DT0011
Design tip

Benefits in using FIFO buffer embedded in ST MEMS sensors

By Petr Stukjunger

Main components	
LIS3DH	Ultra low-power high performance 3-axes “nano” accelerometer
LIS3DSH	Ultra low-power high performance three-axis “nano” accelerometer
L3GD20	Three-axis digital output gyroscope
L3GD20H	Three-axis digital output gyroscope

Purpose and benefits

Most of ST MEMS sensors embed FIFO buffer to store samples. It can offload the microcontroller from reading data with every new sample. Thanks to its different modes of operation there are several other areas where FIFO buffer can be beneficial for applications with ST MEMS sensors.
This document describes how to use embedded FIFO buffer to utilize MEMS sensors in new application areas, e. g. to decrease power consumption, store information about a movement or avoid losing data.

Description

FIFO buffer allows decreasing the host MCU interaction with the sensor and therefore allows system power savings.

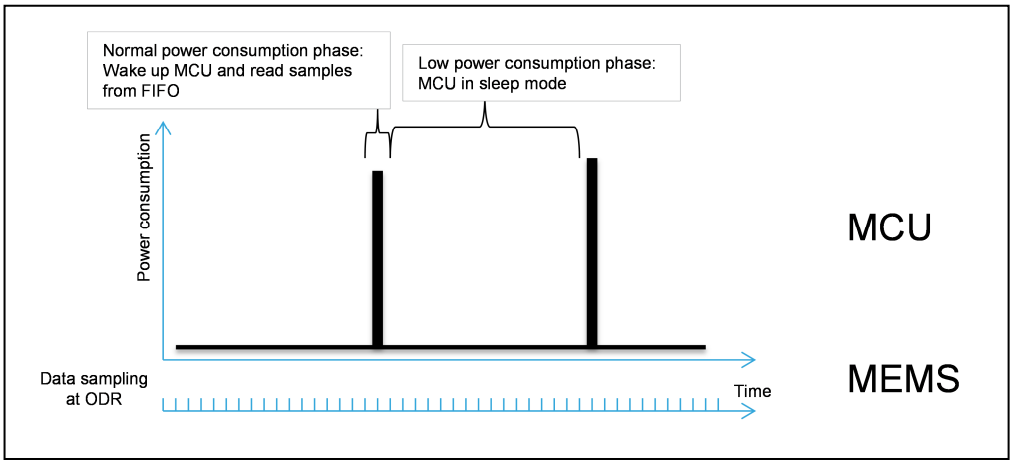
FIFO buffer can work in several different modes of operation for application flexibility reasons: Bypass, FIFO, Stream, Stream to FIFO, Bypass to Stream mode etc.

Events like FIFO programmable watermark level, FIFO overrun and FIFO empty can be enabled to generate interrupts.

Complete sample sets are released from sensor and stored to FIFO at selected output data rate (ODR).

Lowering power consumption – Achieving higher ODR

Figure 1. Lowering power consumption



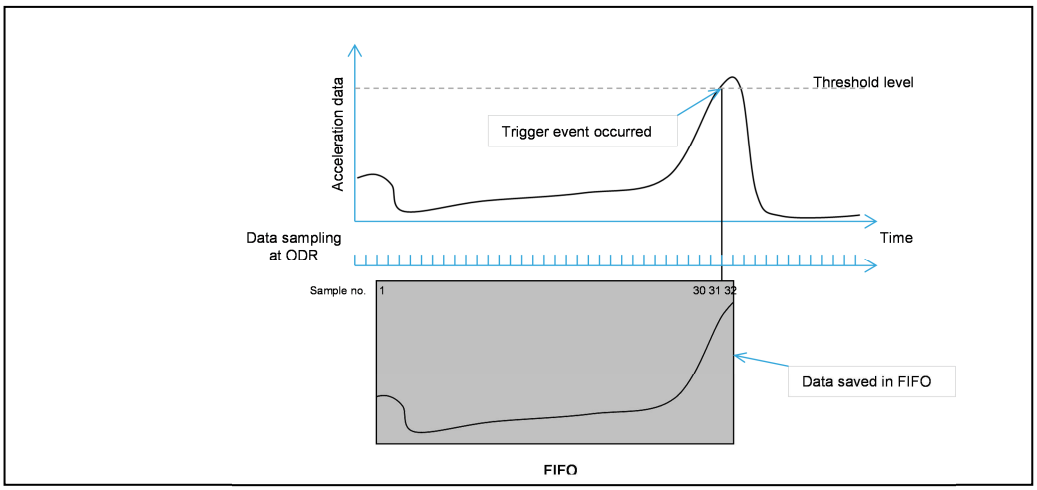
MCU can be put to sleep mode for much longer period of time. MCU does not need to poll for new data frequently, because data is buffered inside the sensor. The same ODR can be achieved with **lower power consumption** or **higher ODR** can be achieved with the same power consumption.

