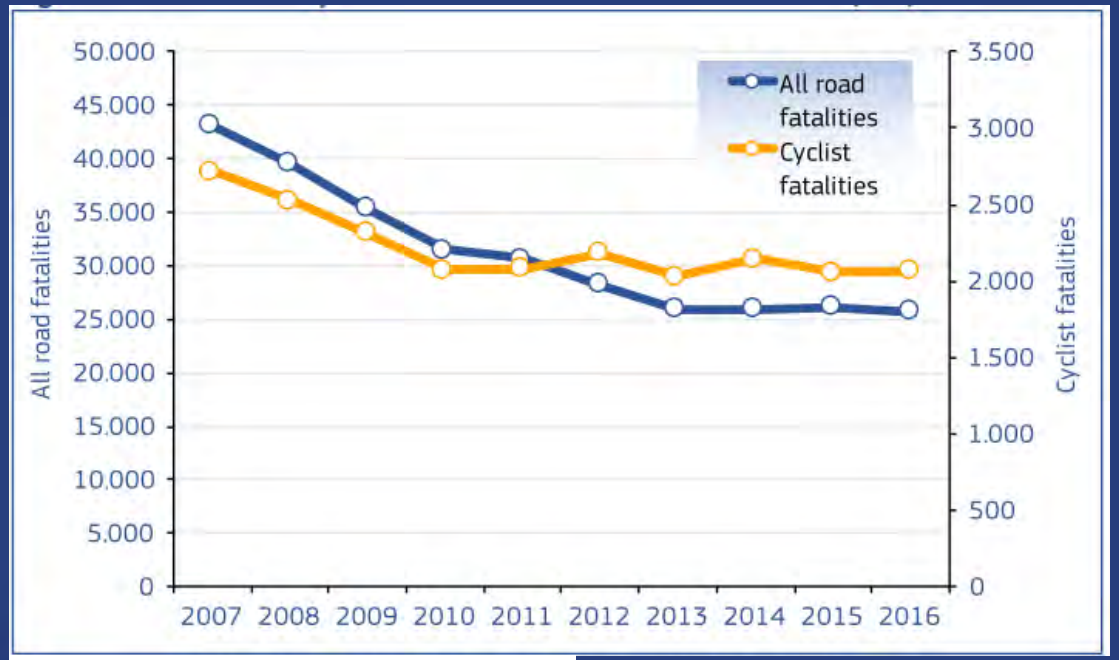
SYSTEM REQUIREMENTS AND DATA TREATMENT FOR CYCLING SAFETY ASSESSMENT WITH PROBE DATA COLLECTION

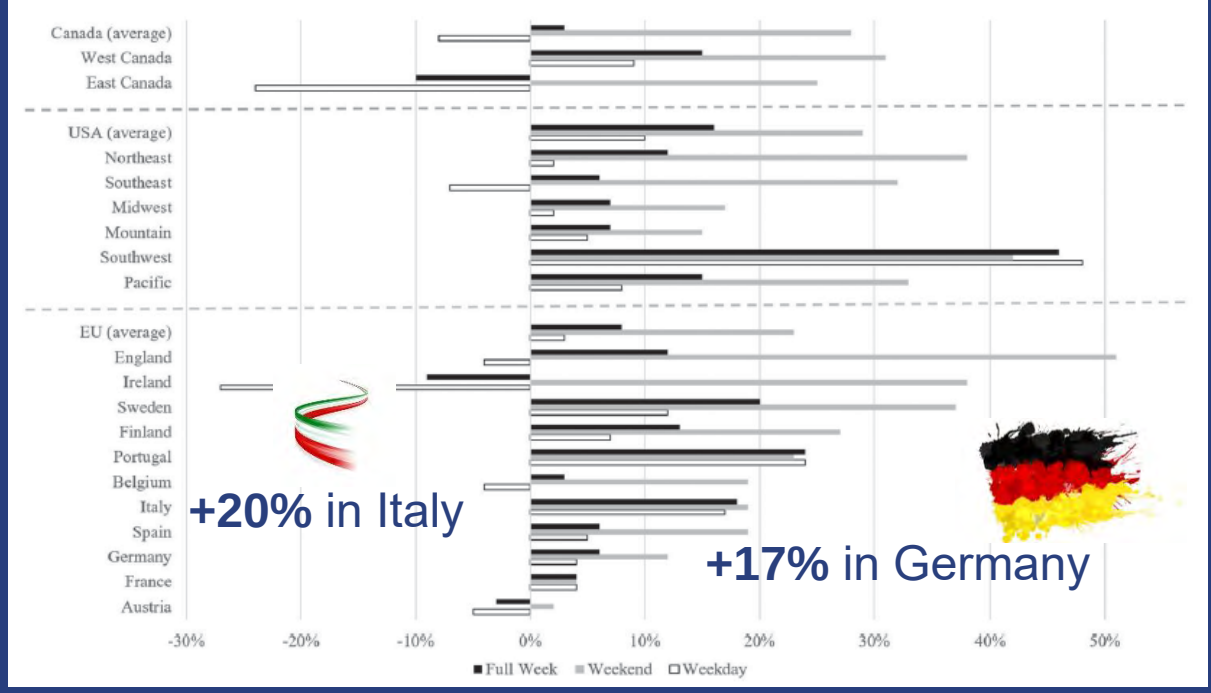
Giuseppina Pappalardo – University of Catania

Cycling safety in number

Cyclists represent 8% of all road deaths in the European Union with about 2,000 fatalities in 2016



Source: CARE database



+20% in Italy

+17% in Germany

Cycling increased significantly from 2019 to 2020, during the COVID-19 period

Problem statement

Non-motorized vehicle based accidents are often not reported to the police, and hence do not appear in official statistics.

