LSM6DSOX
iNEMO* inertial module

Evaluation tools and GUI for Machine Learning

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LSM6DSOX quick prototype

Two solutions to capture and process data

STM32 Nucleo with Expansion board tool & Unicleo GUI

STM32 NUCLEO* with EXPANSION
X-NUCLEO-IKS01A13

DIL24 adapter board
LSM6DSOX STEVAL-MKI197V1

SensorTile.box

Software packages:
- UNICLEO GUI with X-CUBE-MEMS1
- AlgoBuilder
- Unico-GUI for MLC development

* Refer to product specification: NUCLEO-F401RE, NUCLEO-L152RE, NUCLEO-L476RG, NUCLEO-L073RZ

SensorTile.box

STEVAL-MKSBOX1V1

Software packages:
- STBLESensor mobile app
- UNICLEO GUI
- AlgoBuilder
- UNICO GUI for MLC development
LSM6DSOX performance evaluation

Form Factor Tool & GUI to capture and process data

Professional MEMS motherboard
STEVAL-MKI109V3

Evalulation board (adapter)
DIL24 adapter board
STEVAL-MKI197V1

Software package:
UNICO-GUI

Linux  STSW-MKI109L
Mac OS X  STSW-MKI109M
Windows  STSW-MKI109W
LSM6DSOX – SensorTile.box

Capture data
- Accelerometer
- Gyroscope
- External sensors

Label data
- Filters
- Features

Build decision tree
- Classification
- Results

Embed decision tree
- DT implementation

Process new data
- Real-time test

SensorTile.box
- STEVAL-MKSBOX1V1

WHAT

SensorTile.box

No USB cable:
- STBLESensor

With USB cable:
- FP-SNS-STBOX1
- Unicleo GUI
- AlgoBuilder

Unico GUI *

*External tools for building decision tree: Weka, RapidMiner, MATLAB, Python

HOW

HW

No USB cable:
- STBLESensor

With USB cable:
- FP-SNS-STBOX1
- Unicleo GUI
- AlgoBuilder

SW

*Unico GUI

(for advanced level)

(Process new data
- Real-time test

SensorTile.box
- STEVAL-MKSBOX1V1

Unico GUI

(for advanced level)

*External tools for building decision tree: Weka, RapidMiner, MATLAB, Python

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*Unico GUI

(for advanced level)
LSM6DSOX - STM32 Nucleo with expansion board

**WHAT**

- Accelerometer
- Gyroscope
- External sensors

**Capture data**

**Label data**

- Filters
- Features

**Build decision tree**

- Classification
- Results

**Embed decision tree**

- DT implementation

**Process new data**

- Real time test

**HOW**

- STM32 Nucleo board*
  - Expansion board:
    - X-NUCLEO-IKS01A3 Adapter (DIL24)
    - STEVAL-MKI197V1

- Unico GUI
  - X-CUBE-MEMS1 (for advanced level)
  - AlgoBuilder
  - X-CUBE-ALGOBUIDL

**SW**

**Unico GUI**

**External tools for building decision tree:**
- Weka, RapidMiner, MATLAB, Python

**Uni GUI**

- STM32 Nucleo board*
  - Expansion board:
    - X-NUCLEO-IKS01A3 Adapter (DIL24)
    - STEVAL-MKI197V1

- Unico GUI
  - X-CUBE-MEMS1 (for advanced level)
  - AlgoBuilder
  - X-CUBE-ALGOBUIDL

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* NUCLEO-F401RE, NUCLEO-L152RE, NUCLEO-L476RG, NUCLEO-L073RZ
With STM32CubeMX to generate SW support
LSM6DSOX - Professional MEMS tool motherboard

**WHAT**
- Accelerometer
- Gyroscope
- External sensors

**HOW**
- Capture data
- Label data
- Build decision tree
- Embed decision tree
- Process new data

**Unico GUI** *
*External tools for building decision tree: Weka, RapidMiner, MATLAB, Python

**SW**
- Professional MEMS tool motherboard
  - STEVAL-MKI109V3
- Adapter (DIL24)
  - STEVAL-MKI197V1

**HW**
- Professional MEMS tool motherboard
  - STEVAL-MKI109V3
- Adapter (DIL24)
  - STEVAL-MKI197V1

**Features**
- Filters
- Features
- Classification
- Results
- DT implementation
- Real-time test
ST sensor tools
Dataset generation & label

Capture data

b) STM32 Nucleo board with expansion
Unicleo-GUI
(USB cable)
or
AlgoBuilder

Unico-GUI

from Logs in .csv files to .arff file generation

Label data

STEPS
1. Import .csv files in Unico
2. Assign label (class) to the files
3. When all files are imported, start MLC configuration:
sensors setup (ODR, FS, etc), windows length,
filters and features
4. Generation of .arff file

Unico-GUI

STBLESensor or AlgoBuilder

c) Professional MEMS tool motherboard
Unico-GUI
(USB cable)

ST sensor tools
Dataset generation & label
ST sensor tools
Decision tree creation process – build & embed

Build decision tree

Unico-GUI

→ ST MLC development tool

→ MLC development tool

Embed decision tree

Unico-GUI

From .arff file to Decision Tree generation in .txt file
(only for Weka/RapidMiner copy the content in .txt file)

From .txt file to .ucf/.h file generation

STEPS:
1. Import .txt file in Unico
2. Assign values to the classes
3. Meta-classifier configuration (if needed)
4. Generation of .ucf/.h file
ST sensor tools
Real-time test with trained decision tree

- Test the Decision Tree on STM32 Nucleo board with expansion using USB cable
- Test the Decision Tree on Professional MEMS board using USB cable
- PC application for advanced development level
- Mobile app using BLE

Import .ucf file to configure the device
AlgoBuilder is a graphical design tool to build and use algorithms.

AlgoBuilder GUI uses the outputs from MLC and FSM to allow you to build more complex projects.

An existing MLC / FSM configuration (.ucf file) can be implemented.
Explore MLC examples and resources

- Decision tree examples are available online at the dedicated GitHub project for Machine Learning Core

https://github.com/STMicroelectronics/STMems_Machine_Learning_Core
MEMS Machine Learning & AI @ ST Community!
Ask questions, collaborate and share insights!

Join our MEMS and Sensor community and participate in Q&As

Our experts are there to help you!

For questions related to implementing AI in sensors, visit the Q&A section on MEMS Machine Learning & AI
Thank you