Sensor & motion algorithm
software pack for STM32Cube

POSITION TRACKING

ACTIVITY TRACKING
FOR WRIST DEVICES

ACTIVITY TRACKING FOR
MOBILE DEVICES

CALIBRATION
ALGORITHMS
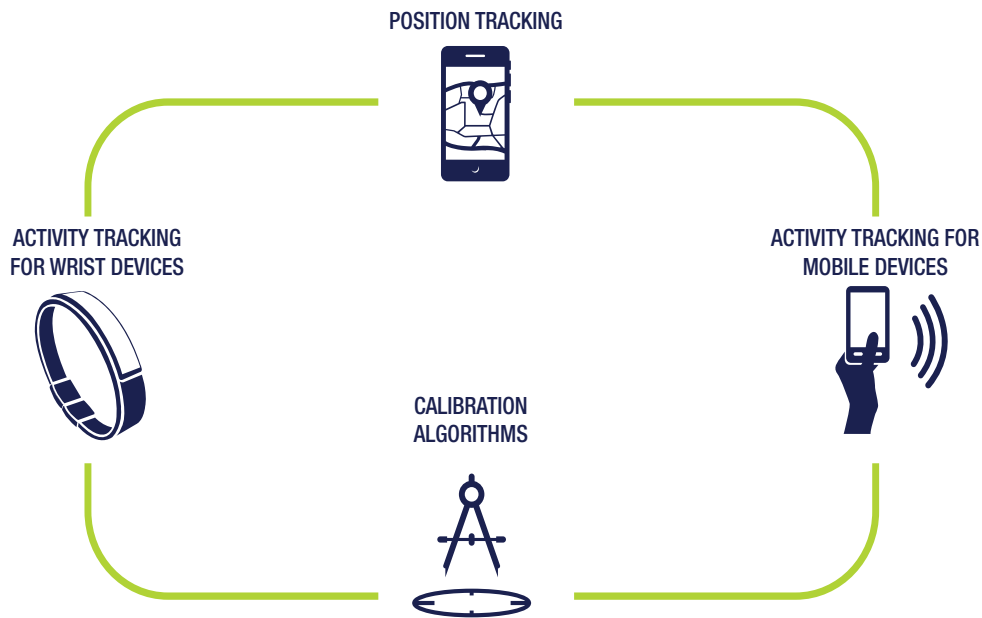
Complete motion sensor and environmental software libraries with example code and sample applications for STM32 development ecosystem

The sensor solution libraries included in the X-CUBE-MEMS1 software expansion offer developers a useful tool to rapidly develop and evaluate applications based on real-time data from ST's MEMS sensors.

Built on STM32Cube software technology for ease of portability across different STM32 microcontroller series, the expansion software package provides advanced motion libraries for microcontrollers based on ARM Cortex-M3, M4 and M0+ architecture and also sample applications prepared for STM32 Nucleo-64 development boards with high-performance STM32F4 MCU or ultra-low-power STM32L0, STM32L1, STM32L4 MCU.

X-CUBE-MEMS1 includes also Low Level and High Level drivers, BSP layer for motion, temperature, humidity and pressure sensors.

KEY FEATURES

- Complete software and example code for building applications with ST's innovative inertial and environmental sensors
- Advanced motion libraries (with sample applications available for NUCLEO-F401RE, NUCLEO-L476RG, NUCLEO-L152RE, NUCLEO-L073RZ)
- Compatible with the Unicleo-GUI graphical user interface to configure and display outputs from sensor and algorithm in real time
- Easy portability across different MCU families, thanks to STM32Cube development ecosystem
- Free, user-friendly license terms

