


Sensor and motion algorithm software expansion for STM32Cube

Application	Applications
Middleware	MotionAC
	MotionAD
	MotionAR
	MotionAT
	MotionAW
	MotionCP
	MotionDI
	MotionEC
	MotionFA
	MotionFD
MotionFX	
MotionGC	
MotionGR	
MotionID	
MotionMC	
MotionPE	
MotionPM	
MotionPW	
MotionSD	
MotionSM	
MotionSP	
MotionTL	
MotionVC	
InfraredPD	
Hardware Abstraction	STM32Cube Hardware Abstraction Layer (HAL)
Hardware	STM32 Nucleo expansion boards X-NUCLEO-IKS01A3 (Sense) X-NUCLEO-IKS02A1 (Sense) X-NUCLEO-IKS4A1 (Sense)
	STM32 Nucleo development board

 Magnetometer Calibration  Gyroscope Calibration  Accelerometer Calibration	 Inertial Algorithms  FFT & Vibration Monitoring  Presence Detection
 Sensor Fusion  eCompass  Tilt Sensing  Vertical Context  Airplane Detection  Dynamic Inclination	 Activity Tracking for Mobile Devices  Activity Recognition  Carry Position  Gesture Recognition  Pedometer  Fall Detection
 Activity Tracking for Wearable Devices  Activity Recognition for Watch  Pose Estimation  Motion Intensity Detection  Standing vs Sitting Detection  Fitness Activities  Active Time  Pedometer  Sleep Monitoring	



Features

- Complete software to build applications using the following sensors:
 - motion sensors: A3G4250D, AIS2DW12, AIS2IH, AIS328DQ, AIS3624DQ, ASM330LHH, ASM330LHHX, H3LIS331DL, IIS2DLPC, IIS2ICLX, IIS2MDC, IIS3DWB, ISM303DAC, ISM330DHCX, ISM330DLC, LIS2DH12, LIS2DTW12, LIS2DU12, LIS2DW12, LIS2MDL, LIS3MDL, LSM303AGR, LSM6DSL, LSM6DSO, LSM6DSO32, LSM6DSO32X, LSM6DSOX, LSM6DSR, LSM6DSRX, LSM6DSV16BX, LSM6DSV16X, LSM6DSO16IS
 - pressure sensors: ILPS22QS, ILPS28QSW, LPS22CH, LPS22DF, LPS22HB, LPS22HH, LPS27HHTW, LPS28DFW, LPS33HW, LPS33K
 - infrared sensor: STHS34PF80
 - temperature and humidity sensors: HTS221, STTS22H, STTS751
 - audio sensor: IMP34DT05
 - X-NUCLEO-IKS4A1 expansion board with onboard LSM6DSV16X, LSM6DSO16IS, LIS2DUXS12, LIS2MDL, LPS22DF and STTS22H sensors
 - X-NUCLEO-IKS01A3 expansion board with onboard LSM6DSO, LIS2DW12, LIS2MDL, LPS22HH, STTS751 and HTS221 sensors
 - X-NUCLEO-IKS02A1 expansion board with onboard ISM330DHCX, IIS2DLPC, IIS2MDC and IMP34DT05 sensors
- Several examples to show the innovative inertial and environmental sensors
- Sample application to transmit real-time sensor data to a PC
- Compatible with the [Unicleo-GUI](#) graphical user interface to display sensor data and configure outputs
- Sample implementation available on the X-NUCLEO-IKS4A1/X-NUCLEO-IKS01A3/X-NUCLEO-IKS02A1 boards connected to a NUCLEO-F401RE, NUCLEO-L152RE, NUCLEO-U575ZI-Q, or NUCLEO-L073RZ development board
- Advanced motion libraries with sample applications
- Package compatible with [STM32CubeMX](#), can be downloaded from and installed directly into [STM32CubeMX](#)
- Easy portability across different MCU families, thanks to [STM32Cube](#)
- Free, user-friendly license terms

Description

The X-CUBE-MEMS1 expansion software package for [STM32Cube](#) runs on the STM32 and includes drivers that recognize the sensors and collect temperature, humidity, pressure, and motion data. The expansion is built on [STM32Cube](#) software technology to ease portability across different STM32 microcontrollers. The software comes with a sample implementation of the drivers running on the X-NUCLEO-IKS4A1/X-NUCLEO-IKS01A3/X-NUCLEO-IKS02A1 expansion boards connected to a featured [STM32 Nucleo](#) development board. The software is also available on [GitHub](#), where the users can signal bugs and propose new ideas through [\[Issues\]](#) and [\[Pull requests\]](#) tabs.

