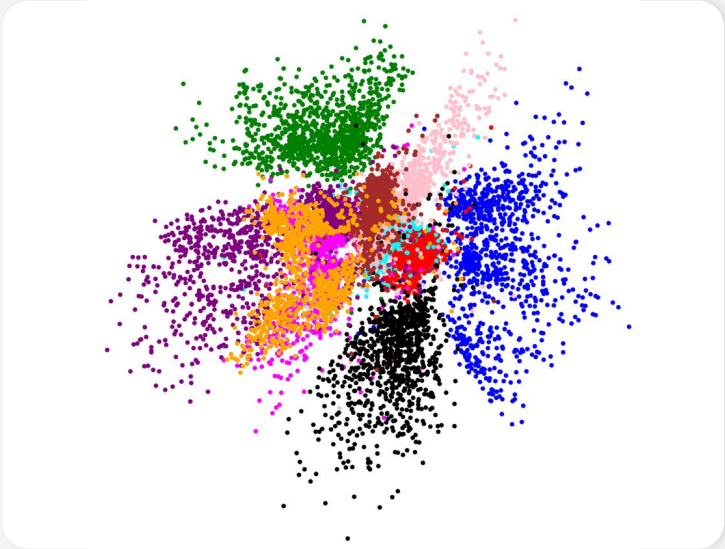
Unsupervised Anomaly Detection



ICNAP

30-31 July 2025

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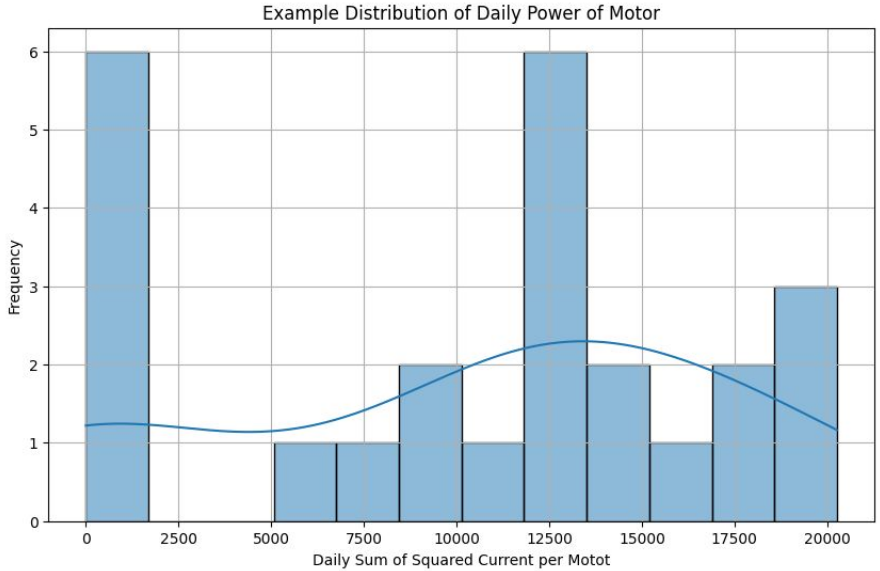
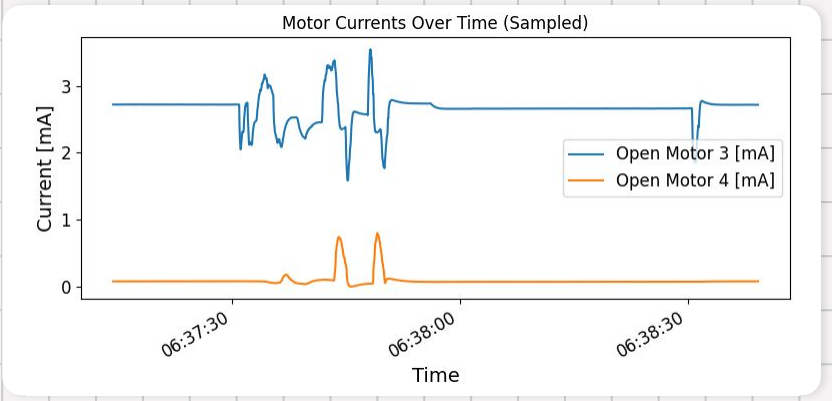
Challenge: Detecting single filling anomalies