Only 50% of traffic accidents in which cyclists are hospitalized are reported in European police data.

Source: Laureshyn et al., 2018

Observational studies usually do not suffer from such bias and the traffic conflict technique (TCT) which is a promising methodology of field observations to quantitatively describe the interactions between road users those are involved in a critical event for safety, not only in the occurrence of a crash.

Safety Critical Events (SCEs)

Research questions

- *What equipment can provide suitable measures and data?*

In cycling **GPS data** was only used to determine the model of cyclists' route.

Two types of limitations:

1. aggregated information
2. sampling frequency

GPS data are sampled from three up to five seconds to minimize their dimension for the storage requirements

not **suitable** for

Safety Critical Events detection

Method

- *What equipment can provide suitable measures and data?*

Instrumented Probe Bicycle

GPS: Frequency of 10Hz

Video VBOX Lite

GPS: Frequency of 1 Hz

Smartphone

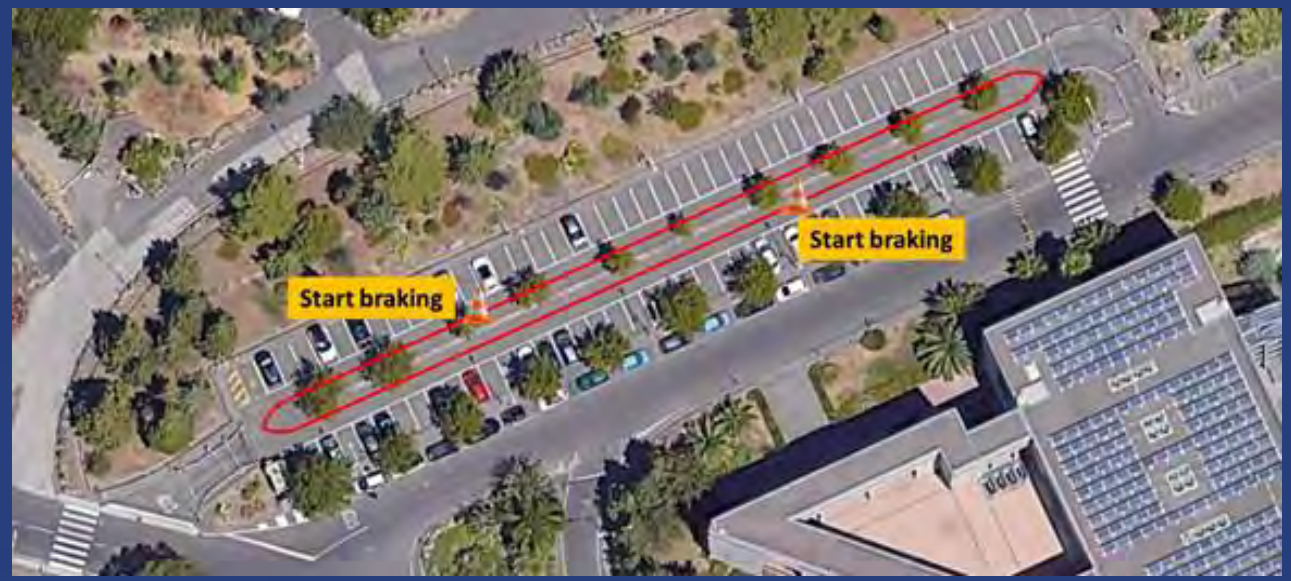
Acceleration: Frequency of 50 Hz

Smartphone

Speedmeter (as reference)

