

Double-Filter System

Track 3 (Offsite-Online)



CAIRO

Center for Artificial Intelligence and Robotics

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IPIN 2023

THIRTEENTH INTERNATIONAL CONFERENCE ON

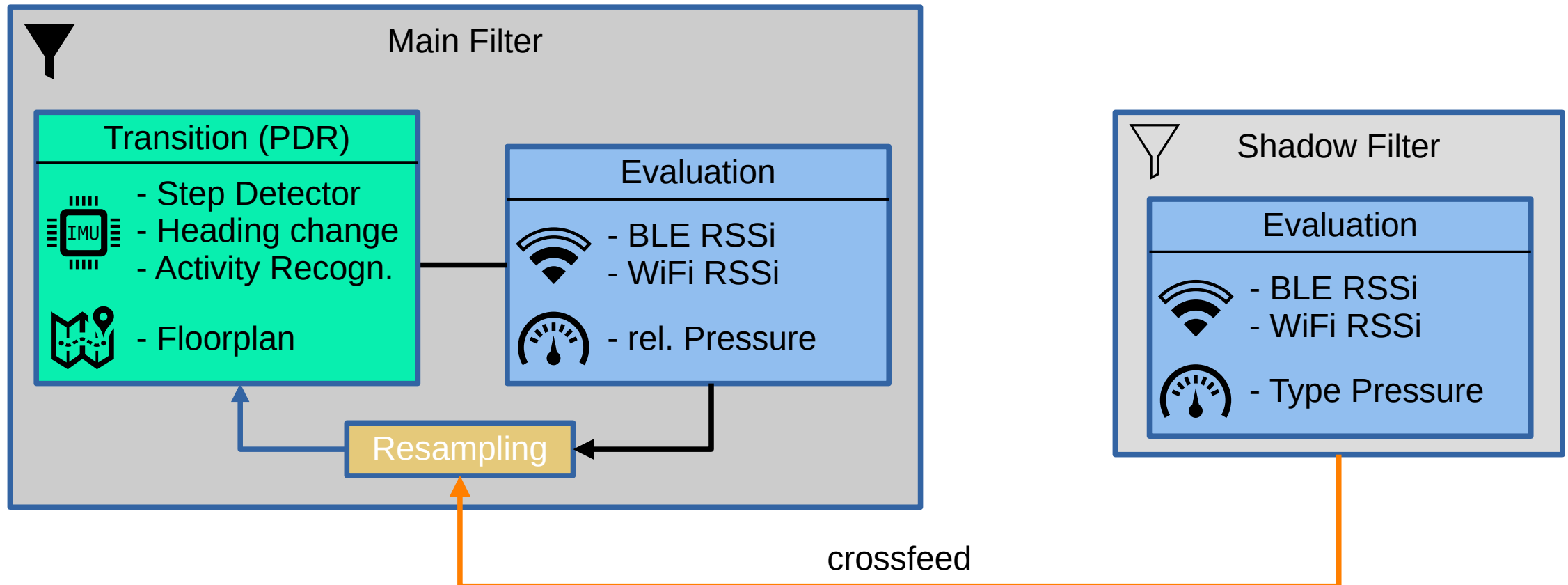
**INDOOR POSITIONING
AND INDOOR NAVIGATION**

25th-28th Sep. 2023, Nuremberg Germany

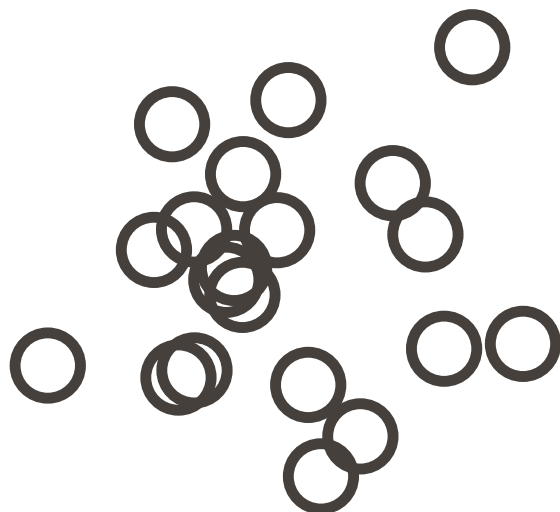
NUREMBERG



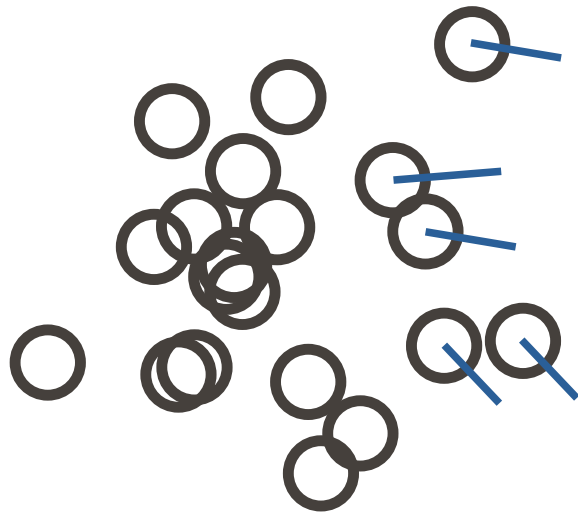
System Overview



State

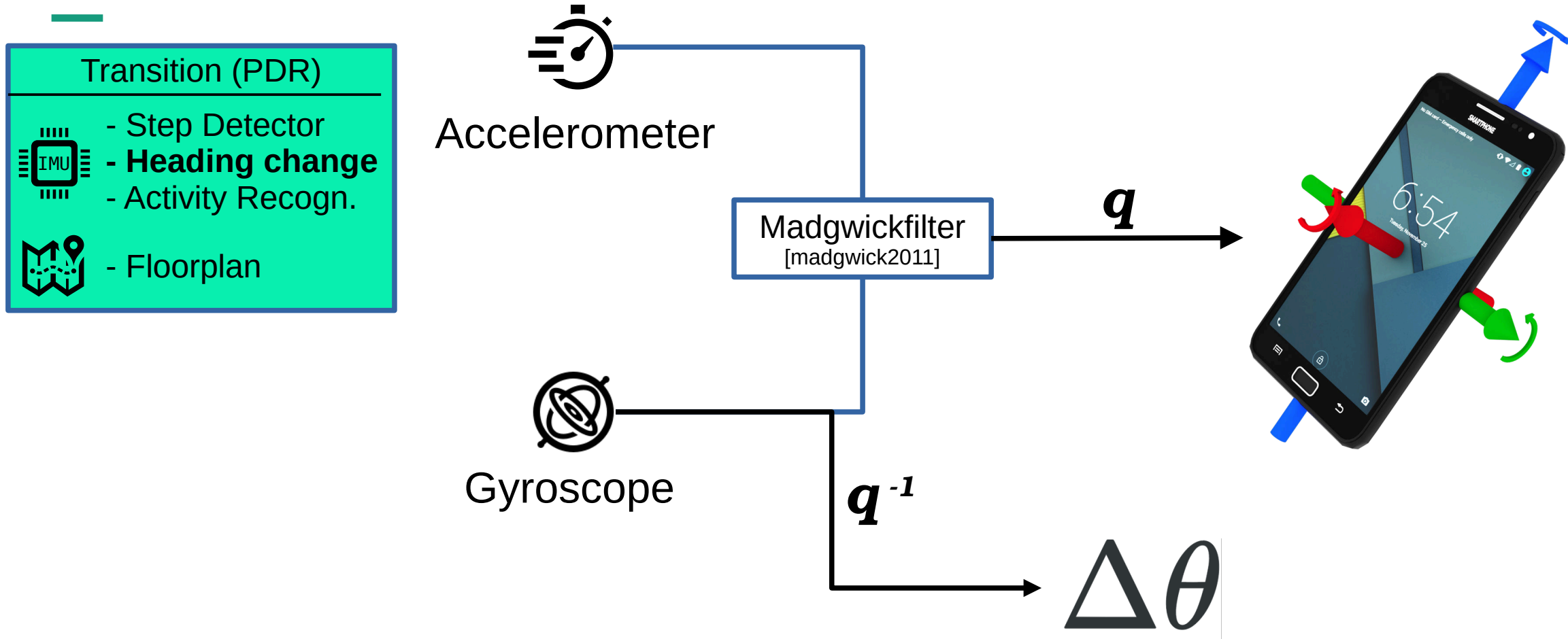


Particle State



- Position
- Heading θ
- Position History (5 sec)

PDR

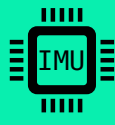


[magdwick2011] Estimation of IMU and MARG orientation using a gradient descent algorithm

