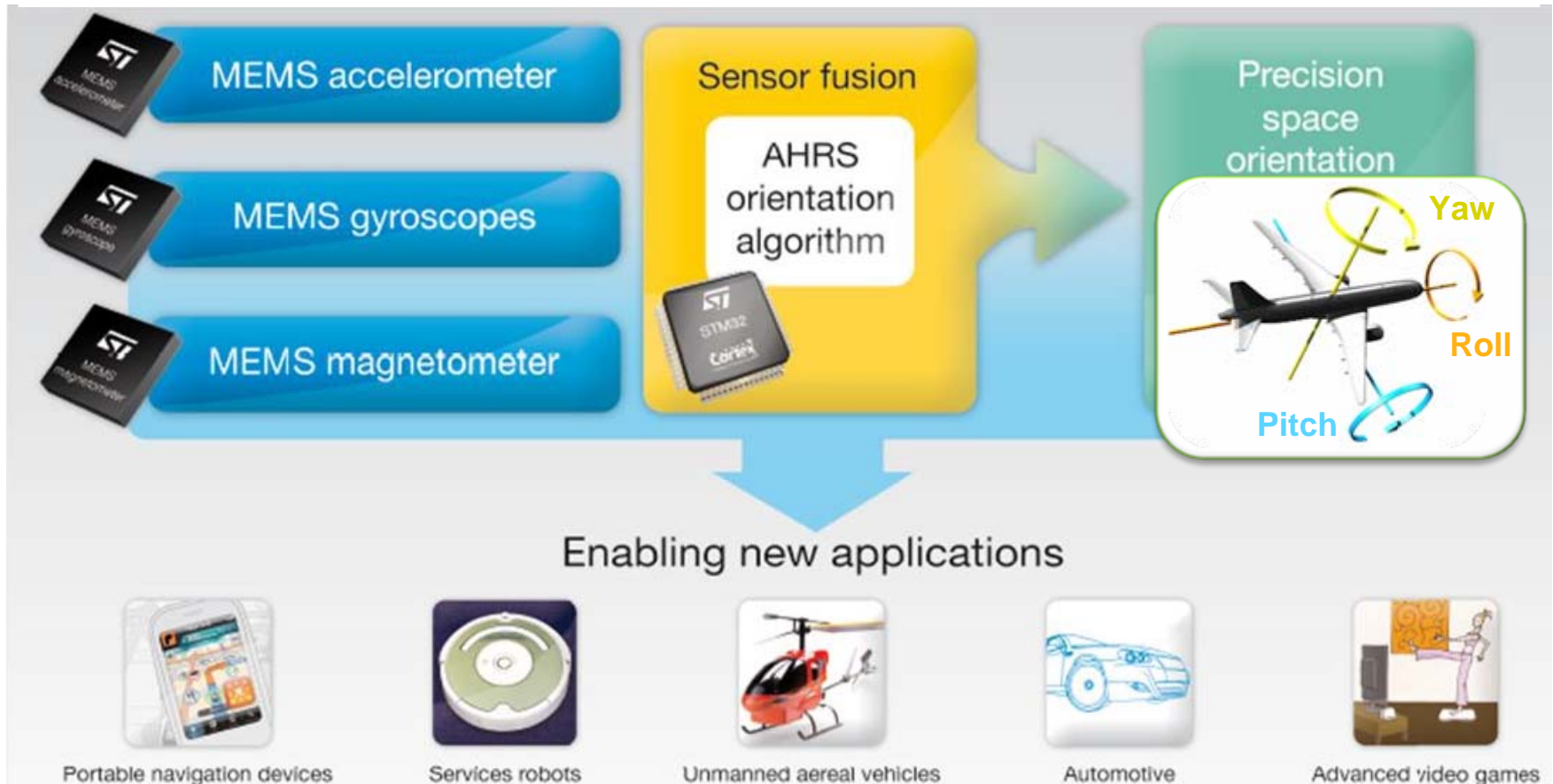


*3xGyroscope*



# iNEMO™ enabling new applications

The iNEMO inertial system, with integrated ST sensors (2-axis gyroscope + 1-axis gyroscope, 6-axis geomagnetic module and a pressure sensor ), gives 10 degrees of freedom that can be used in numerous applications such as virtual reality, augmented reality, image stabilization, human machine interfaces and robotics.



# Gaming and entertainment



Implementing enhanced tracking algorithms, MEMS sensors allow the user to convert player motion into game action.