The X-CUBE-MEMS1 contains following advanced motion libraries:

| Action	Library	Description	MEMS sensor	Application
	MotionAC accelerometer calibration	Calibrates the accelerometer in real time. The library acquires data from the accelerometer and calculates the offset and scale factor coefficients together with the calibration quality value.	Accelerometer	-
	MotionAR activity recognition	Provides real-time information on the type of activity performed by the user including stationary, walking, fast walking, jogging, biking, or driving.	Accelerometer	Phone
	MotionAT active time	Based on type of activity, detects motion intensity and pedometer data in real time using wrist algorithms to determine the number of active seconds.	Accelerometer	Wearables
	MotionAW activity recognition for wrist	Provides real-time information on the type of activity performed by the user including stationary, standing, sitting, lying, walking, fast walking, jogging, or biking.	Accelerometer	Wearables
	MotionCP carrying position	Provides real-time information about how the user is carrying a device (e.g. cell phone). It is able to distinguish the following positions: on desk, in hand, near head, shirt pocket, trouser pocket, swinging arm and jacket pocket.	Accelerometer	Phone
	MotionEC eCompass	Provides real-time information about the device orientation and movement: device orientation (quaternions, Euler angles), device rotation (virtual gyroscope functionality), gravity vector and linear acceleration.	Accelerometer and Magnetometer	-
	MotionFA fitness activities	Provides real-time information about the repetition quantity of various fitness activities performed by a user.	Accelerometer and Pressure Sensor	Wearables
	MotionFD fall detection library	Provides real-time information about user fall events. It is able to distinguish if the user fell or not.	Accelerometer and Pressure Sensor	Wearables
	MotionFX sensor fusion	Provides real-time motion-sensor data from the accelerometer, gyroscope (6-axis fusion) and magnetometer (9-axis fusion) and provides real-time motion-fusion sensing. It also performs gyroscope bias and magnetometer hard iron calibration.	Accelerometer, Magnetometer and Gyroscope	-
	MotionGC gyroscope calibration	Used to calibrate the gyroscope in real time using angular zero-rate level coefficients (offset). The gyroscope sensor can have significant offset, which can cause problems when using the gyroscope output data. The MotionGC library is able to minimize the offset and solve this issue.	Accelerometer and Gyroscope	-
	MotionGR gesture recognition	Provides real-time information about the gesture just performed by the user with the device, such as a cell phone, including pick-up, glance, wake up.	Accelerometer	Phone
	MotionID motion intensity detection	Provides real-time information about the user motion intensity. It is able to distinguish motion intensity in a range from 0 (still) to 10 (sprinting).	Accelerometer	Wearables

	MotionMC magnetometer calibration	Used to calibrate the magnetometer in real time using hard iron (HI) and scale factor coefficients.	Magnetometer	-
	MotionPE pose estimation	Provides real-time information about the user current pose such as sitting, standing and lying down.	Accelerometer	Wearables
	MotionPW pedometer for wrist	Provides real-time information about the number of steps and cadence which the user just performed wearing the device on the wrist (e.g. a smart watch).	Accelerometer	Wearables
	MotionPM pedometer for mobile	Provides real-time information about the number of steps and cadence just performed by the user carrying the device, such as a cell phone.	Accelerometer	Phone
	MotionSD standing and sitting desk detection	Provides real-time information about the user working mode: sitting at the desk or standing desk position.	Accelerometer	Wearables
	MotionSM sleep monitoring	Provides real-time information if the man wearing the device is sleeping or not.	Accelerometer	Wearables
	MotionTL tilt sensing	Provides real-time information about the tilt angles of the user carrying the device, i.e. cell phone. The library is also able to perform 6-position accelerometer calibration.	Accelerometer	-

For quick and easy testing, the X-CUBE-MEMS1 contains examples to test sensor's features and sample applications for libraries. These examples and application are available in source code with projects for most common IDE. Already compiled binaries are available for even easier testing. The samples and application are prepared for following STM32 MCU Nucleo boards and X-NUCLEO-IKS01A2 Motion MEMS and environmental sensor expansion board.