Gyroscope: <https://icons8.com/icons/set/gyroscope>

PDR

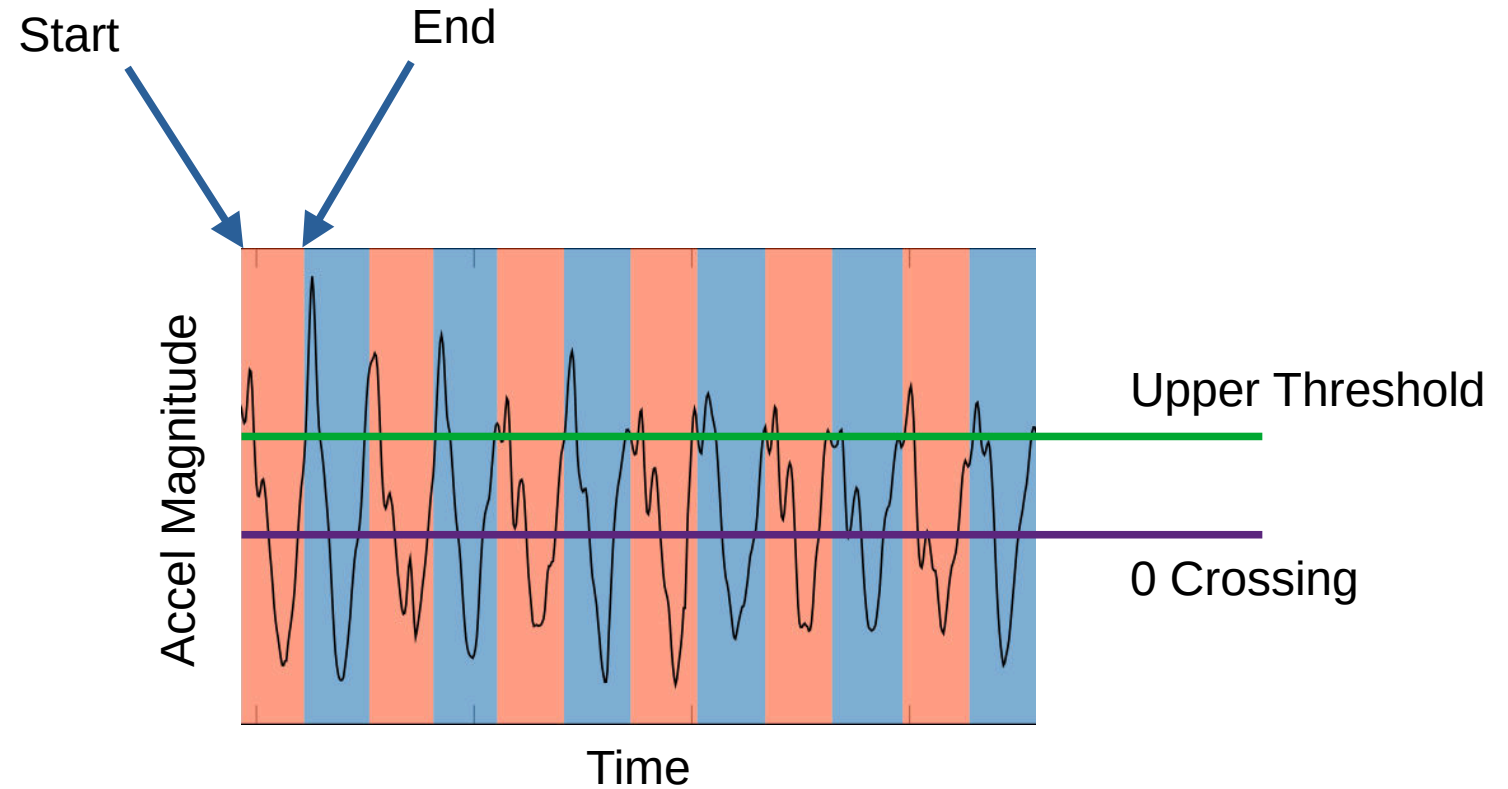
Transition (PDR)



- **Step Detector**
- Heading change
- Activity Recogn.



- Floorplan



Filter Update Strategy

Timeline:

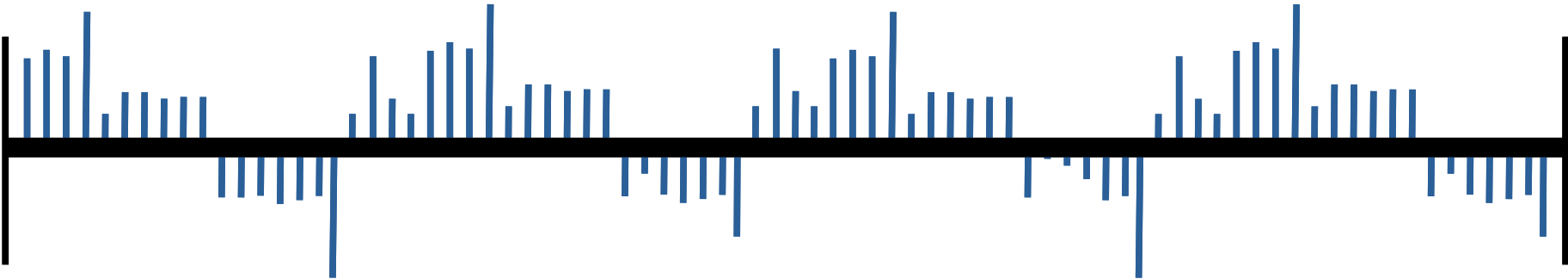


Estimations:



Filter Update Strategy

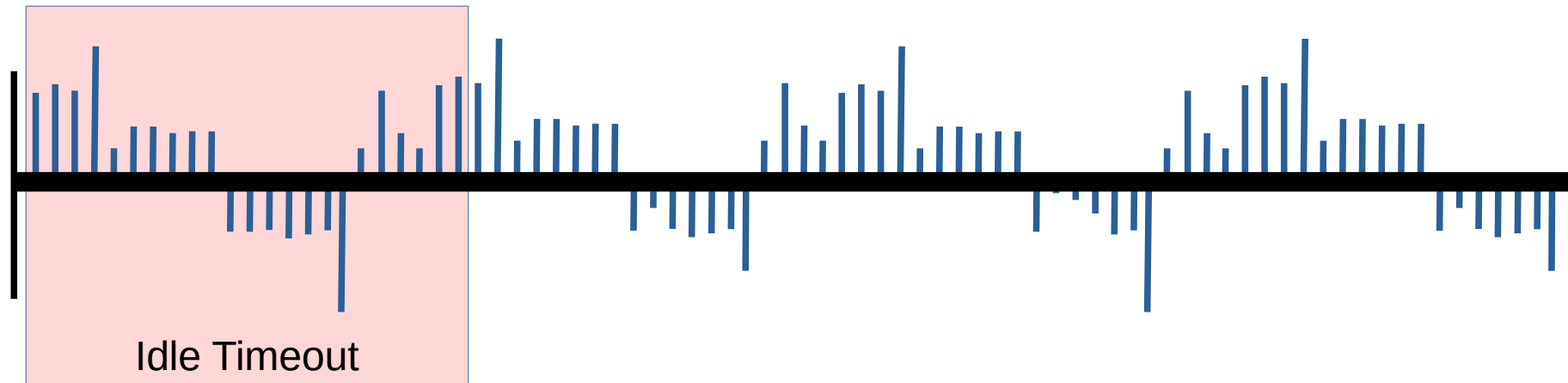
Heading



Estimations: 

Filter Update Strategy

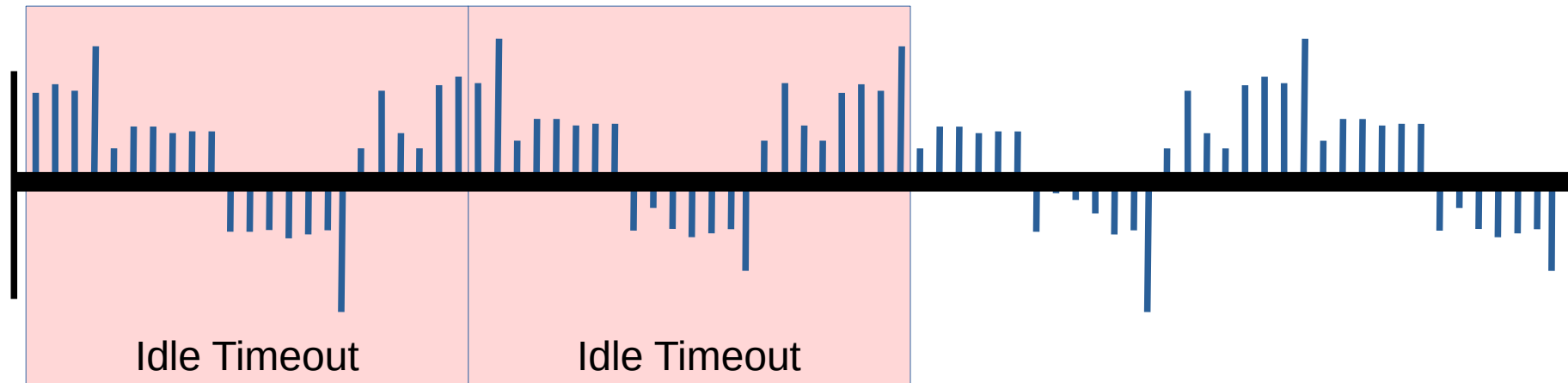
Heading



Estimations:

Filter Update Strategy

Heading

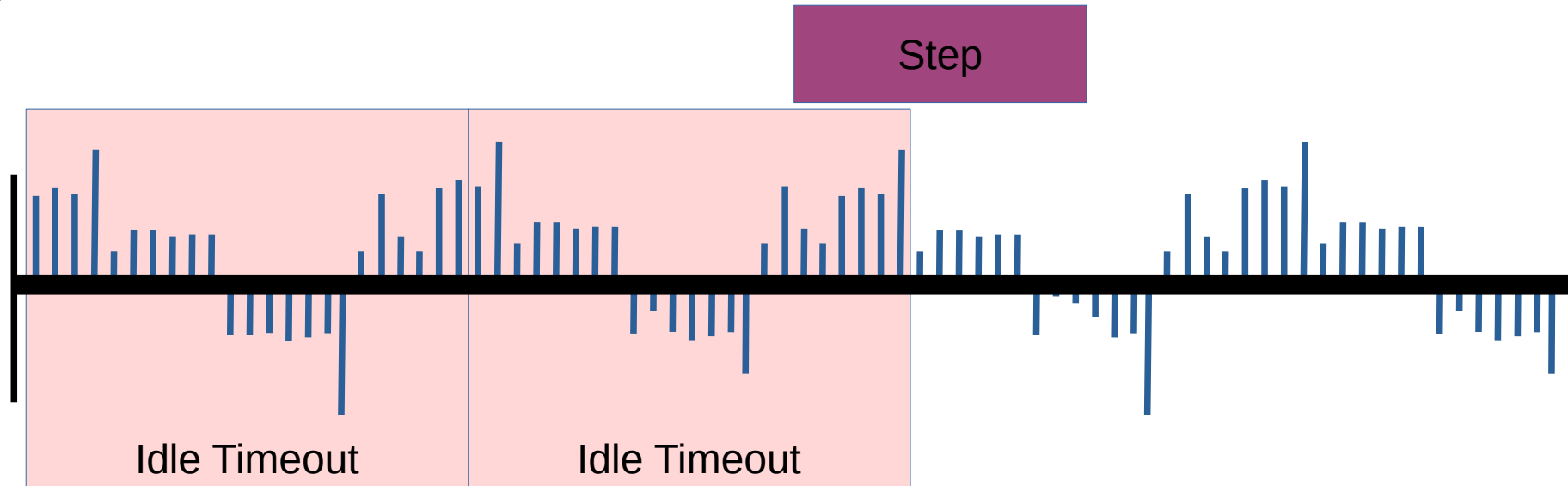


Estimations:



Filter Update Strategy

Heading

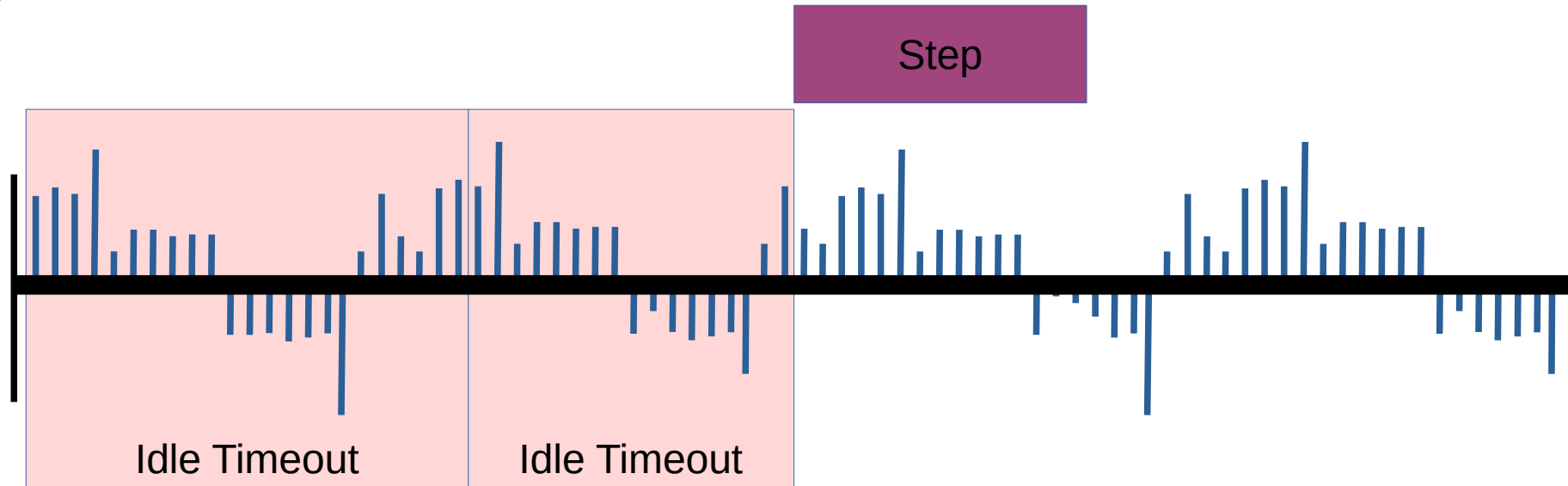


Estimations:



Filter Update Strategy

Heading

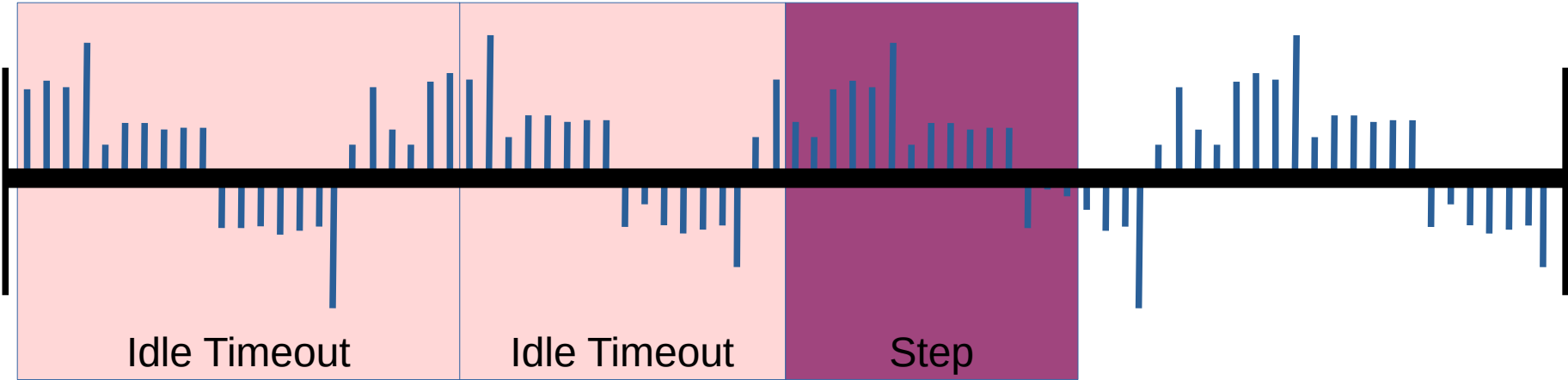


Estimations:



Filter Update Strategy

Heading

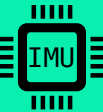




Estimations:



PDR

Transition (PDR)

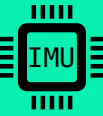



-  - Step Detector
- Heading change
- Activity Recogn.
-  - Floorplan

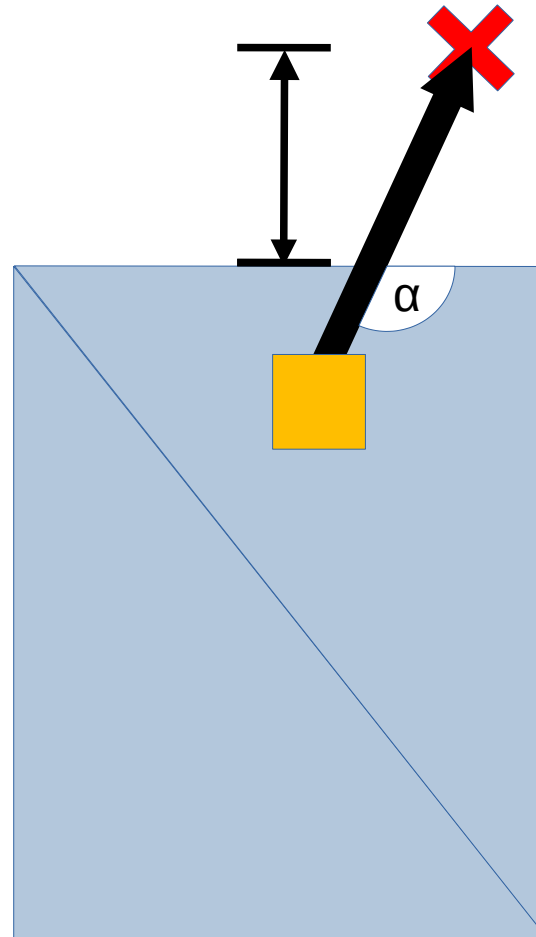
 (x, y, z, tria)



PDR

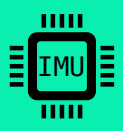

Transition (PDR)

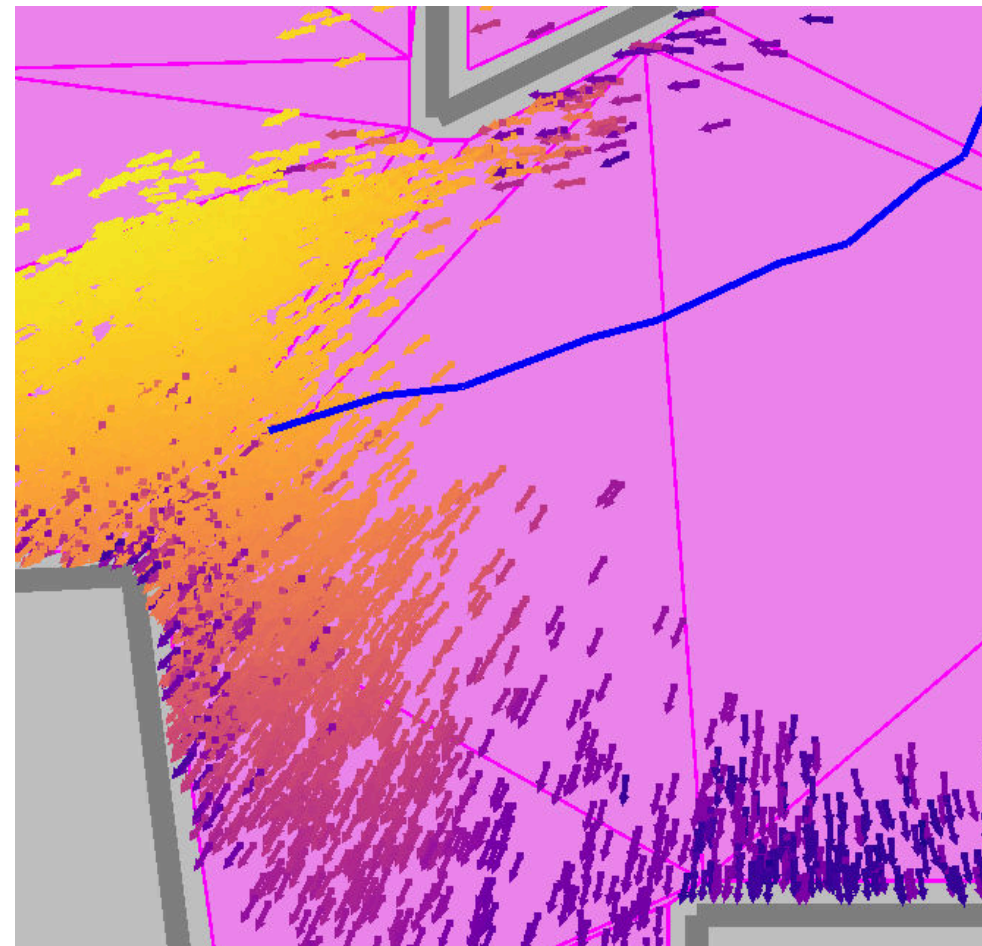
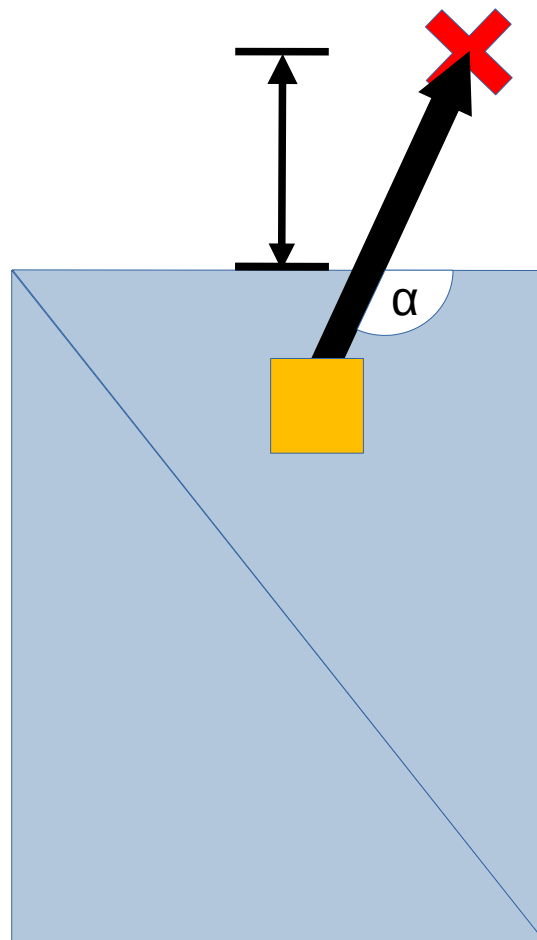
-  - Step Detector
-  - Heading change
-  - Activity Recogn.
-  - Floorplan