Method

- *What equipment can provide suitable measures and data?*

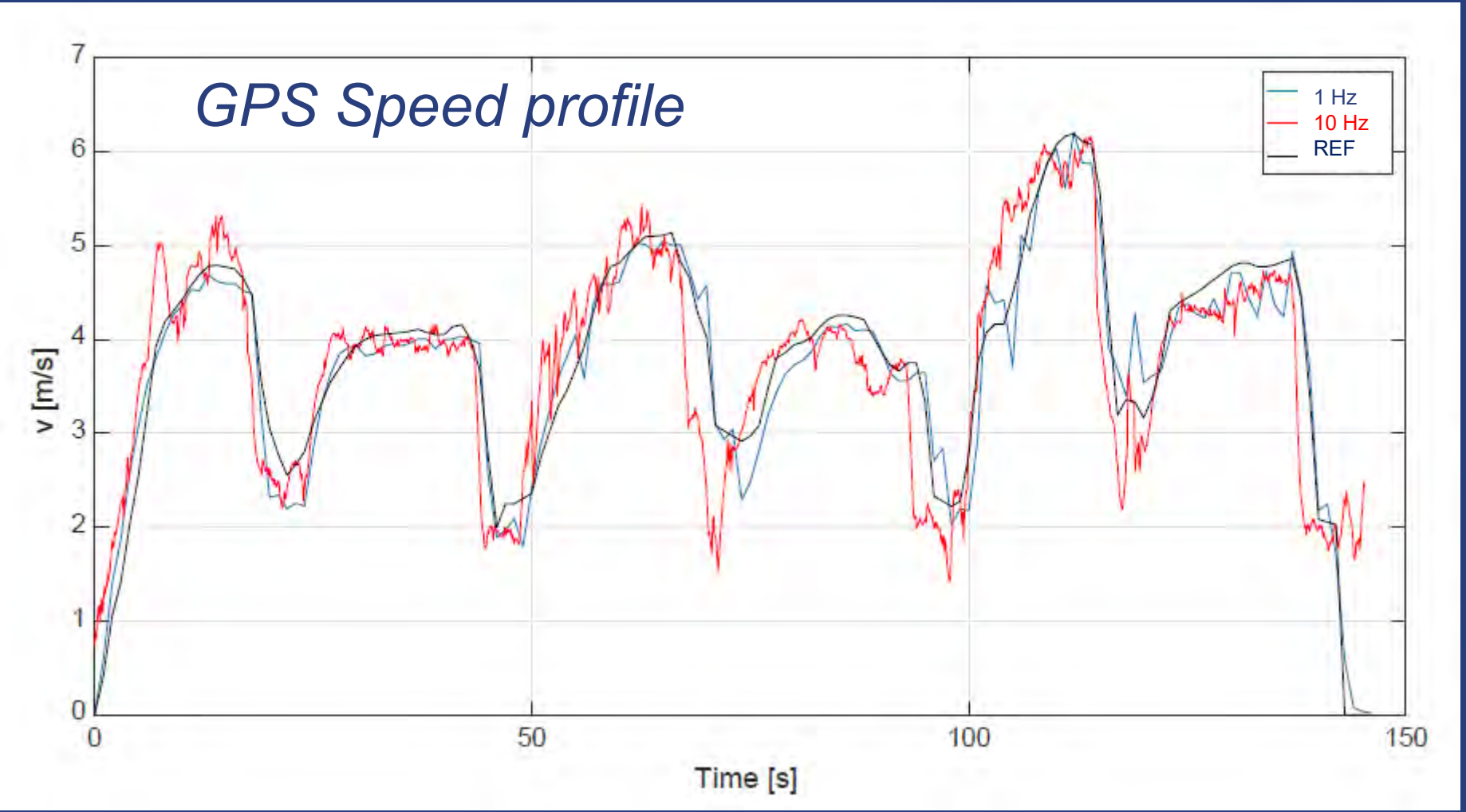


A test was carried out in a close route with an approximate length of 300m in the University of Catania's campus.

During the experiment, the test cyclist was instructed ride at different speeds, applying braking maneuvers with different deceleration rates.

Research questions

- *How to handle the noise induced in the sensor's signals?*



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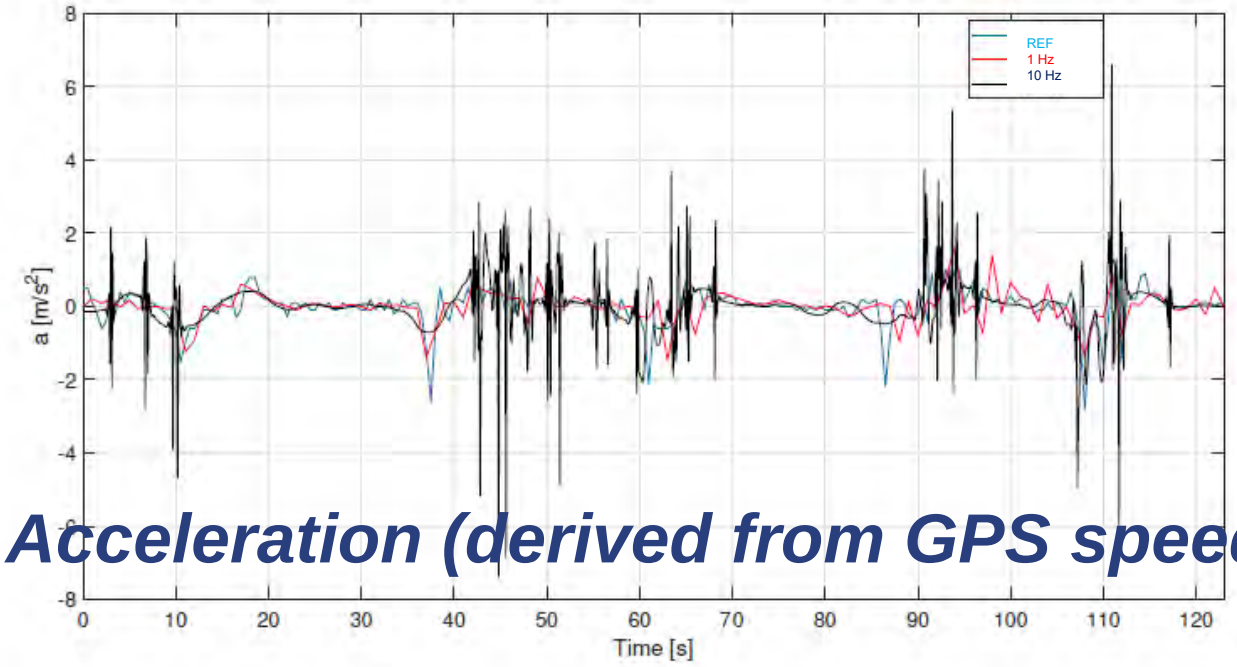
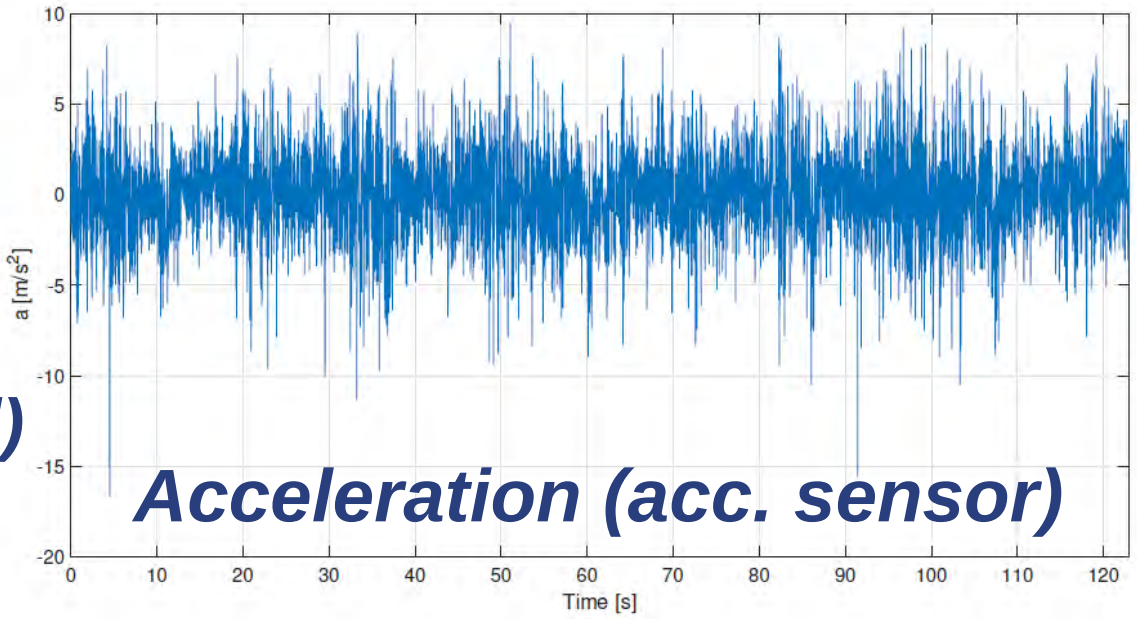