X-NUCLEO-IKS01A2

- LSM6DSL MEMS 3D accelerometer and 3D gyroscope
- LSM303AGR MEMS 3D accelerometer and MEMS3D magnetometer
- LPS22HB MEMS pressure sensor, absolute digital output barometer
- HTS221: capacitive digital relative humidity and temperature
- DIL24 socket for additional MEMS adapters and other sensors
- I2C sensor hub features on LSM6DSL available
- Compatible with STM32 Nucleo boards
- Equipped with Arduino UNO R3 connector
- RoHS compliant
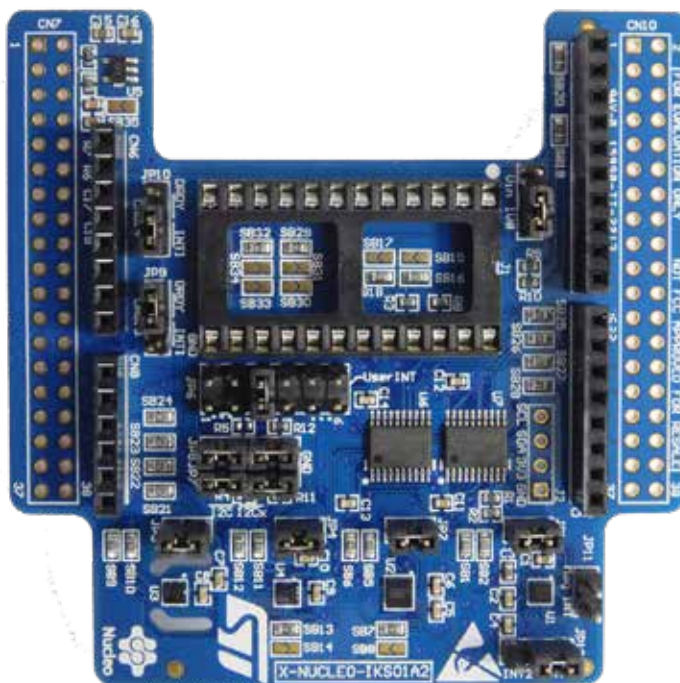
STM32 MCU NUCLEO

- NUCLEO-F401RE
  STM32F401RE (ARM Cortex-M4)
- NUCLEO-L476RG
  STM32L476RG (ARM Cortex-M4)
- NUCLEO-L152RE
  STM32L152RE (ARM Cortex-M3)
- NUCLEO-L073RZ
  STM32L073RZ (ARM Cortex-M0+)

To learn more and to download the X-CUBE-MEMS1 Sensor and motion algorithm software expansion pack for STM32Cube, visit:
https://www.st.com/en/embedded-software/x-cube-mems1.html
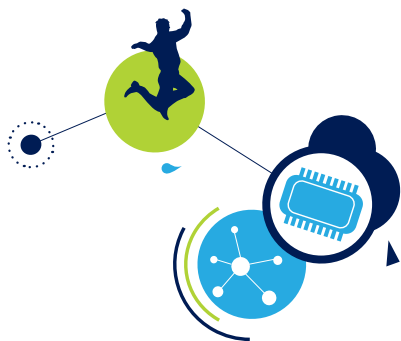
X-CUBE-MEMS-XT1

Sensor and DSP algorithm expansion software pack for STM32Cube

X-CUBE-MEMS-XT1 package is designed to support devices connected via the DIL24 socket on one of the compatible X-NUCLEO-IKS01Ax expansion boards. X-CUBE-MEMS-XT1 includes drivers for following sensors A3G4250D, AIS328DQ, AIS3624DQ, H3LIS331DL, HTS221, IIS2DLPC, IIS2MDC, ISM303DAC, ISM330DLC, LIS2DH12, LIS2DW12, LIS2MDL, LIS3MDL, LPS22HB, LPS22HH, LPS25HB, LPS33HW, LSM303AGR, LSM6DS0, LSM6DS3, LSM6DSL and LSM6DSR devices.

Application	Applications
Middleware	FFT
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)
Hardware	STM32 Nucleo expansion boards X-NUCLEO-IKS01A2
	STM32 Nucleo development board NUCLEO-F401RE NUCLEO-L476RG

KEY FEATURES

- Complete software to build applications using temperature and humidity sensors HTS221, pressure sensor LPS22HB and motion sensors LSM303AGR and LSM6DSL, as per X-CUBE-MEMS1

- In addition, the sensors available through the DIL24 adapter are supported

- Easy portability across different MCU families thanks to STM32Cube

- Free user-friendly license terms

- Three sample implementations to transmit real time sensor data to a PC including the Unicleo-GUI application and terminal application support