Way of operation:

- Acceleration data is stored in the FIFO without MCU intervention.
- Once FIFO is full, MCU is woken up by interrupt signal coming from sensor.
- Data is read in a single read sequence using address auto-increment.

Saving history of an event

Figure 2. Saving history of an event



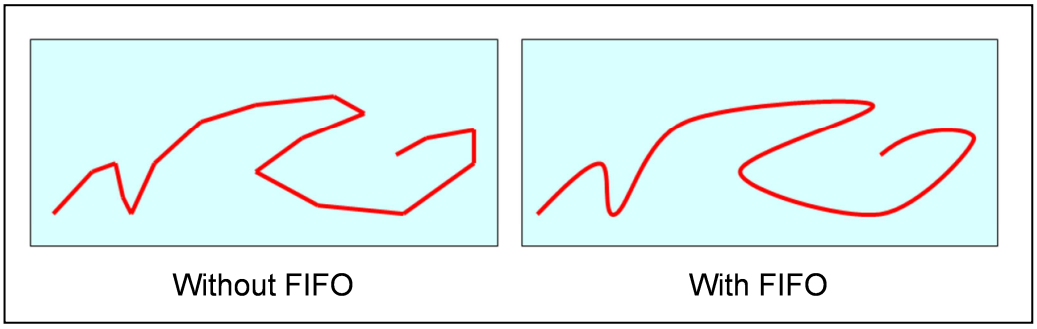
History of an event trigger can be read from the FIFO at any time. After occurrence of the event the FIFO will contain: 30 samples before trigger + trigger sample + 1 sample after trigger.

Way of operation:

- Data is being continuously stored in FIFO.
- When pre-selected trigger occurs, FIFO stops storing new data.

Avoiding data loss – Smooth data capture

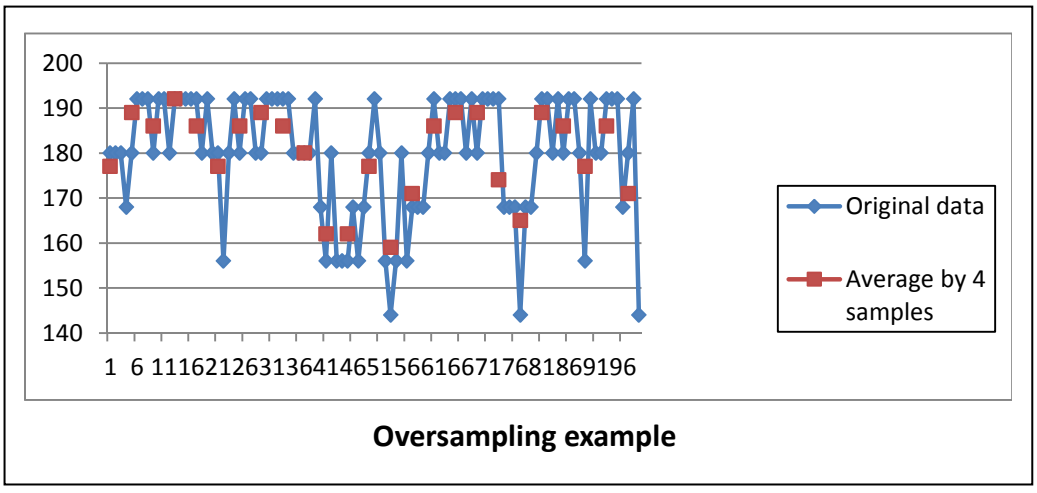
Figure 3. Avoiding data loss – Smooth data capture



When MCU cannot read data at given ODR, MCU would lose data because of other operation. FIFO stores data at ODR and instructs MCU to read data only when FIFO is full or when user-selected watermark level (number of samples) is reached.

Easy data acquisition for filtering or oversampling

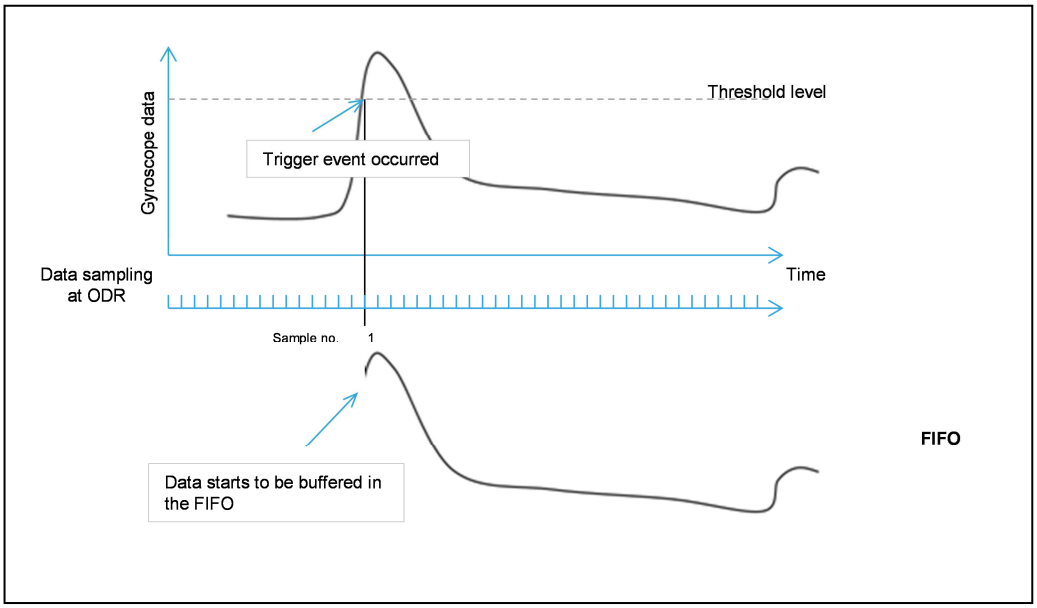
Figure 4. Easy data acquisition for filtering or oversampling