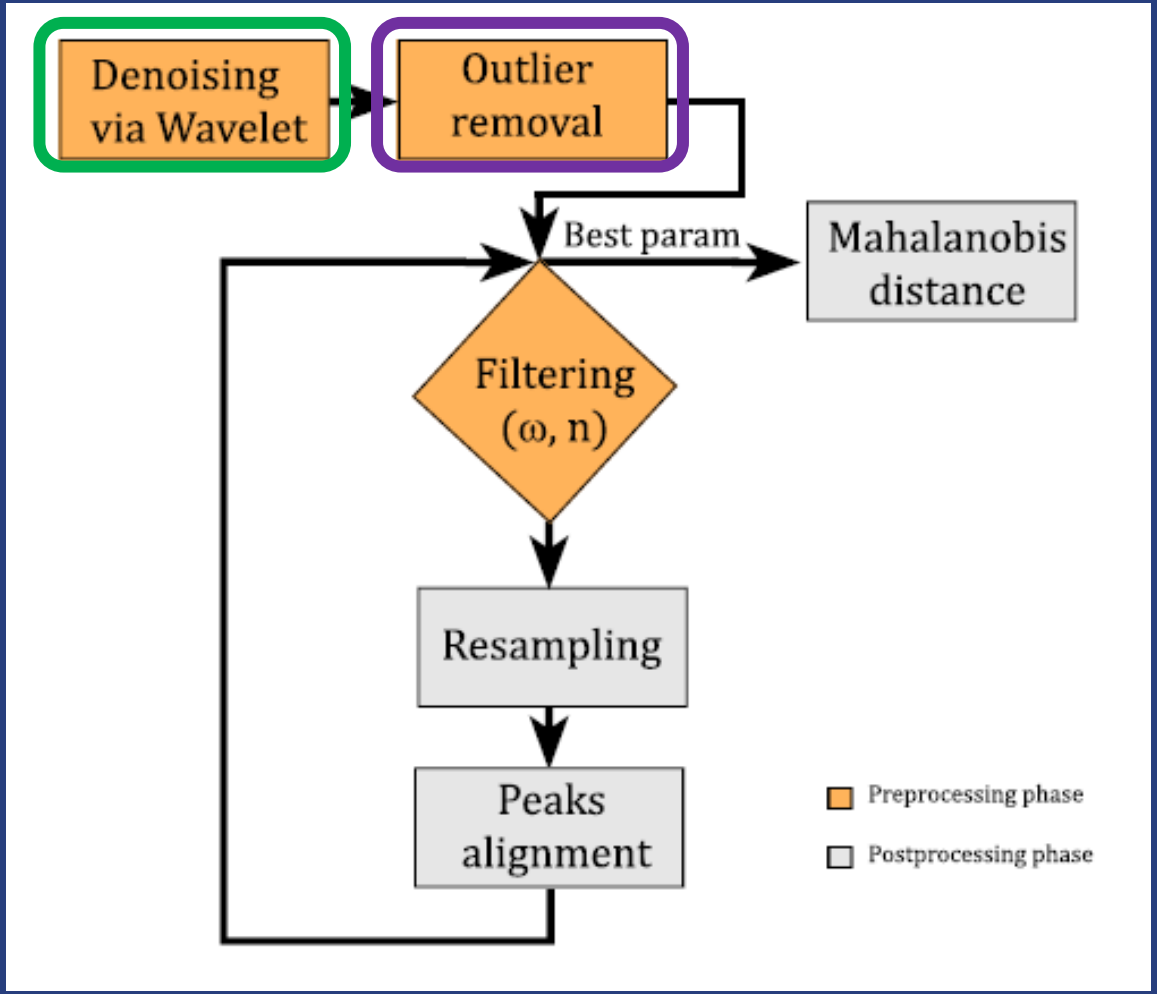
Acceleration (derived from GPS speed)



Acceleration (acc. sensor)