- Integrated Fast Fourier Transform (FFT) algorithm for vibration analysis

- Sample implementation of extended features like FIFO usage, detection of 6D orientation, free-fall, pedometer, single/double tap, tilt, wake-up, sensor hub and self-test
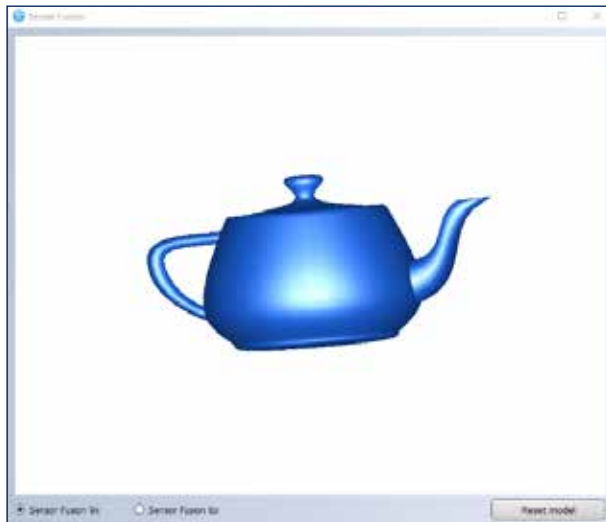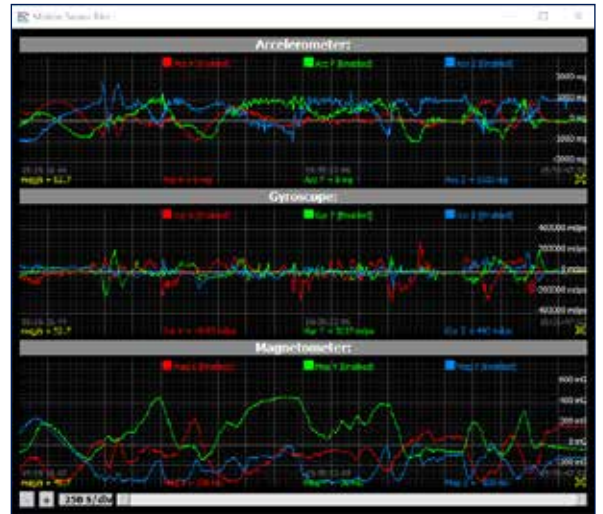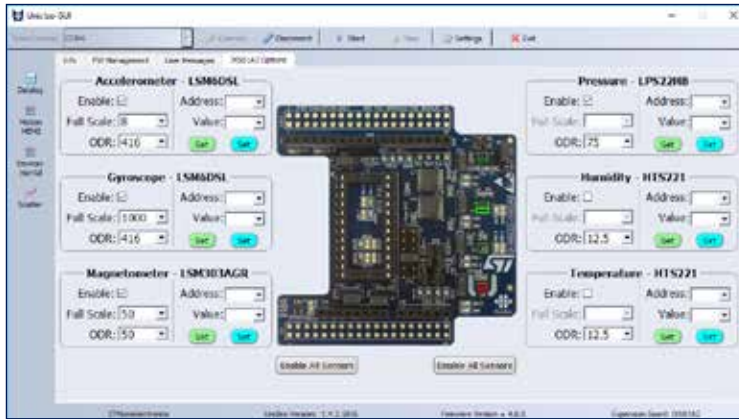
To learn more and to download the X-CUBE-MEMS-XT1 Sensor and DSP algorithm expansion software pack for STM32, visit:
https://www.st.com/en/embedded-software/x-cube-mems-xt1.html

UNICLEO-GUI

Graphical user interface for X-CUBE-MEMS1 and X-CUBE-MEMS-XT1 expansion software and STM32 Nucleo expansion boards (X-NUCLEO-IKS01A2).

Unicleo-GUI is designed to demonstrate and evaluate ST MEMS sensors and algorithms. Sample applications and examples available in X-CUBE-MEMS1 and X-CUBE-MEMS-XT1 cooperate with Unicleo-GUI. The application offers various display formats to show output data from sensors and algorithms. Sensor configuration can be also adjusted by using this tool. Unicleo-GUI is able to cooperate with firmware created by AlgoBuilder application, which is tool for graphical design of custom algorithms.

Watch our featured Getting Started video to learn more about the Unicleo graphical user interface.
https://youtu.be/45baO5Lxv-o
https://youtu.be/sdnJNdpMDrM
https://youtu.be/WoSqZhmIkbs

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