Normal behavior

Macroscopical physical values describe system

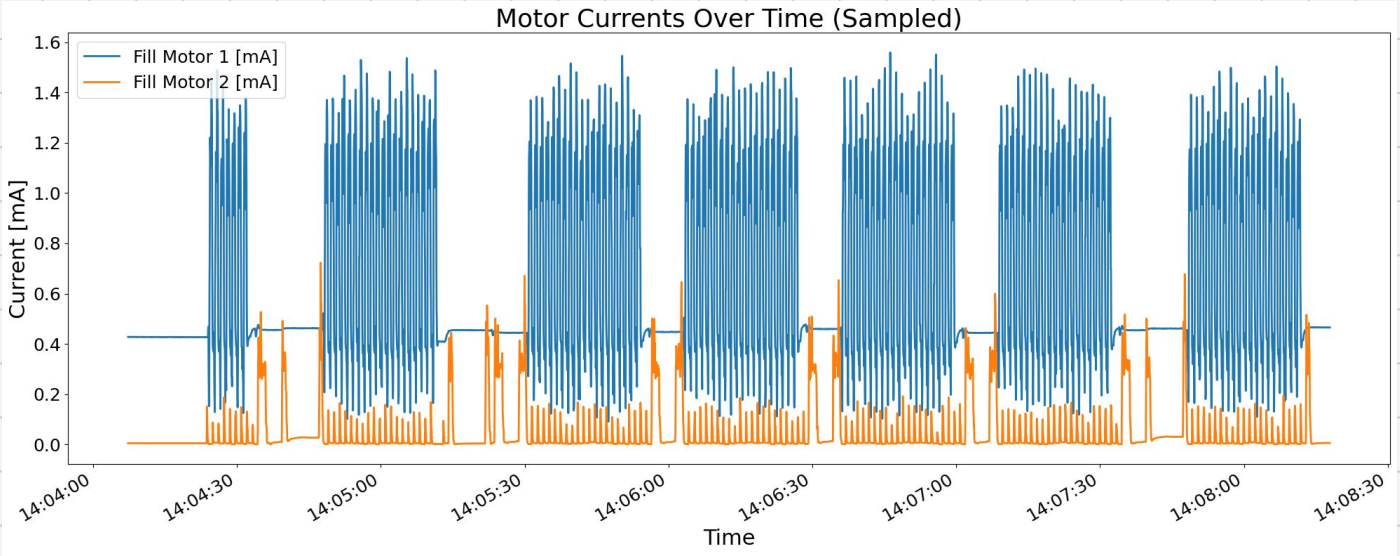