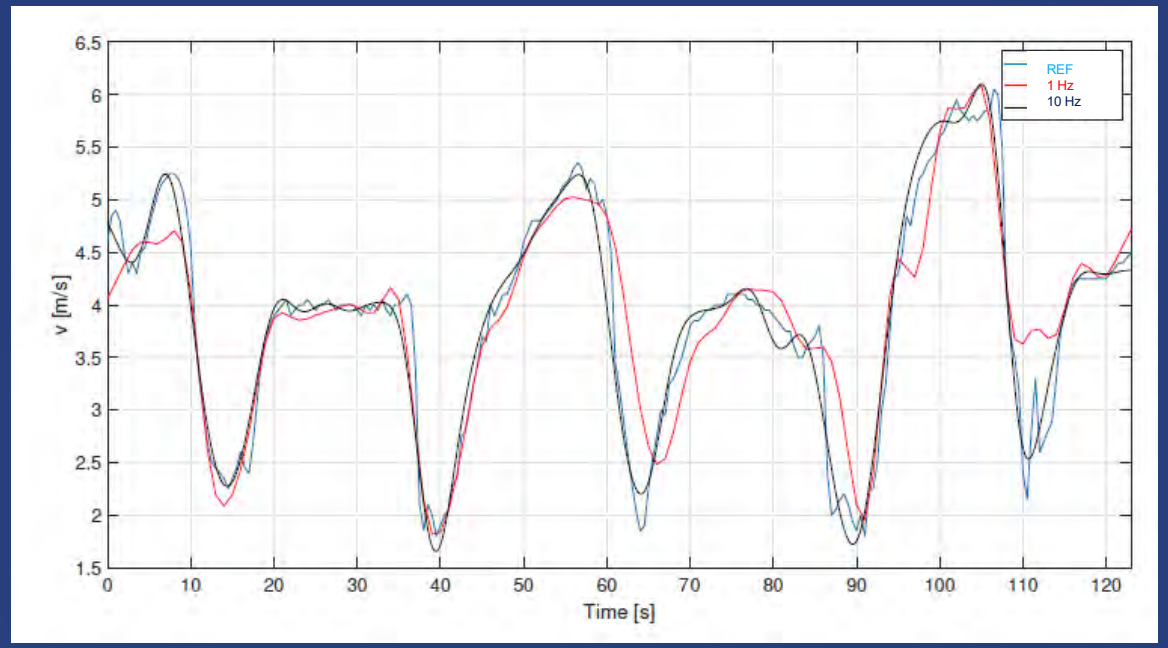
Method

- *How to handle the noise induced in the sensor's signals?*

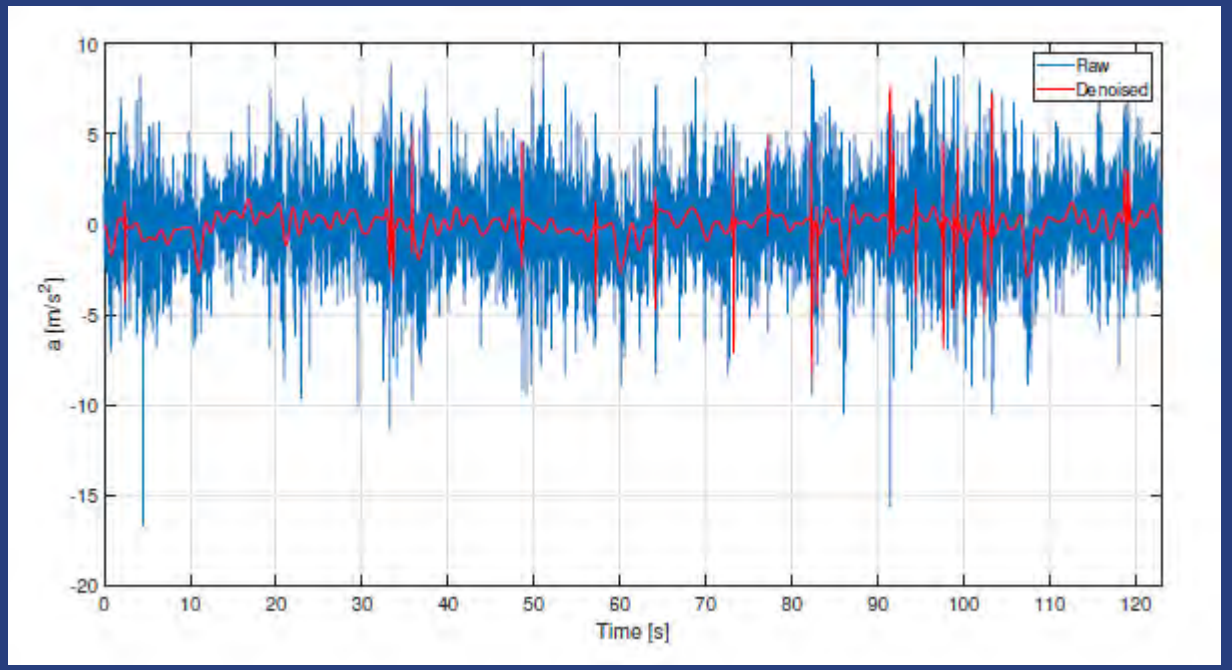


Result

- *How to handle the noise induced in the sensor's signals?*