## Gyroscopes

- Motion tracking for yaw, roll and pitch rotation

## Magnetometers

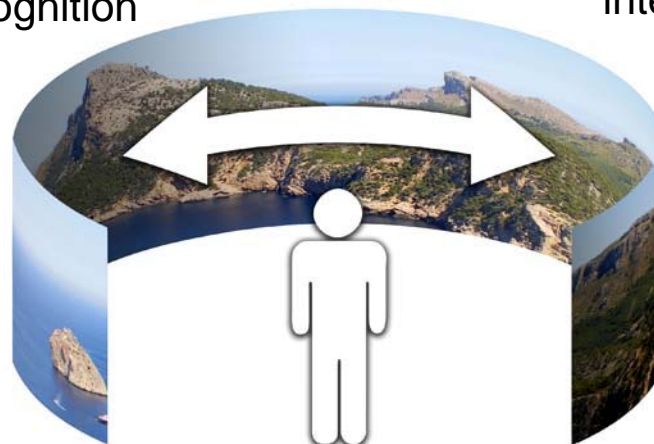
- Correct orientation in graphical navigation

## Accelerometers

- Adding enhanced user movement feedback

Complete 360°  
gesture recognition

Intuitive user  
interface



**NEMO™ V1/V2** platforms application example (no dedicated software/firmware available). For further details, please refer to ST on-line support.

# Location based services (LBS)



Implementing enhanced tracking algorithms, MEMS sensors allow the user to retrieve the exact position and orientation even when the GPS signal is lost.

## Gyroscopes

- Motion tracking when GPS signal is lost

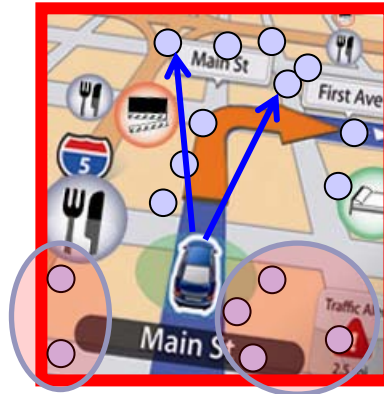
## Magnetometers

- Correct orientation while pointing to buildings

## Accelerometers

- Tilt information for precise movement recognition

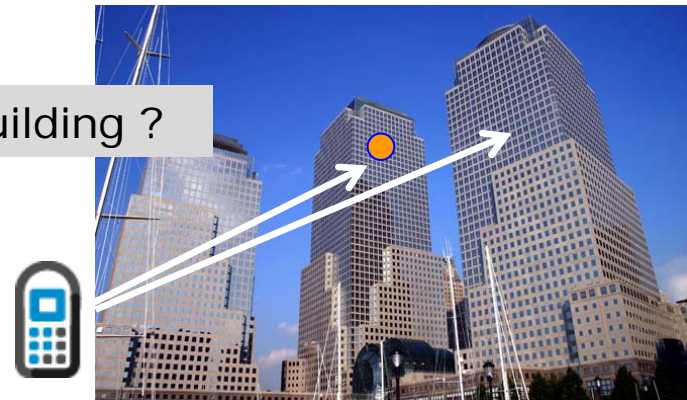
POI without compass



POI filtering with compass



Which building ?



**NEMO™ V1/V2 platforms application example (no dedicated software/firmware available). For further details, please refer to ST on-line support.**