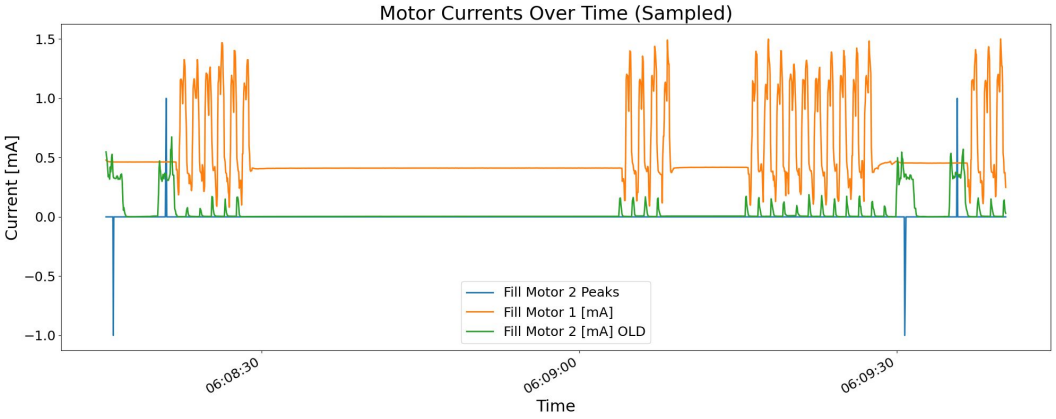
$$Power \sim I^2$$

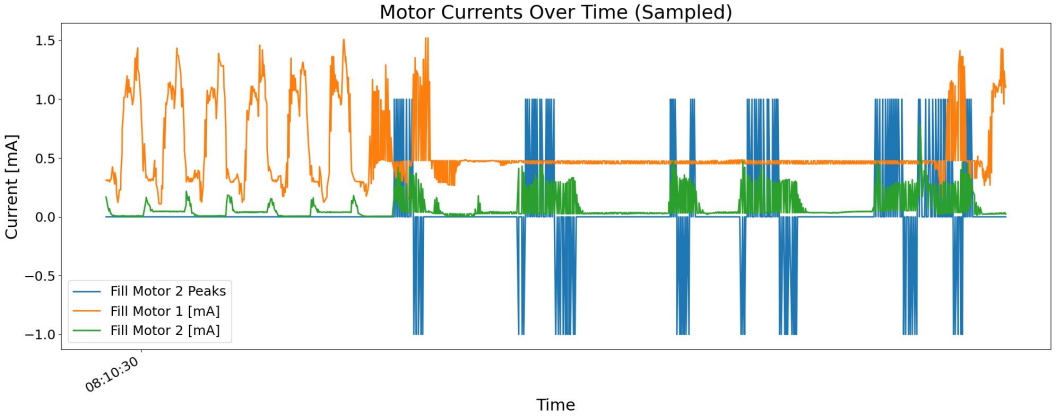
The data