Speed



Acceleration

Method

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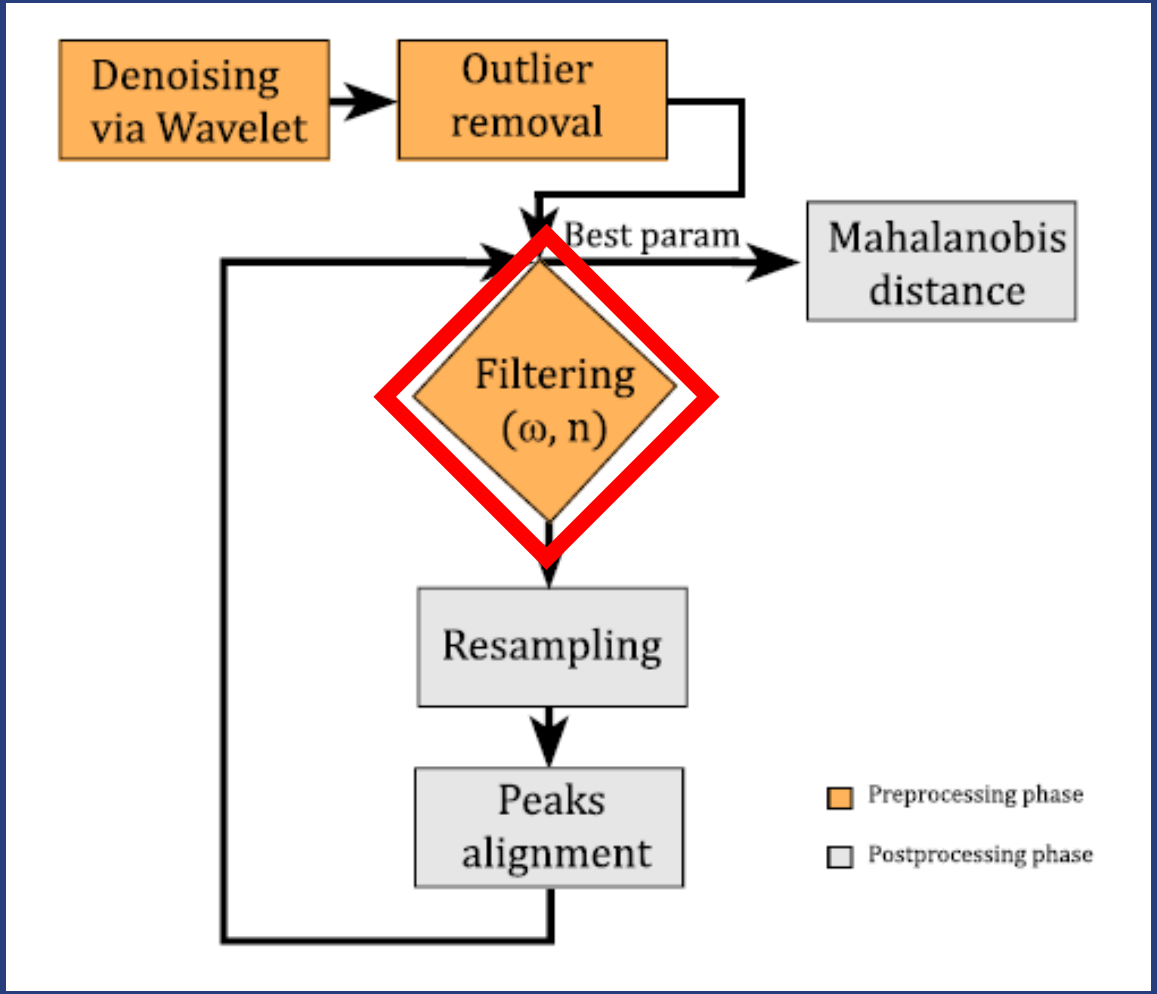
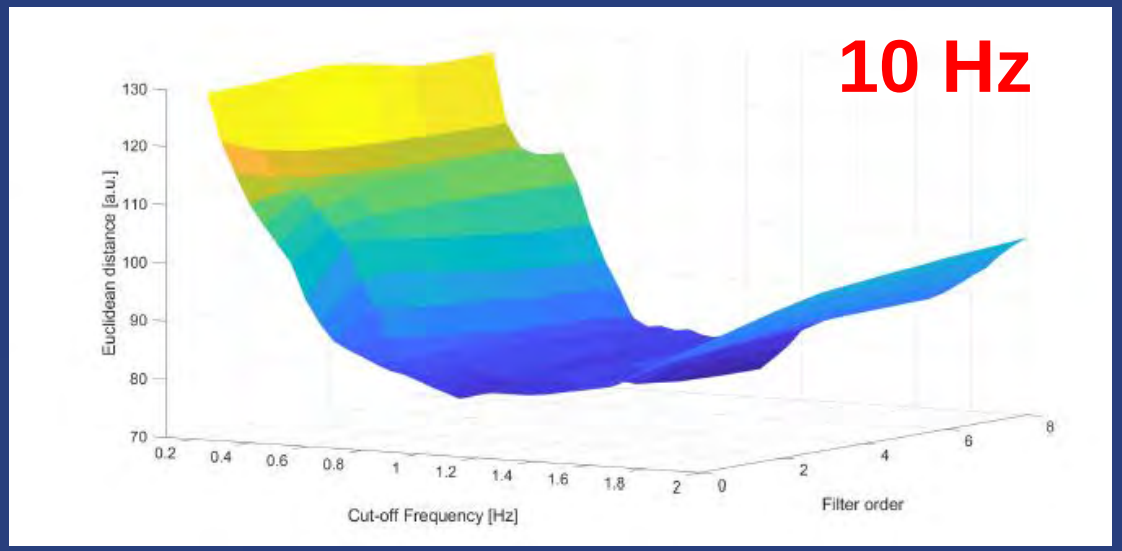
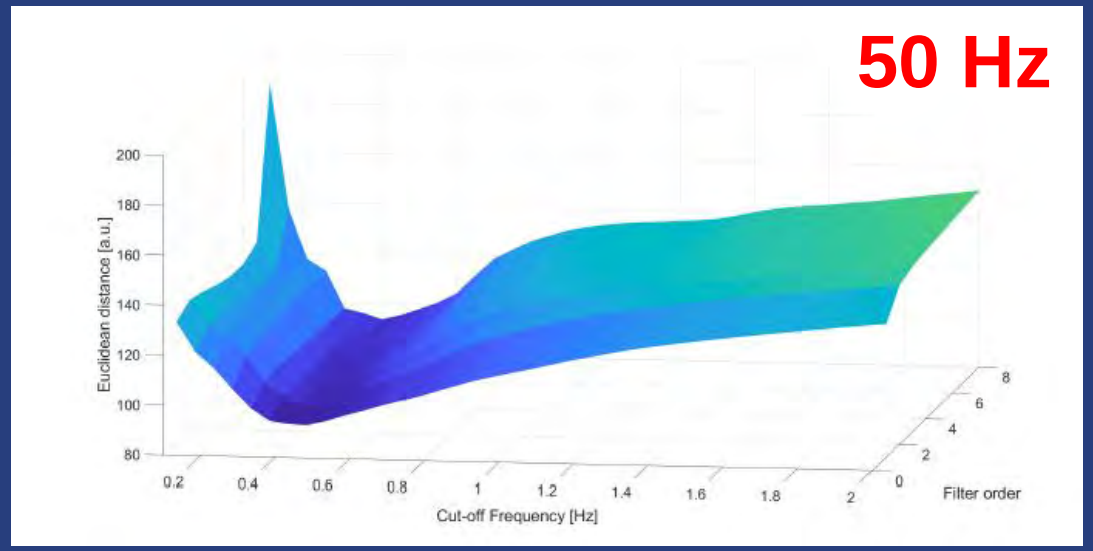