FIFO is being filled until required number of samples is reached and then read in one shot by MCU. For example oversampling for averaging filter: 2^{2n} samples is required to gain n extra bits in resolution.

Start data buffering when needed

Figure 5. Start data buffering when needed



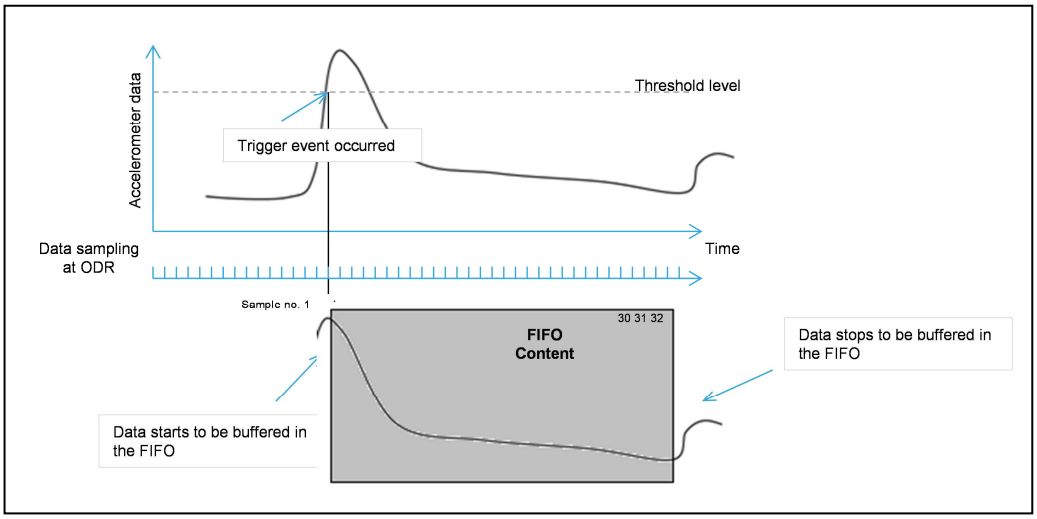
Buffering the sensor data after occurrence of a trigger event

Way of operation

- FIFO starts working in the bypass mode (FIFO is not operational).
- FIFO switches to stream mode when the selected interrupt event occurs.
- Bypass-to-stream mode is used in order to start the FIFO buffering when the configured interrupt is generated.
- When the FIFO is full, next samples overwrite the oldest.

Buffer and store data after an event

Figure 6. Buffer and store data after an event



Buffering the sensor data (up to 32 samples) after occurrence of a trigger event.

Way of operation

- FIFO starts working in the bypass mode (FIFO buffering is not operational).
- FIFO operation switches to FIFO mode when the selected interrupt event occurs.
- Bypass-to-FIFO mode is be used in order to start the FIFO buffering when the configured interrupt is generated.
- When the FIFO is full (32 samples), capturing of samples is stopped

Support material

Related design support material	
STEVAL-MKI109V2	eMotion: ST MEMS adapters motherboard based on STM32. Compatible with all ST MEMS adapters based on STM32F103.
STEVAL-MKI105V1	LIS3DH adapter board for standard DIL 24 socket
STEVAL-MKI134V1	LIS3DSH adapter board for standard DIL24 socket
STEAVL-MKI107V2	L3GD20 adapter board for standard DIL 24 socket
STEVAL-MKI136V1	L3GD20H adapter board for standard DIL 24 socket
Documentation	
Datasheet LIS3DH	MEMS digital output motion sensor ultra low-power high performance 3-axes “nano” accelerometer
Datasheet LIS3DSH	MEMS digital output motion sensor: ultra low-power high performance three-axis “nano” accelerometer
Datasheet L3GD20	MEMS motion sensor: three-axis digital output gyroscope

Related design support material	
Datasheet L3GD20H	MEMS motion sensor: three-axis digital output gyroscope
Application note AN3308	LIS3DH: MEMS digital output motion sensor ultra low-power high performance 3-axis “nano” accelerometer
Application note AN3393	LIS3DSH: 3-axis digital output accelerometer

Revision history

Date	Version	Changes
09-Nov-2013	1	Initial release

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