Product summary	
Sensor and motion algorithm software expansion for STM32Cube	X-CUBE-MEMS1
Motion MEMS and environmental sensor expansion board for STM32 Nucleo	X-NUCLEO-IKS4A1/X-NUCLEO-IKS01A3/ X-NUCLEO-IKS02A1
STM32 Nucleo development board	STM32 Nucleo
Applications	Climate control/ Connectivity/ Lighting Controls/ Metering/Sensing/ Smart farming/ Tracking/Virtual - Augmented Reality

The software provides sample applications and advanced motion libraries: MotionAC accelerometer calibration, MotionAD airplane detection, MotionAR activity recognition, MotionAT active time, MotionAW activity recognition for wrist, MotionCP real-time carry position, MotionDI dynamic inclinometer, MotionEC real-time e-compass, MotionFA fitness activity, MotionFD real-time fall detection, MotionFX sensor fusion, MotionGC gyroscope calibration, MotionGR real-time gesture recognition, MotionID motion intensity detection, MotionMC magnetometer calibration, MotionPE real-time pose estimation, MotionPM real-time pedometer library, MotionPW real-time pedometer for wrist, MotionSD standing vs sitting desk detection, MotionTL tilt measurement, MotionVC vertical context, InfraredPD presence and motion detection libraries.

1 Detailed description

1.1 What is STM32Cube?

STM32Cube is a combination of a full set of PC software tools and embedded software blocks running on STM32 microcontrollers and microprocessors:

- **STM32CubeMX** configuration tool for any STM32 device; it generates initialization C code for Cortex-M cores and the Linux device tree source for Cortex-A cores
- **STM32CubeIDE** integrated development environment based on open-source solutions like Eclipse or the GNU C/C++ toolchain, including compilation reporting features and advanced debug features
- **STM32CubeProgrammer** programming tool that provides an easy-to-use and efficient environment for reading, writing and verifying devices and external memories via a wide variety of available communication media (JTAG, SWD, UART, USB DFU, I2C, SPI, CAN, etc.)
- **STM32CubeMonitor** family of tools (**STM32CubeMonRF**, **STM32CubeMonUCPD**, **STM32CubeMonPwr**) to help developers customize their applications in real-time
- **STM32Cube MCU and MPU packages** specific to each STM32 series with drivers (HAL, low-layer, etc.), middleware, and lots of example code used in a wide variety of real-world use cases
- **STM32Cube expansion packages** for application-oriented solutions.

1.2 How does this software complement STM32Cube?

This software is based on the STM32CubeHAL hardware abstraction layer for the STM32 microcontroller.

The package extends **STM32Cube** by providing a board support package (BSP) for the sensor expansion board. The drivers abstract the hardware low-level details and allow the applications to access sensor data in a hardware-independent manner.

The package includes several sample applications that the developer can use to start experimenting with the code. A sample application has been developed to enable sensor data logging on a PC; a Windows PC utility (**Unicleo-GUI**) is available on www.st.com, to allow the developer choose among various sensors available on the expansion board and set the appropriate delay/interval among consecutive data points.

Sensor data can be logged to a file selected by the user.

The package is compatible with **STM32CubeMX**. It can be downloaded from and installed directly into **STM32CubeMX**, as detailed in UM1718 (freely available on www.st.com).

Revision history

Table 1. Document revision history

Date	Revision	Changes
07-Nov-2014	1	First release.
19-Dec-2014	2	Modified the document title, features, and description text on the cover page. Added Section 1: Detailed description.
17-Jun-2015	3	Updated: Title on the cover page.
20-Oct-2015	4	Updated: Overall system architecture, features and description on the cover page.
21-Dec-2015	5	Updated cover image
22-Dec-2015	6	Updated How does this software complement STM32Cube?
04-Nov-2016	7	Updated cover image Updated hardware compatibility information for X-NUCLEO-IKS01A2 expansion board and associated sensors.
20-Mar-2017	8	Updated cover image, features, description and How does this software complement STM32Cube?
20-Sep-2017	9	Updated cover page image and description.
14-Nov-2017	10	Updated cover page title.
09-Jul-2018	11	Updated cover page image, features, and description.
20-Dec-2018	12	Updated cover page features and Section 1.2 How does this software complement STM32Cube?
18-Feb-2019	13	Updated cover page image. Added X-NUCLEO-IKS01A3 expansion board compatibility information.
05-Jun-2019	14	Updated cover page image, features and description.
25-Nov-2019	15	Updated cover page image, product summary table, features and description. Updated Section 1.1 What is STM32Cube?. Added X-NUCLEO-IKS02A1 expansion board compatibility information.
14-May-2020	16	Updated cover page image. Added references to MotionAD and MotionDI libraries.
23-Jul-2020	17	Updated cover page features and description. Added references to LPS33K MEMS pressure sensor and IIS2ICLX digital inclinometer.
14-Jan-2022	18	Added link to GitHub in the description.
04-Nov-2022	19	Replaced NUCLEO-L476RG with NUCLEO-U575ZI-Q.
02-Feb-2023	20	Added new sensors: LSM6DSV, LSM6DSV16B, LIS2DUX12, LIS2DUXS12 and SHT40AD1B.
27-Jul-2023	21	Updated cover image and description. Added new sensor: STHS34PF80.
17-Oct-2023	22	Added X-NUCLEO-IKS4A1 expansion board compatibility information.

IMPORTANT NOTICE – READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgment.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. For additional information about ST trademarks, refer to www.st.com/trademarks. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.

© 2023 STMicroelectronics – All rights reserved