PDR

Transition (PDR)

-  - Step Detector
- Heading change
- Activity Recogn.
-  - Floorplan



Evaluation (Training Workflow)

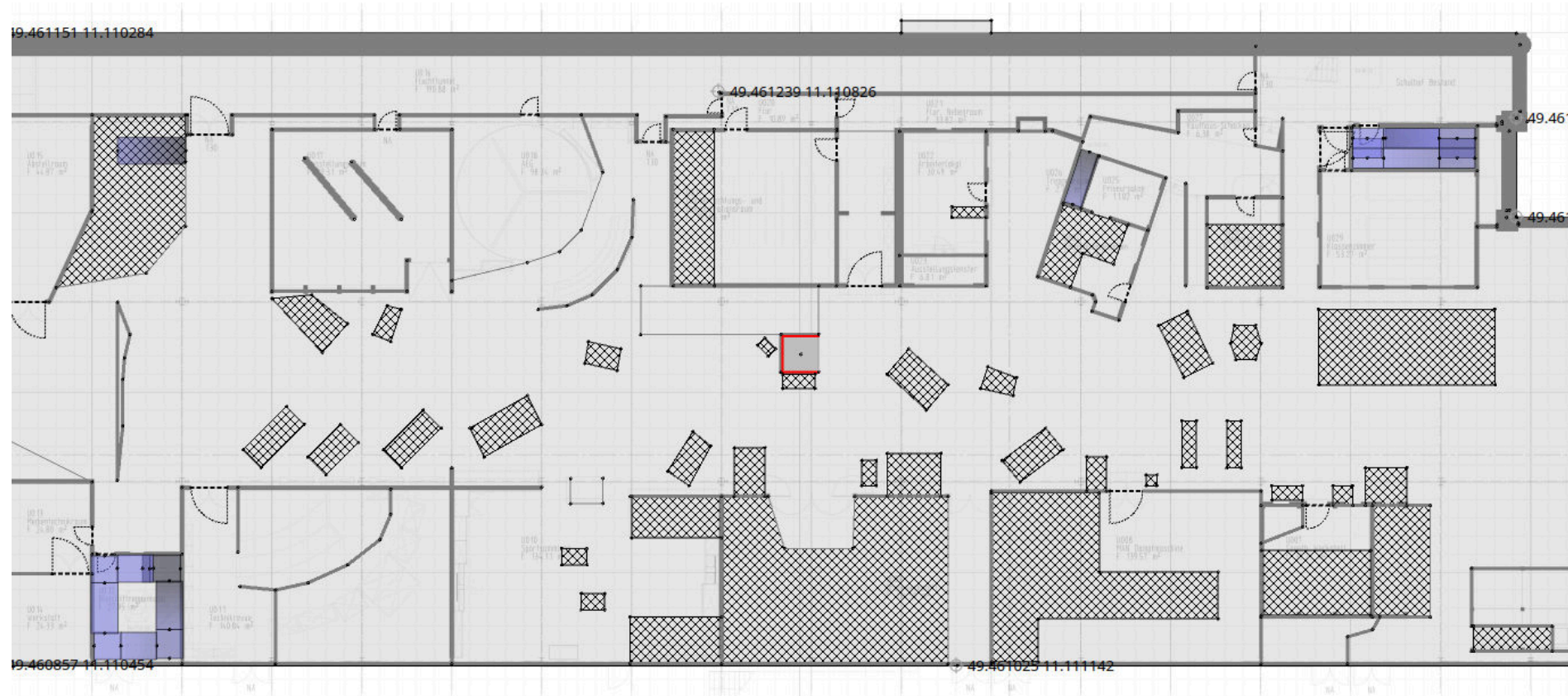
Evaluation



- BLE RSSI
- WiFi RSSI



- rel. Pressure



Evaluation (Training Workflow)

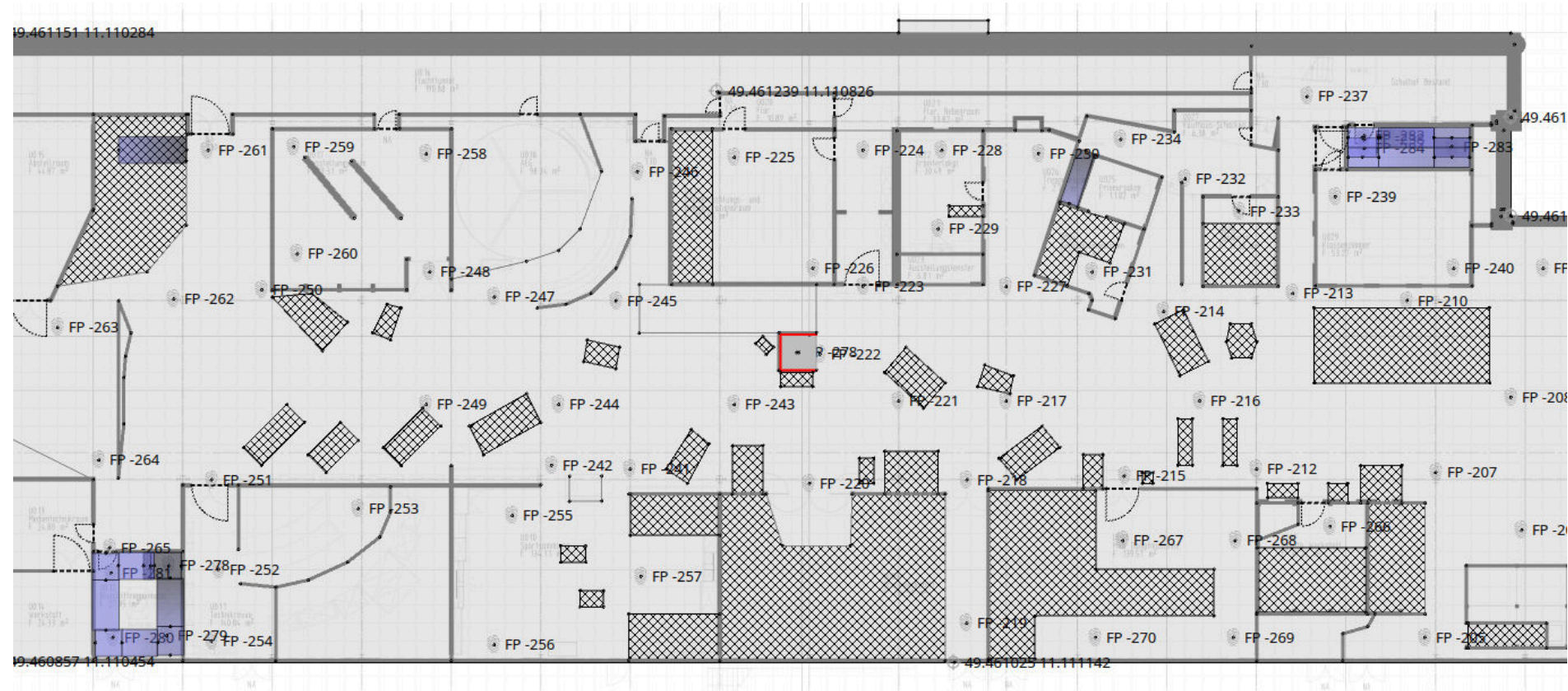
Evaluation



- BLE RSSI
- WiFi RSSI



- rel. Pressure



Evaluation (Training Workflow)