- **3 weeks of filling motor current**
- **3 different samples**

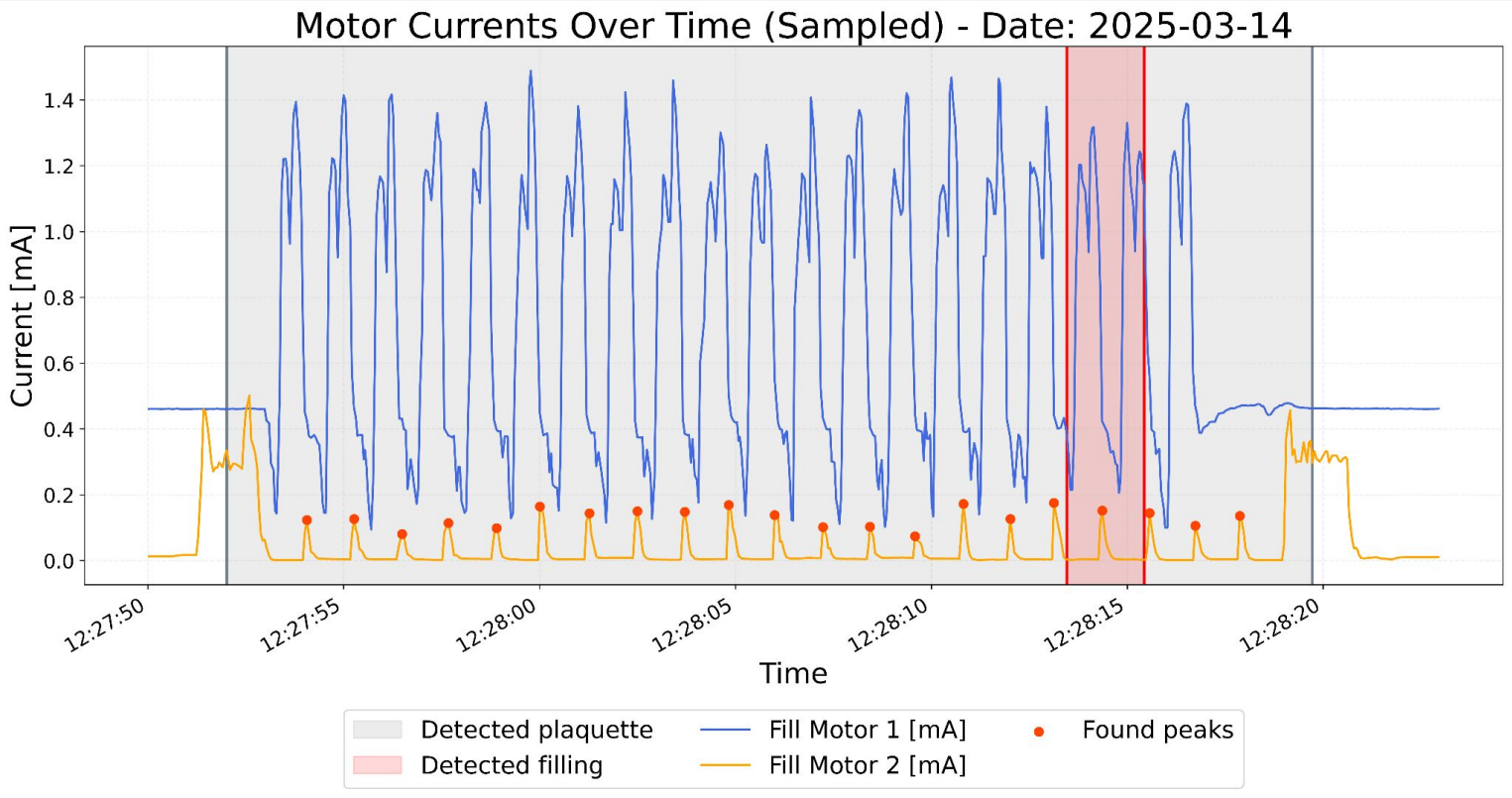


Data cleaning