Result

Setting of Low-pass Butterworth filter parameters to minimize the difference between reference and measured acceleration

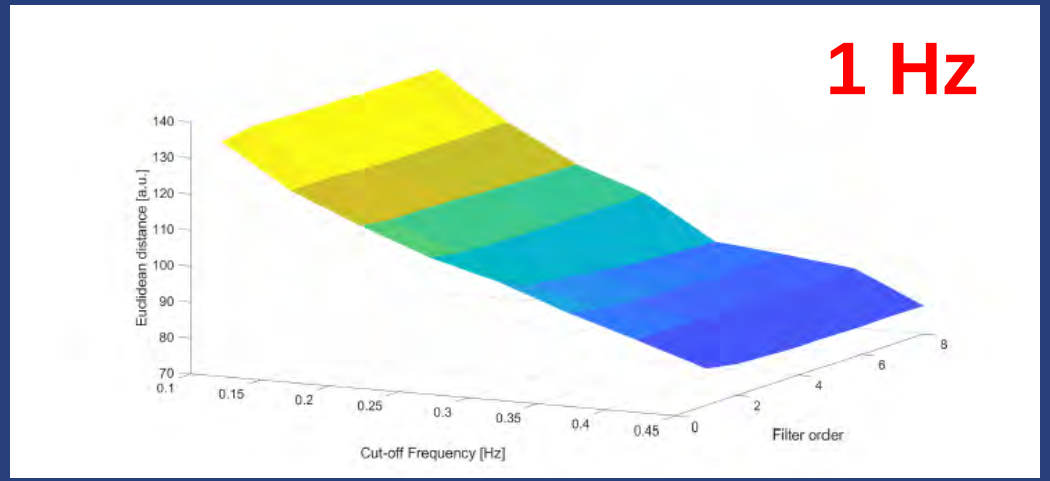


n = 7; wc= 1.05 Hz



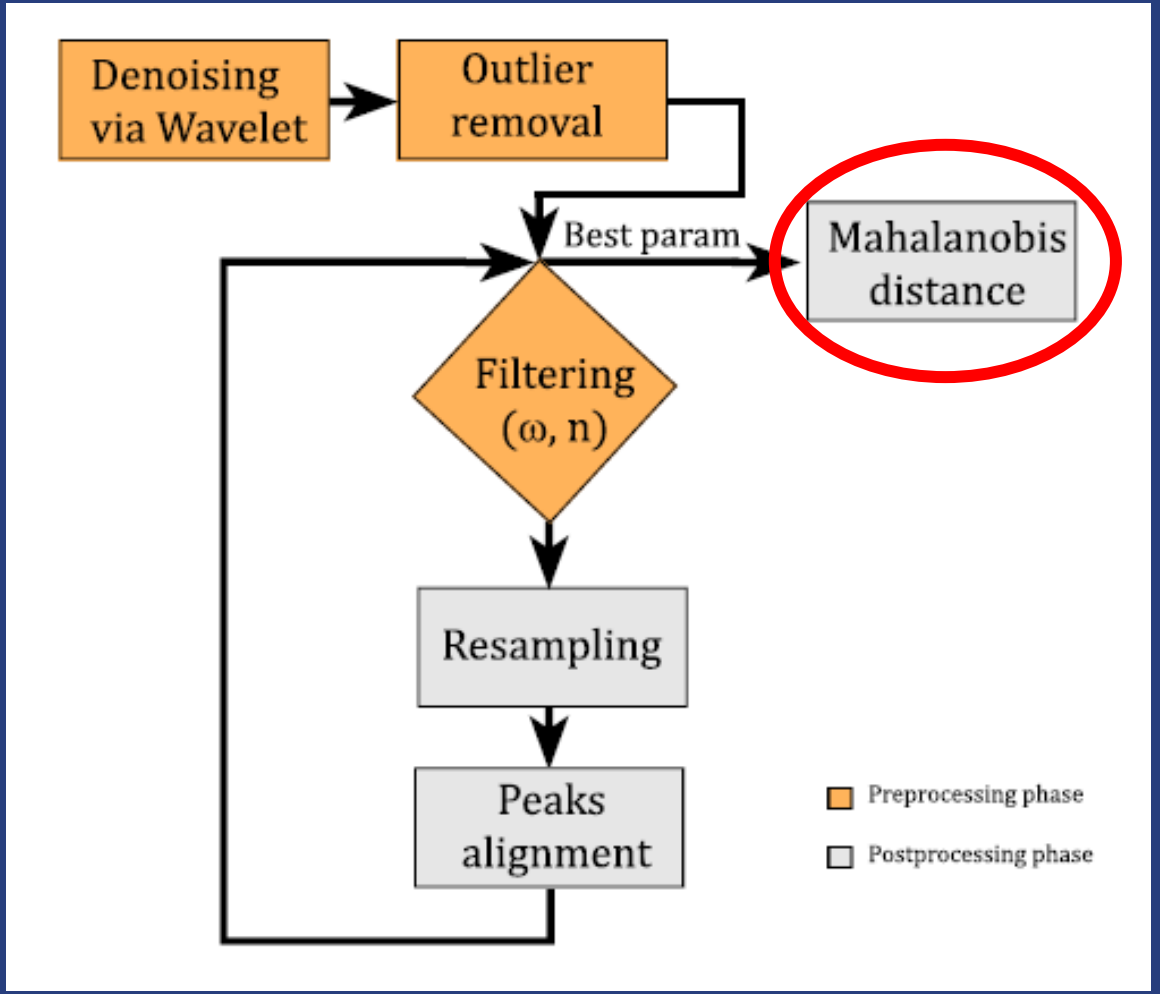
n = 1; wc= 0.45 Hz

n = 6; wc= 0.45 Hz



Method

- *What ride analytics are informative to identify critical events?*



Result

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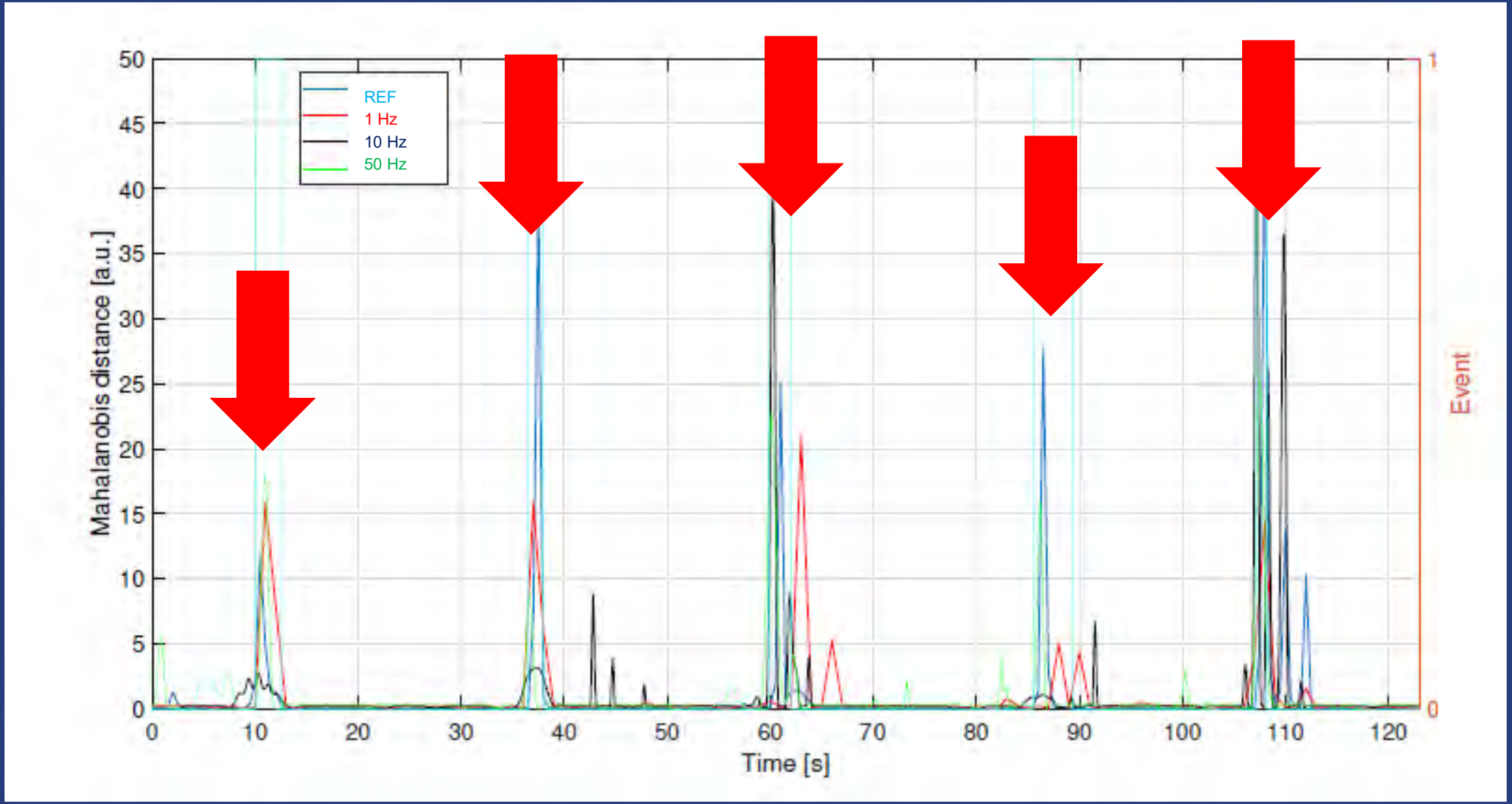

Conclusion

A signal processing procedure has been proposed in order to recognize SCEs in cycling.

Higher sampling frequency allows to detect and evaluate their severity

more storage and battery requirements, which are constraints in Big-Data applications

Smaller sampling frequency can detect them

a simpler hardware setup and less memory storage

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