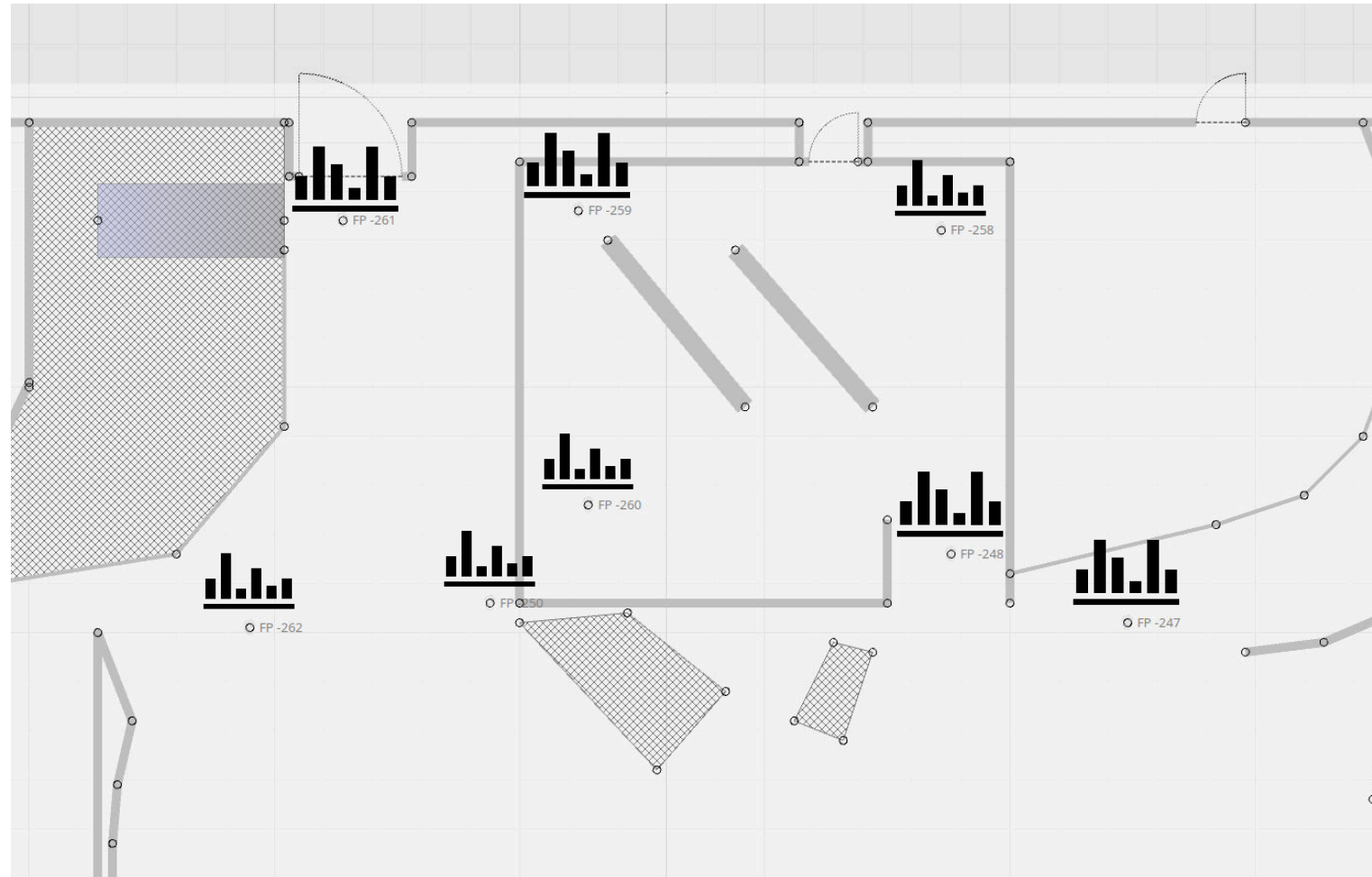
Evaluation



- BLE RSSI
- WiFi RSSI





- rel. Pressure

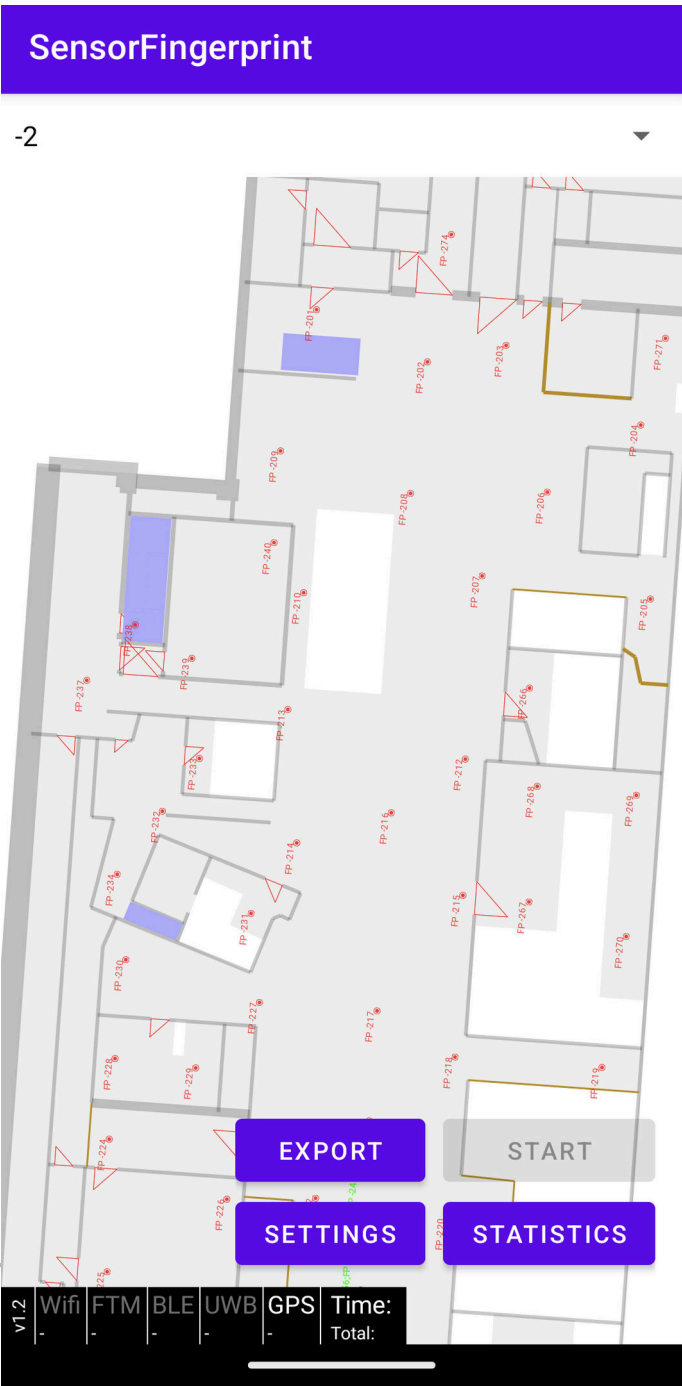


Evaluation

Evaluation

 - BLE RSSI
- WiFi RSSI

 - rel. Pressure




WIP


Watch for publications from:
Markus Bullmann

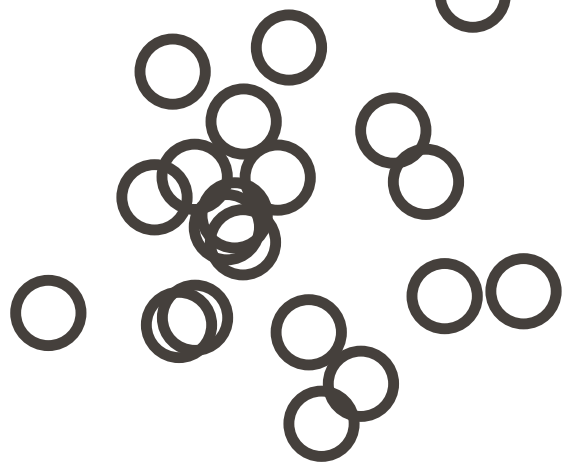
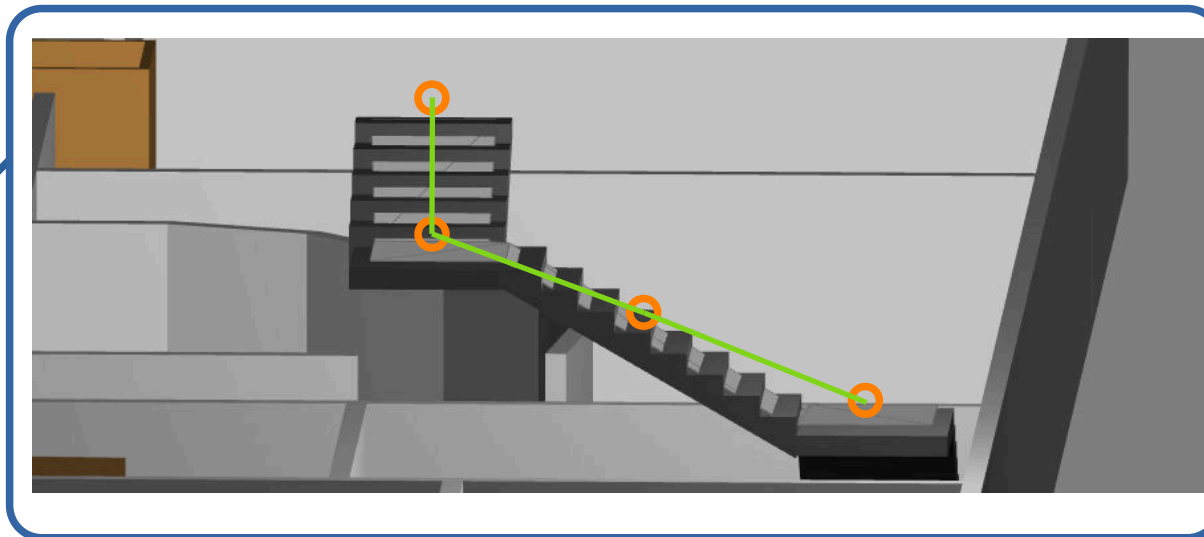
Evaluation

State Position History (5sec)