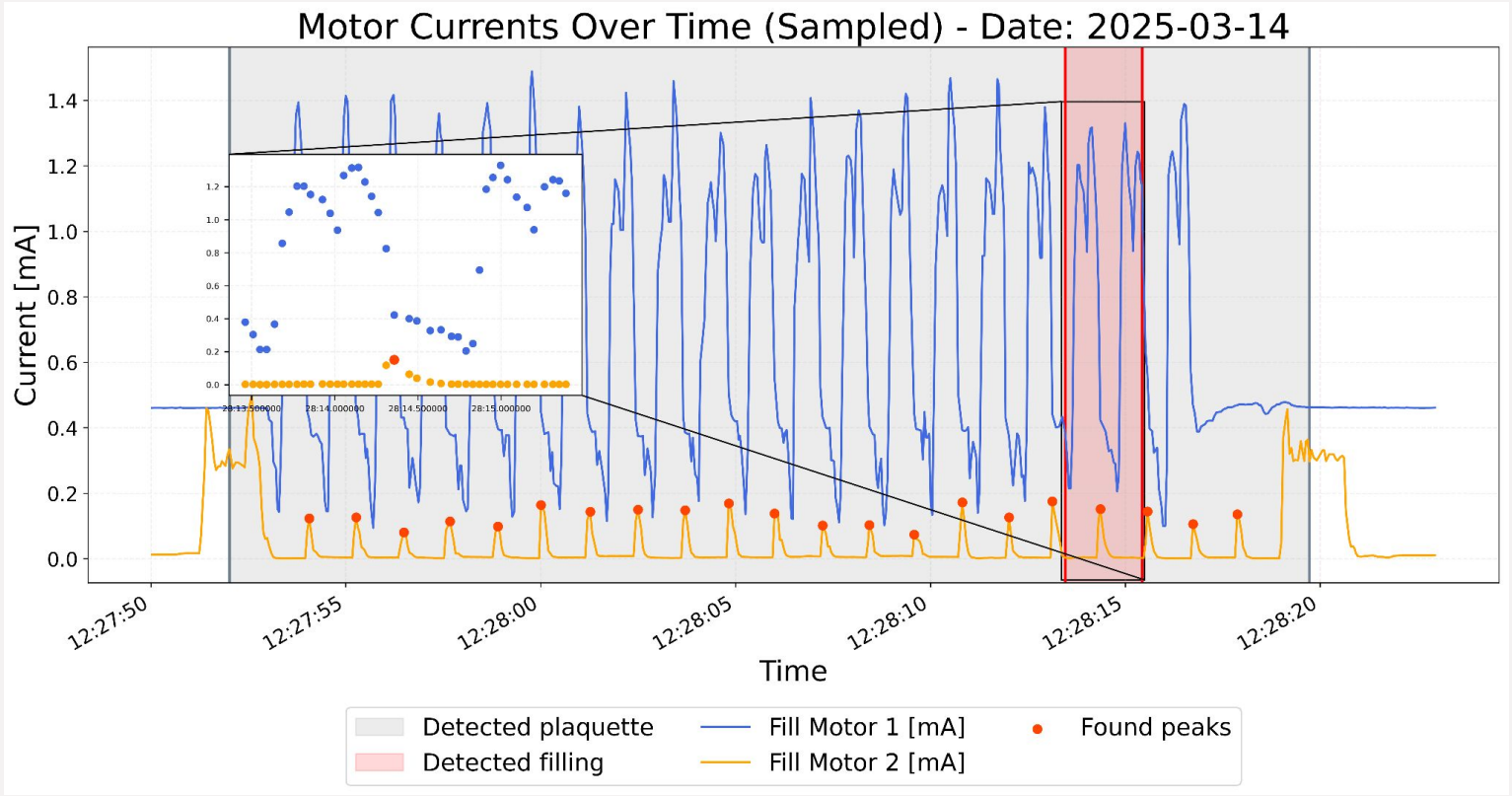




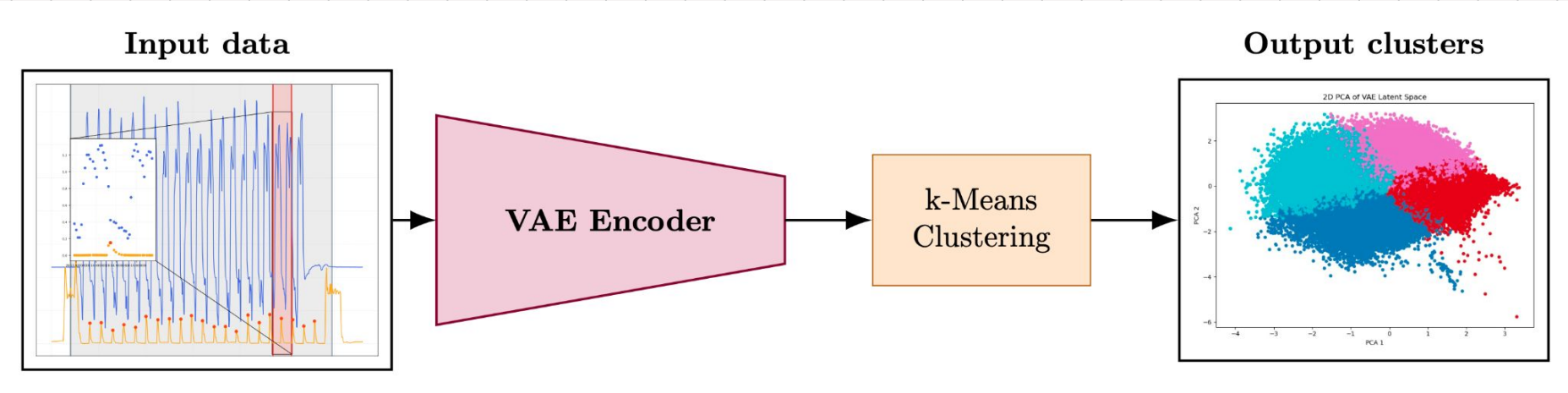
Detecting start and end of fillings