# Human body movement recognition

## 3D movement recognition with ST iNEMO and AHRS sensor fusion.

### Gyroscopes

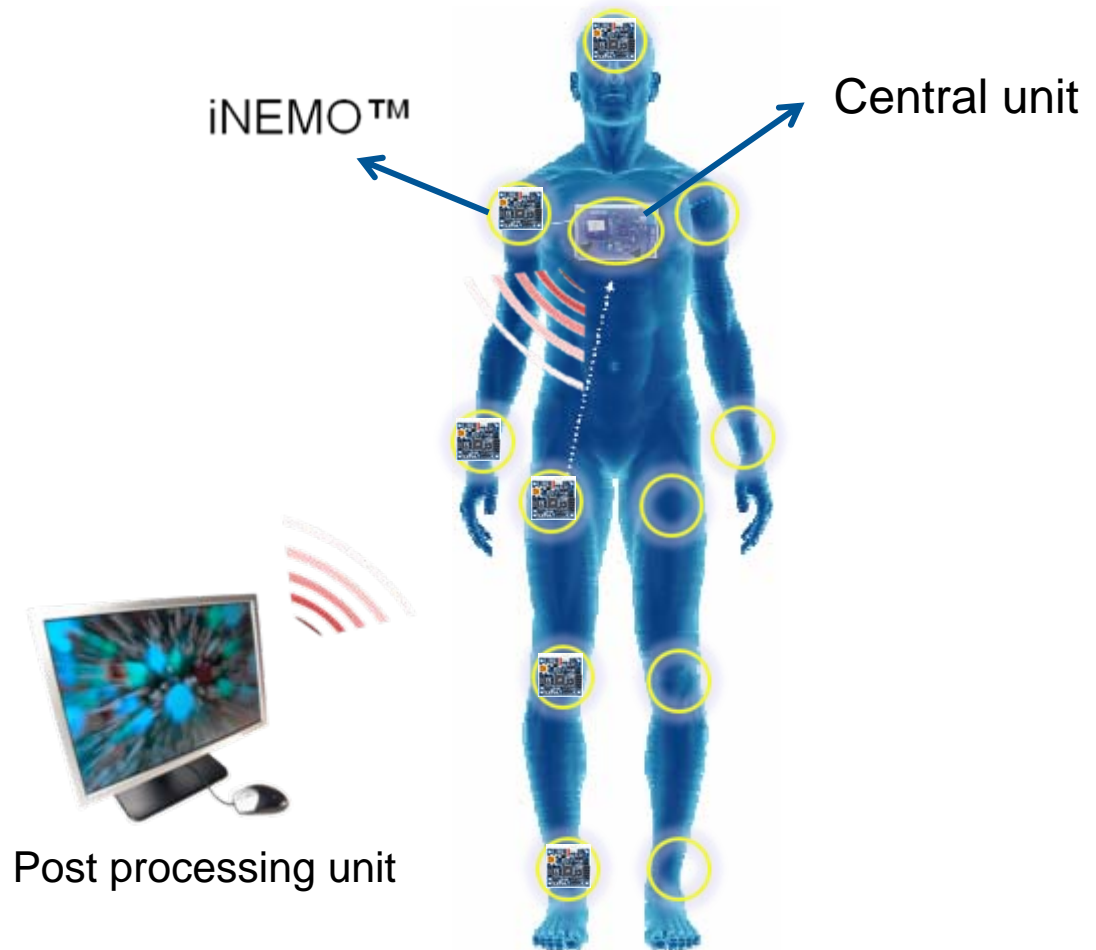
- Motion tracking for yaw, roll and pitch rotation

### Magnetometers

- Correct orientation in space

### Accelerometers

- Adding enhanced user movement feedback

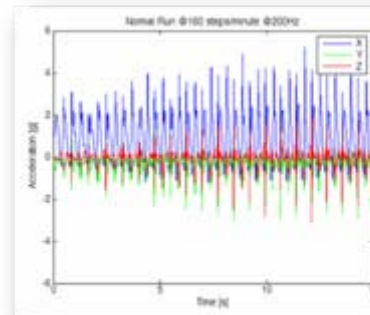


iNEMO™ V1/V2 platforms application example (no dedicated software/firmware available). For further details, please refer to ST on-line support.

The accelerometer provides pedometer data, with high accuracy, for post processing.

## Accelerometers

- High accuracy for user movement feedback and counting



Step count

Speed

Distance

Calories

***!***NEMO™ V1/V2 platforms application example (no dedicated software/firmware available). For further details, please refer to ST on-line support.

# Further information



## **iNEMO™ web pages and technical support**

iNEMO-V2 STEVAL-MKI062V2: [www.st.com/inemo](http://www.st.com/inemo)

iNEMO-V1 STEVAL-MKI062V1: [www.st.com/internet/evalboard/product/246340.jsp](http://www.st.com/internet/evalboard/product/246340.jsp)

(for technical support, click on  icon available in the above web pages)

## **Resources**

Video: <http://www.st.com/internet/com/support/edemoroom.jsp>

## **Communities and FAQ at my.st.com:**

STe2e communities:

<https://my.st.com/public/STe2ecomunities/mcu/Lists/STM32F%20MEMS%20%20iNEMO/AllItems.aspx>

FAQ: <https://my.st.com/public/FAQ/faq.aspx?level=3&objectid=1116&type=product>

[www.st.com](http://www.st.com)