Evaluation

 - BLE RSSI
- WiFi RSSI


 - rel. Pressure




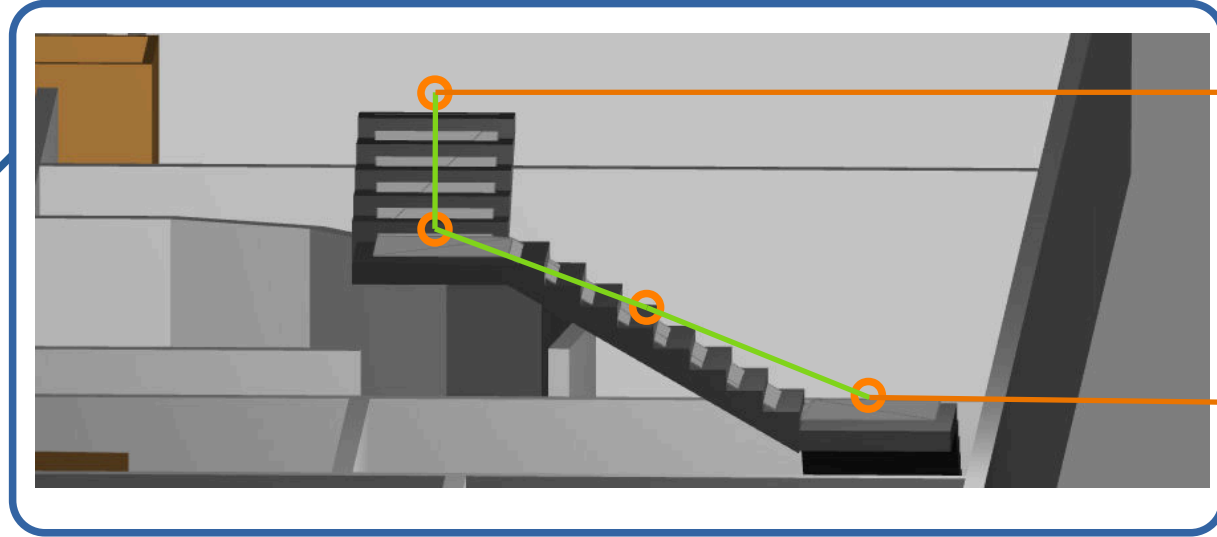
Evaluation

State Position History (5sec)

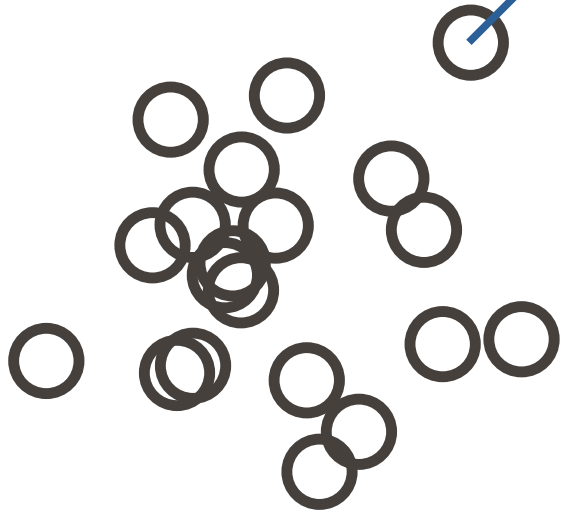
Evaluation

 - BLE RSSI
- WiFi RSSI

 - rel. Pressure



$$\Delta z = \Delta p_{expect}$$

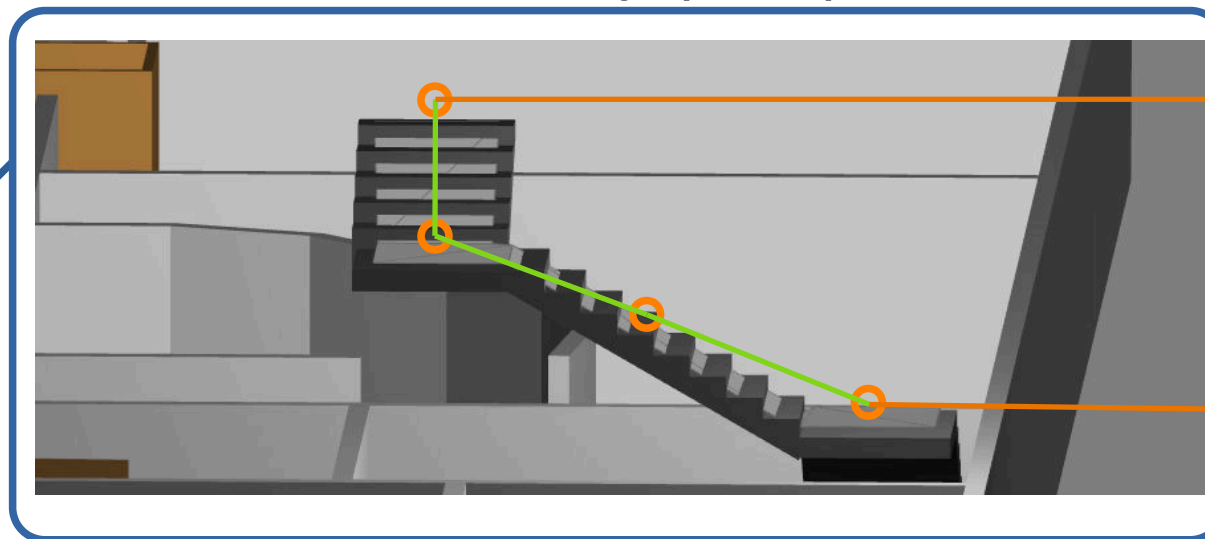


Evaluation

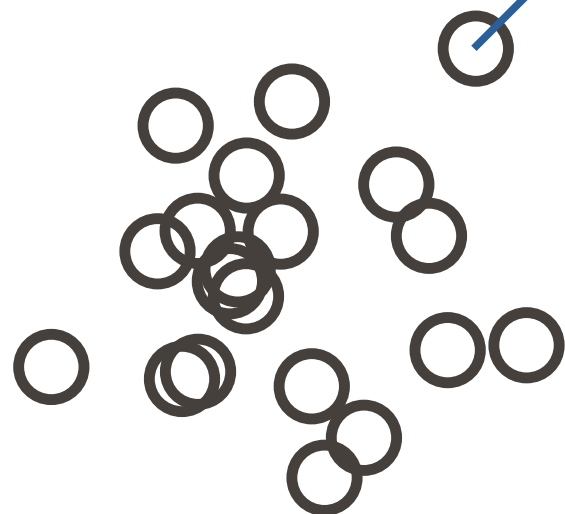
State Position History (5sec)

Evaluation

- BLE RSSI
- WiFi RSSI
- rel. Pressure

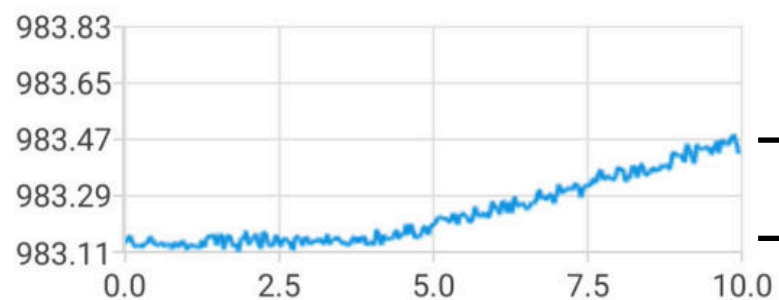


$$\Delta z = \Delta p_{expect}$$



Barometer

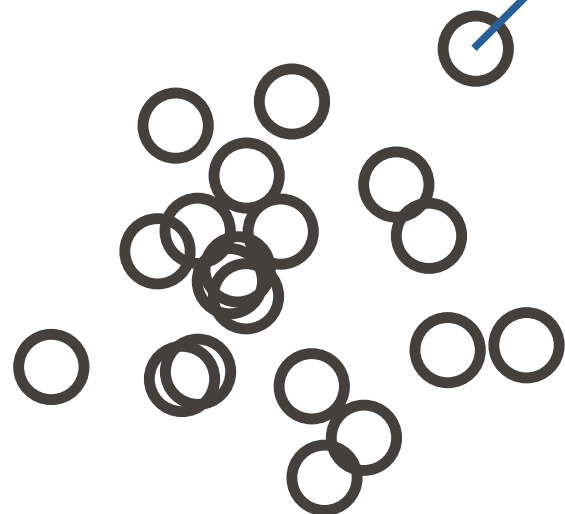
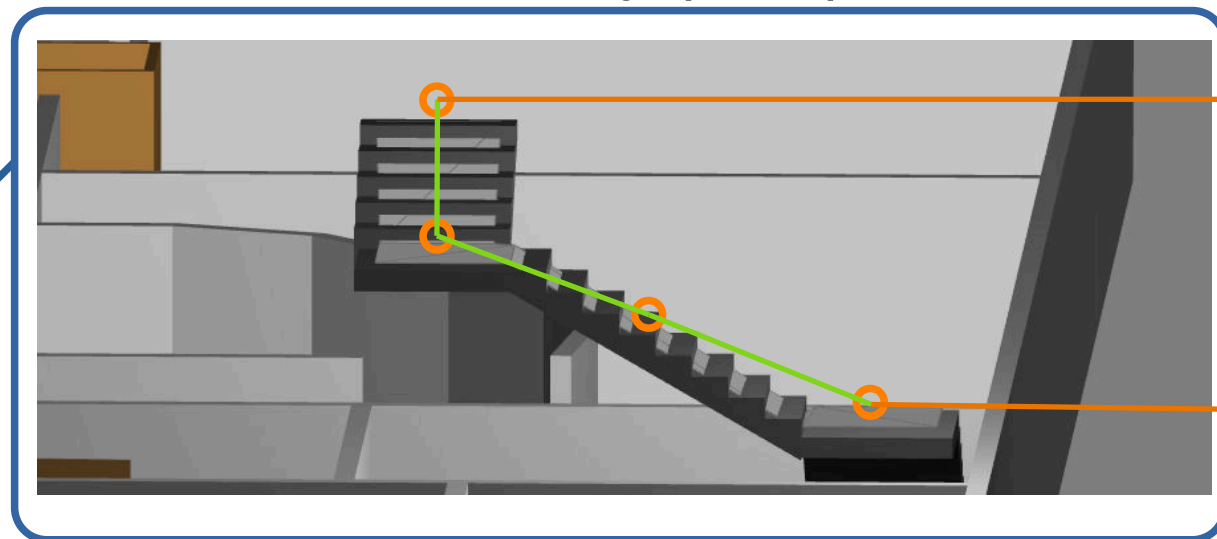
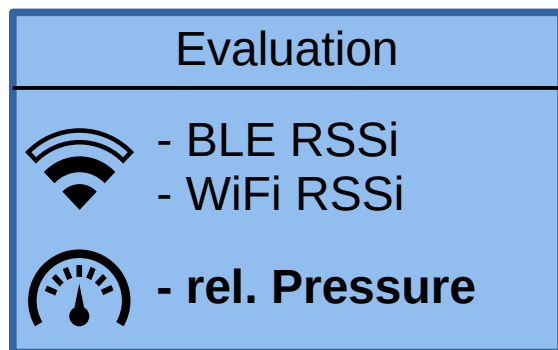
■ hPa



$$\Delta p_{Baro}$$

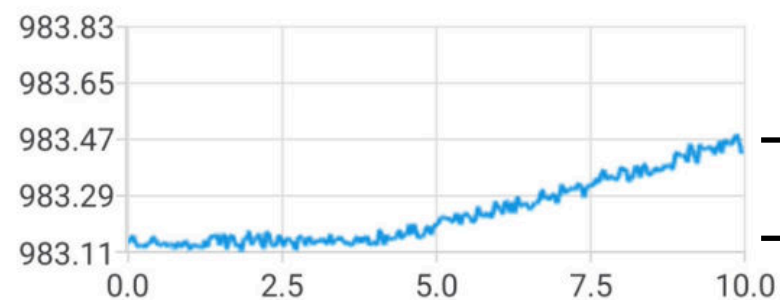
Evaluation

State Position History (5sec)