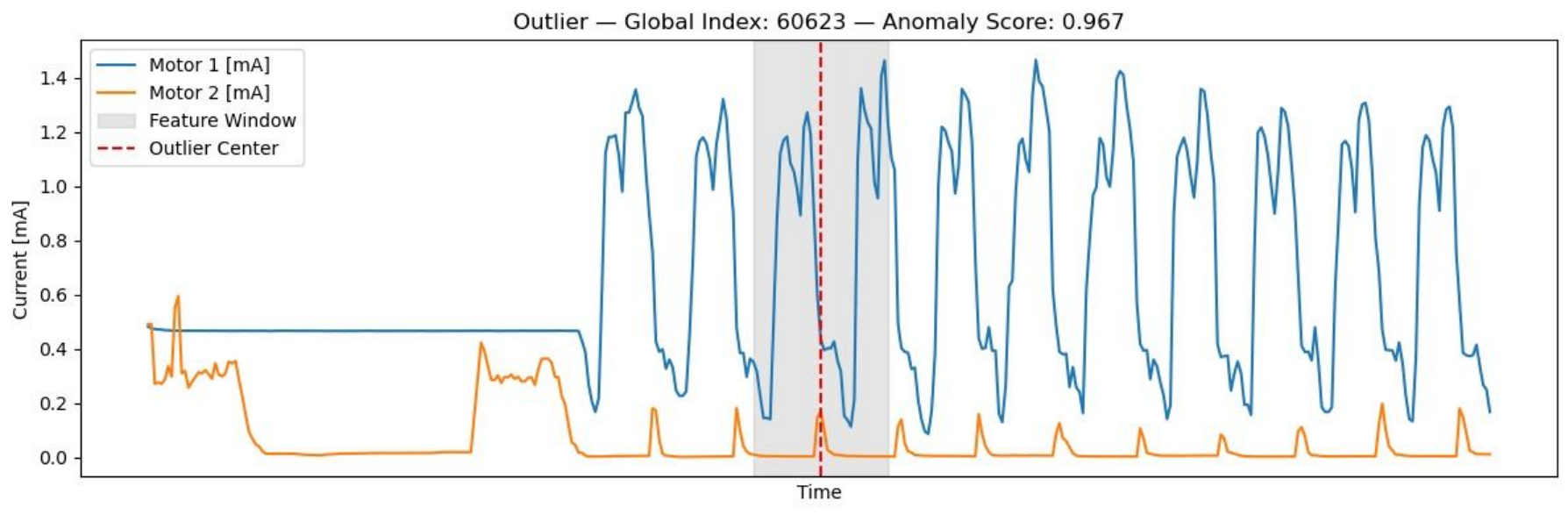


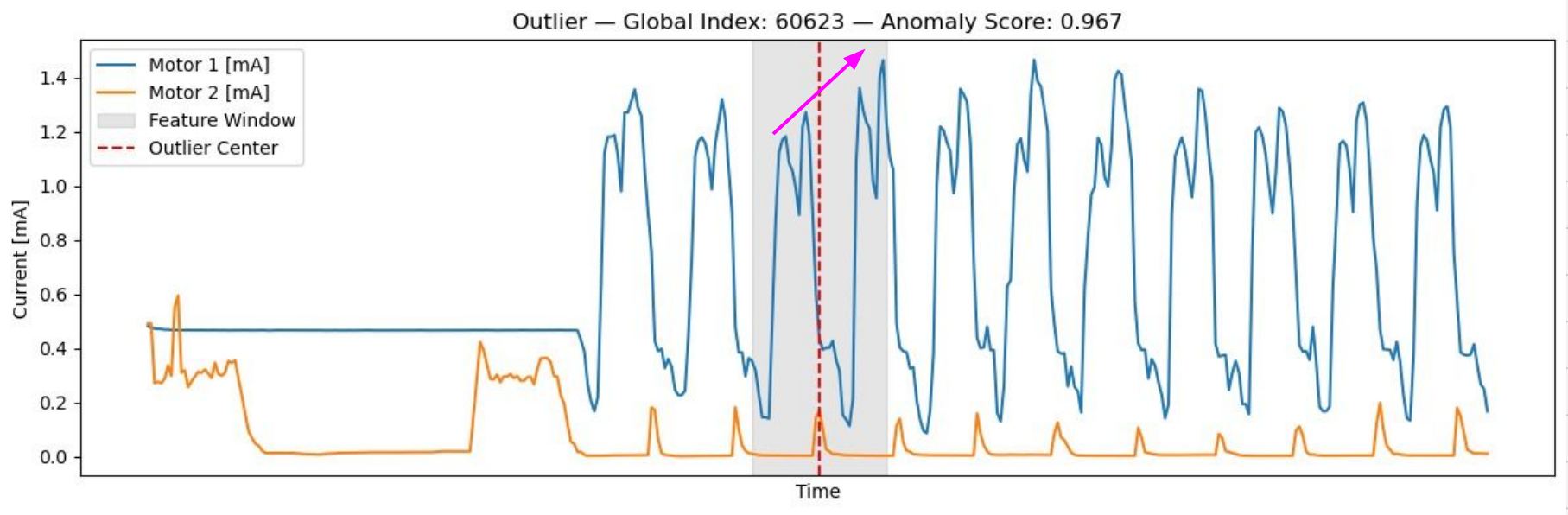
Detecting start and end of fillings