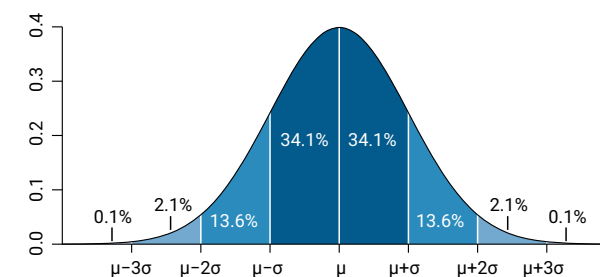


Barometer

■ hPa





Δp_{Baro}

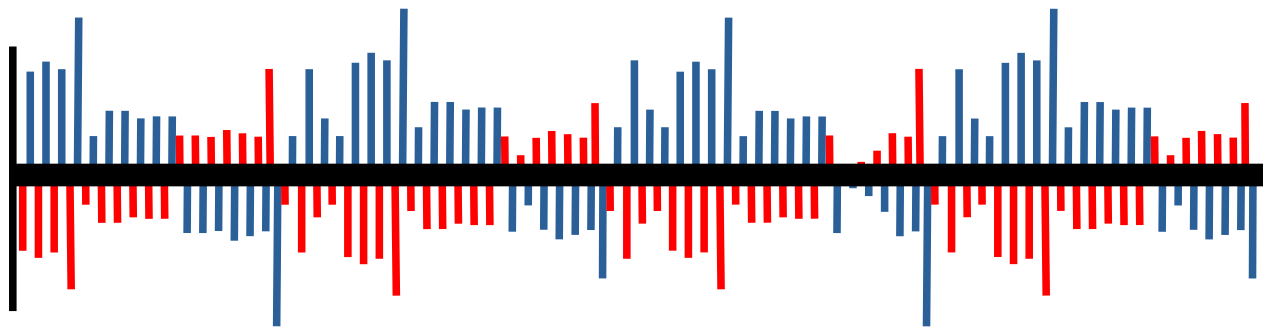


Normal distribution: https://en.wikipedia.org/wiki/Normal_distribution#/media/File:Standard_deviation_diagram_micro.svg

Challenges

Training Data

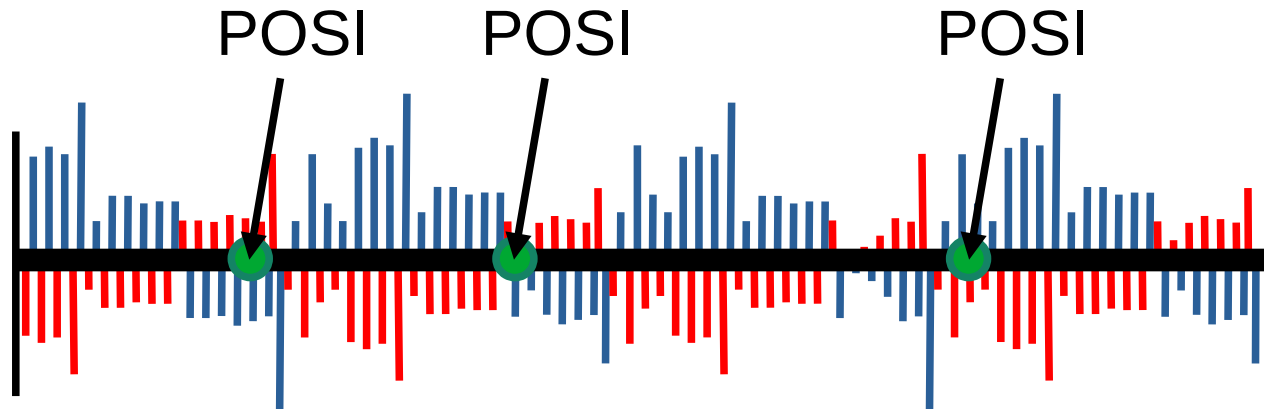
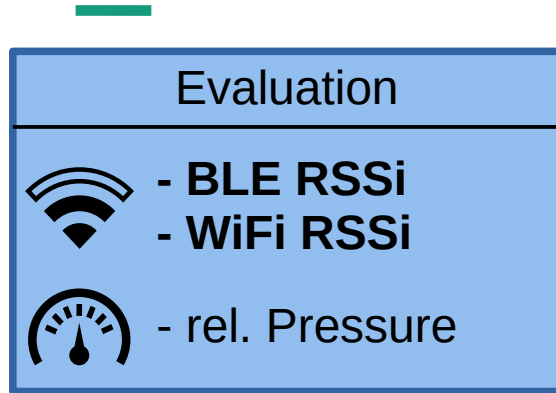
Evaluation	
	- BLE RSSi
	- WiFi RSSi
	- rel. Pressure



Accelerometer
Gyroscope
Magnetic Field Sensor
Barometer

...

Training Data



Accelerometer
Gyroscope
Magnetic Field Sensor
Barometer

...

Training Data

Evaluation



- BLE RSSI
- WiFi RSSI

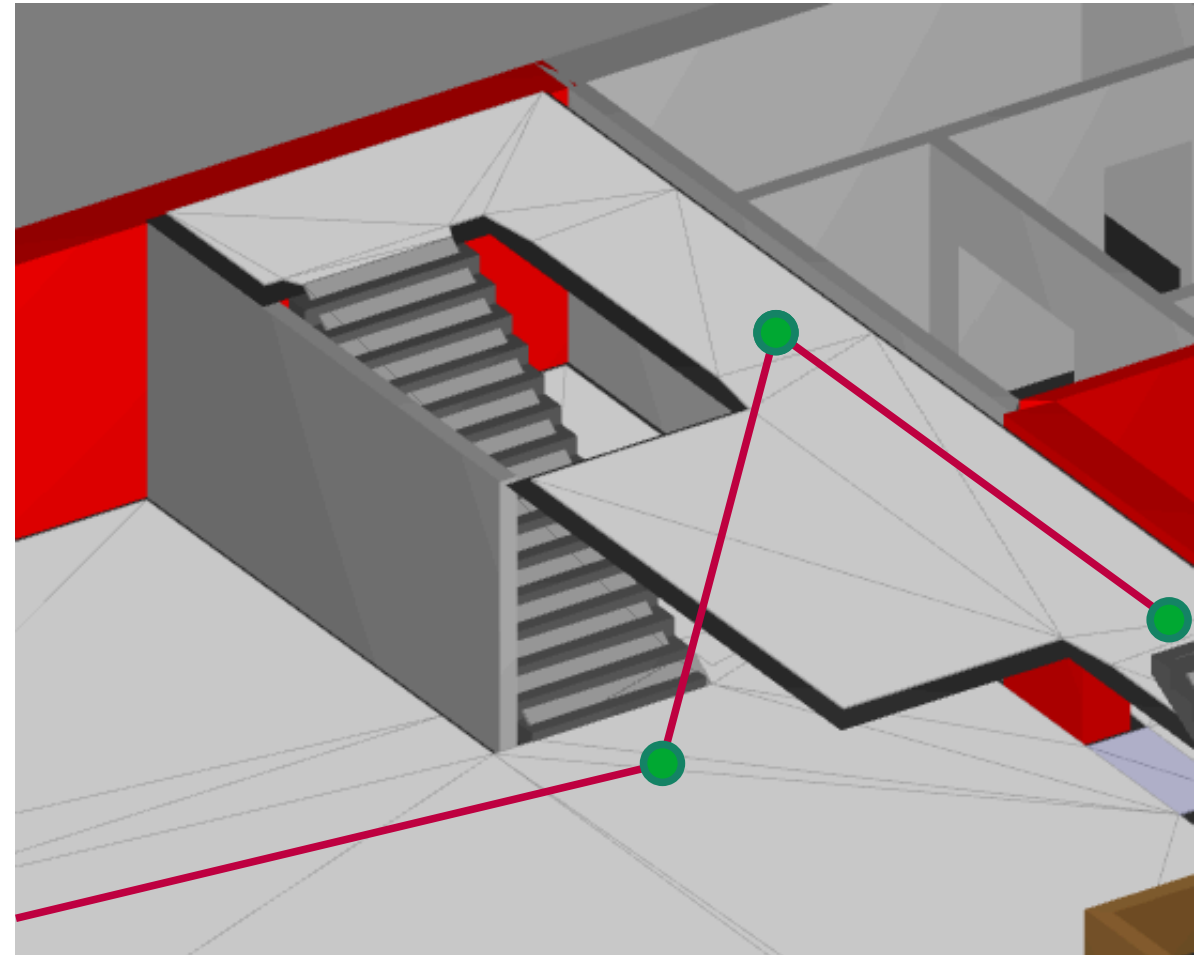


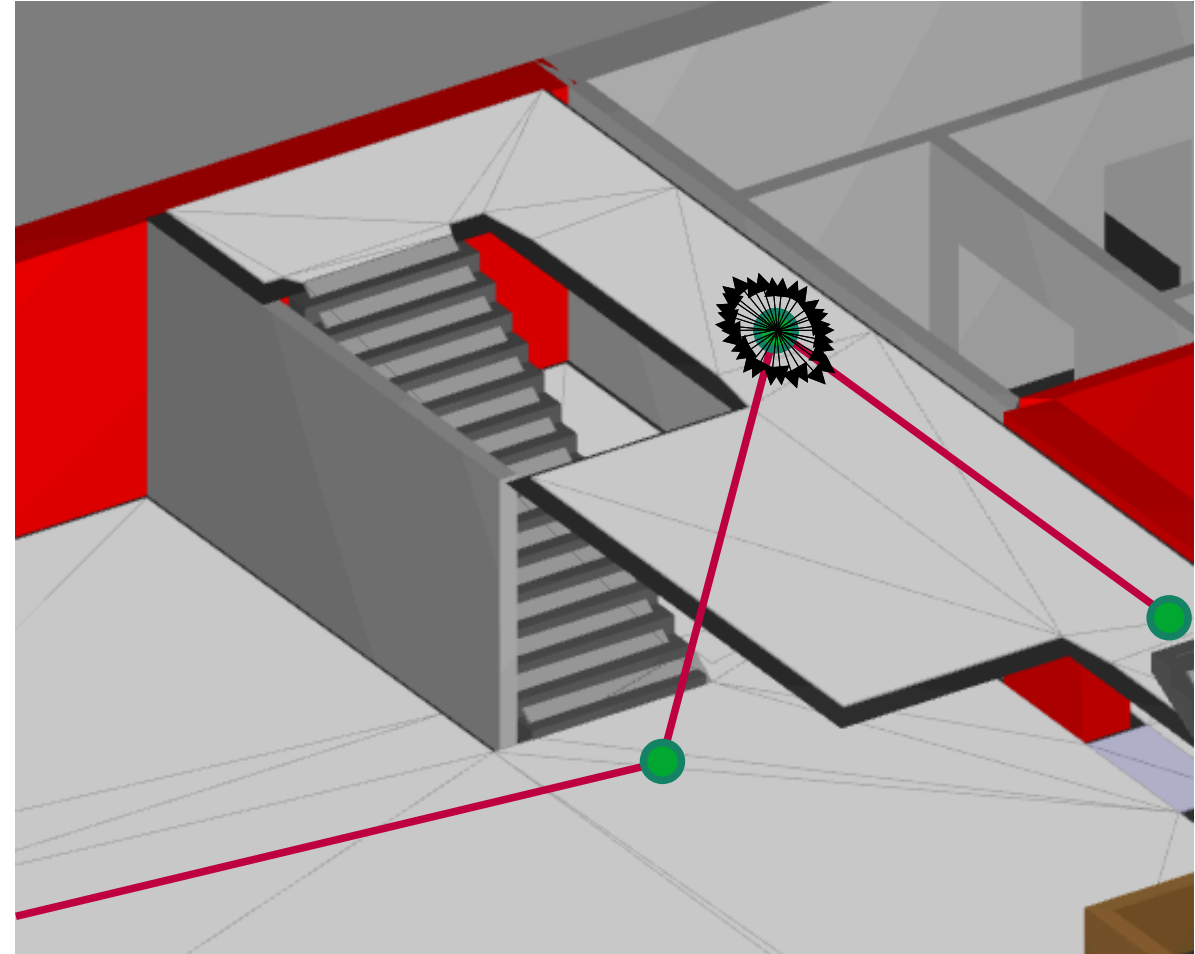
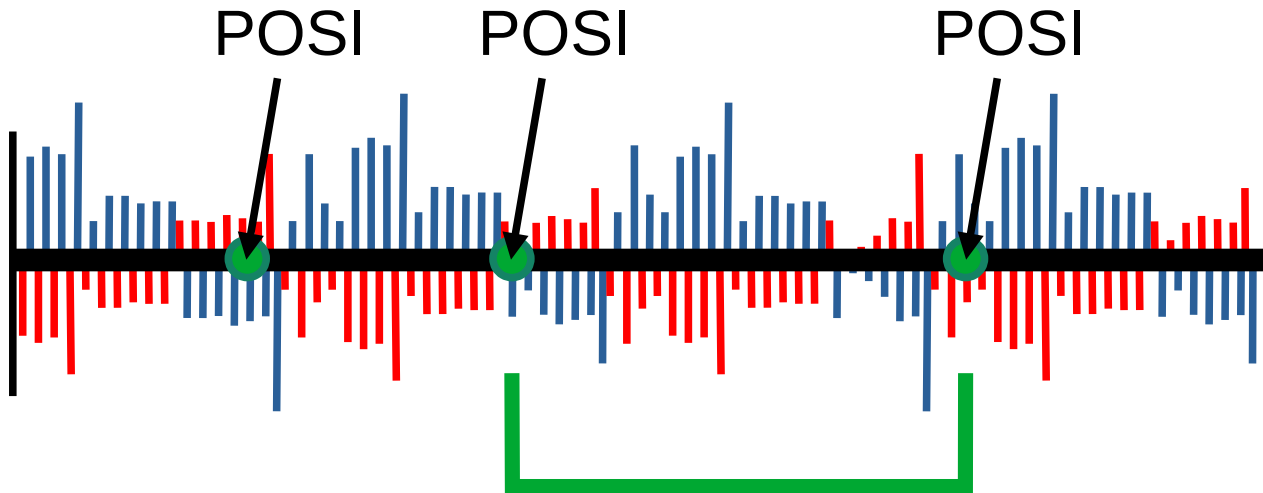
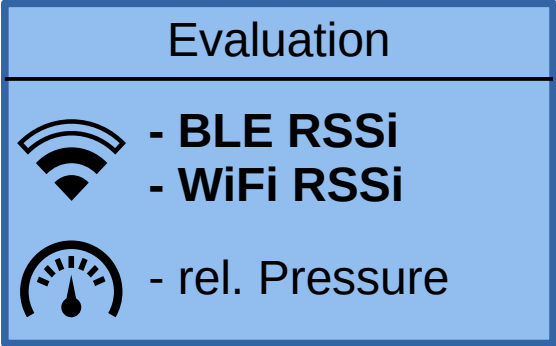
- rel. Pressure

POSI

POSI

POSI





Training Data

Evaluation



- BLE RSSI

- WiFi RSSI

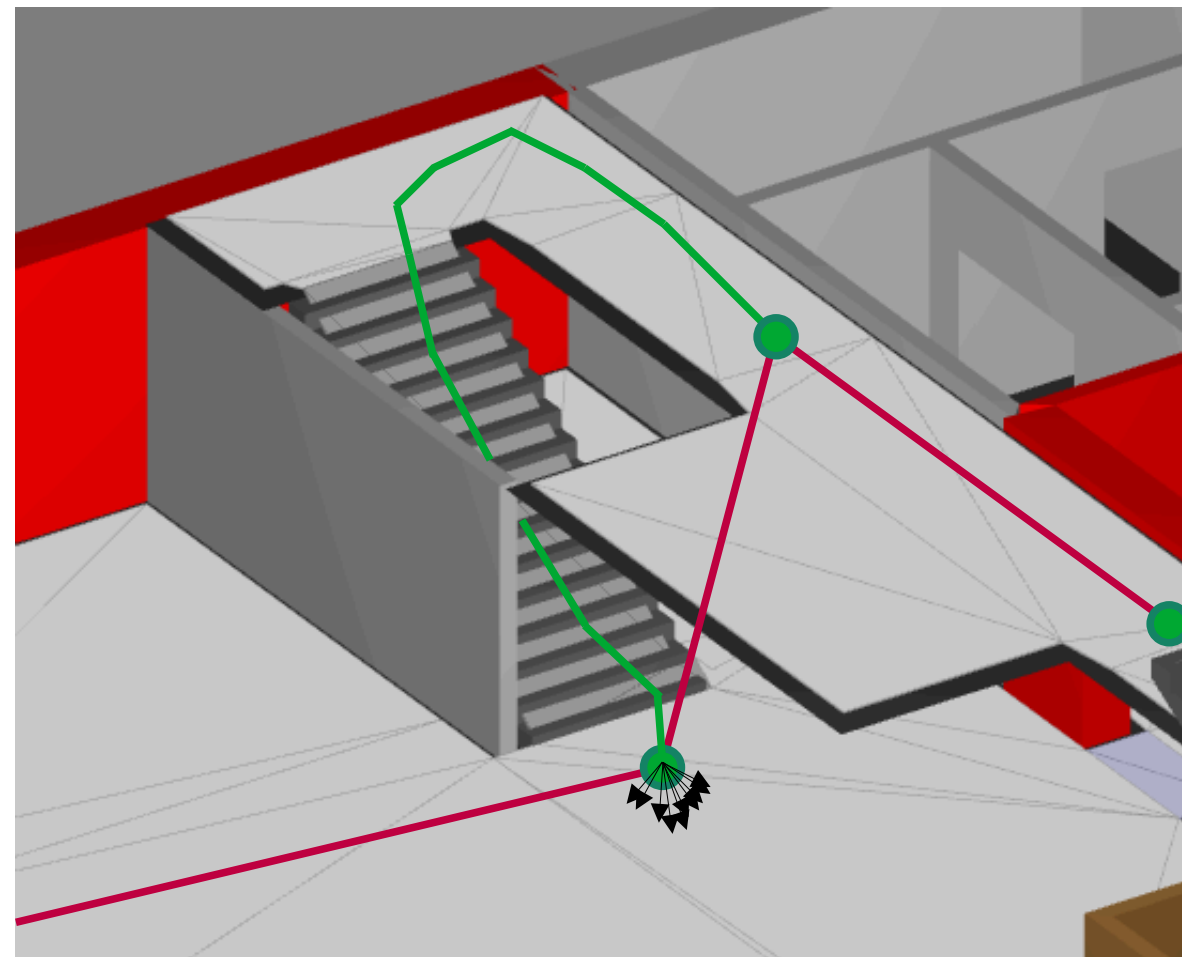


- rel. Pressure

POSI

POSI

POSI



Thank You