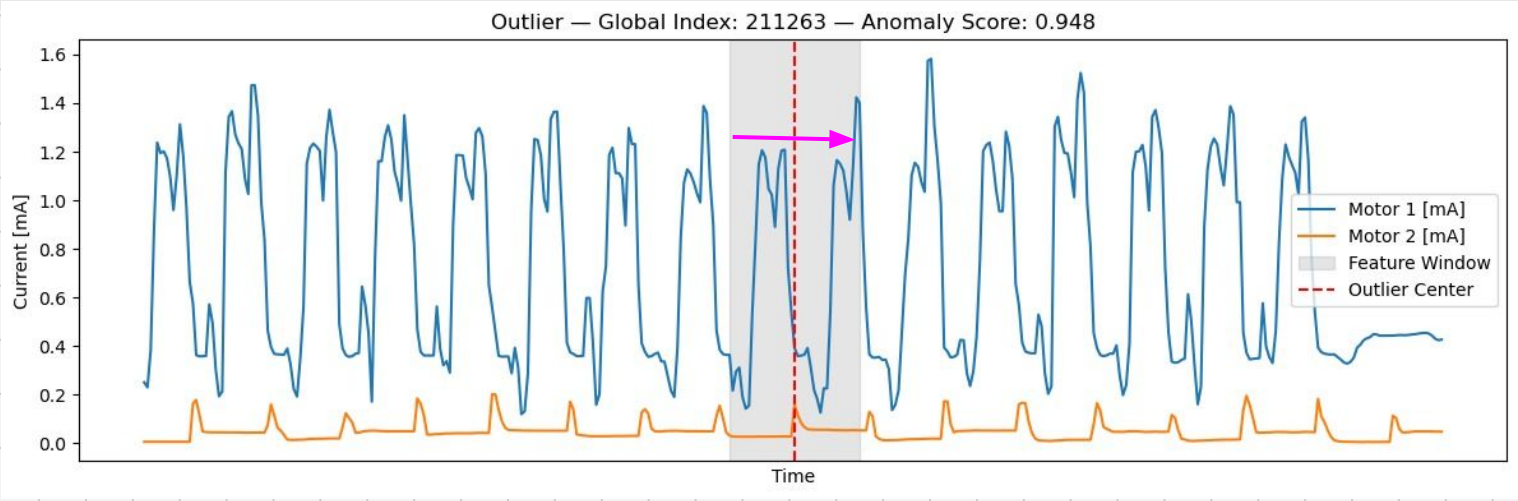


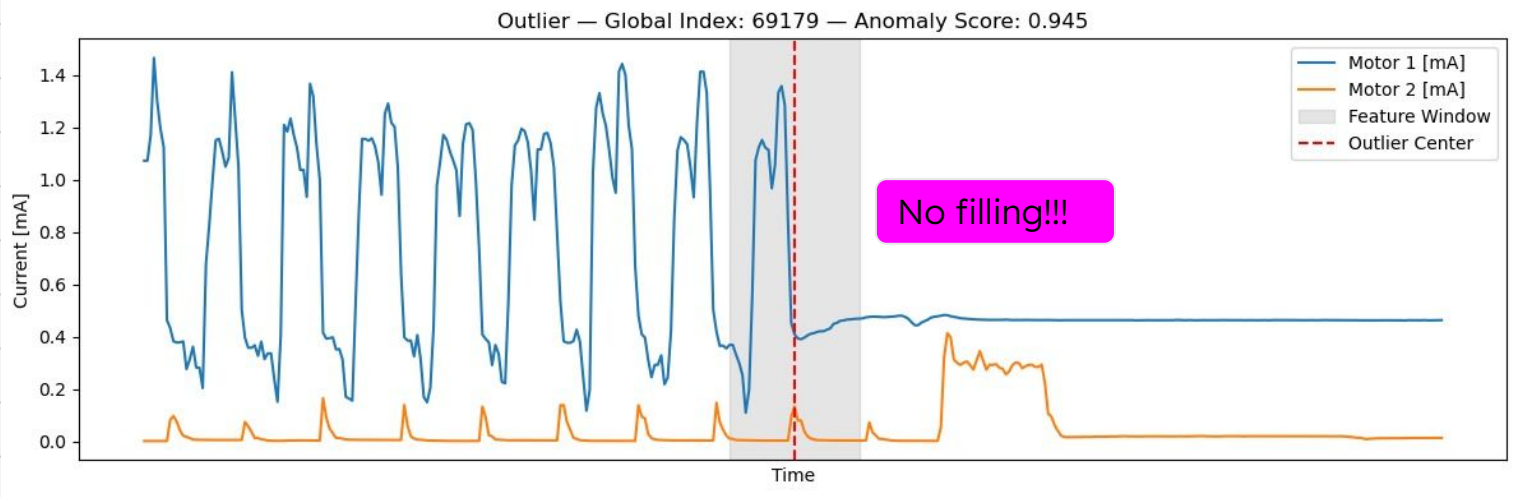
Model description

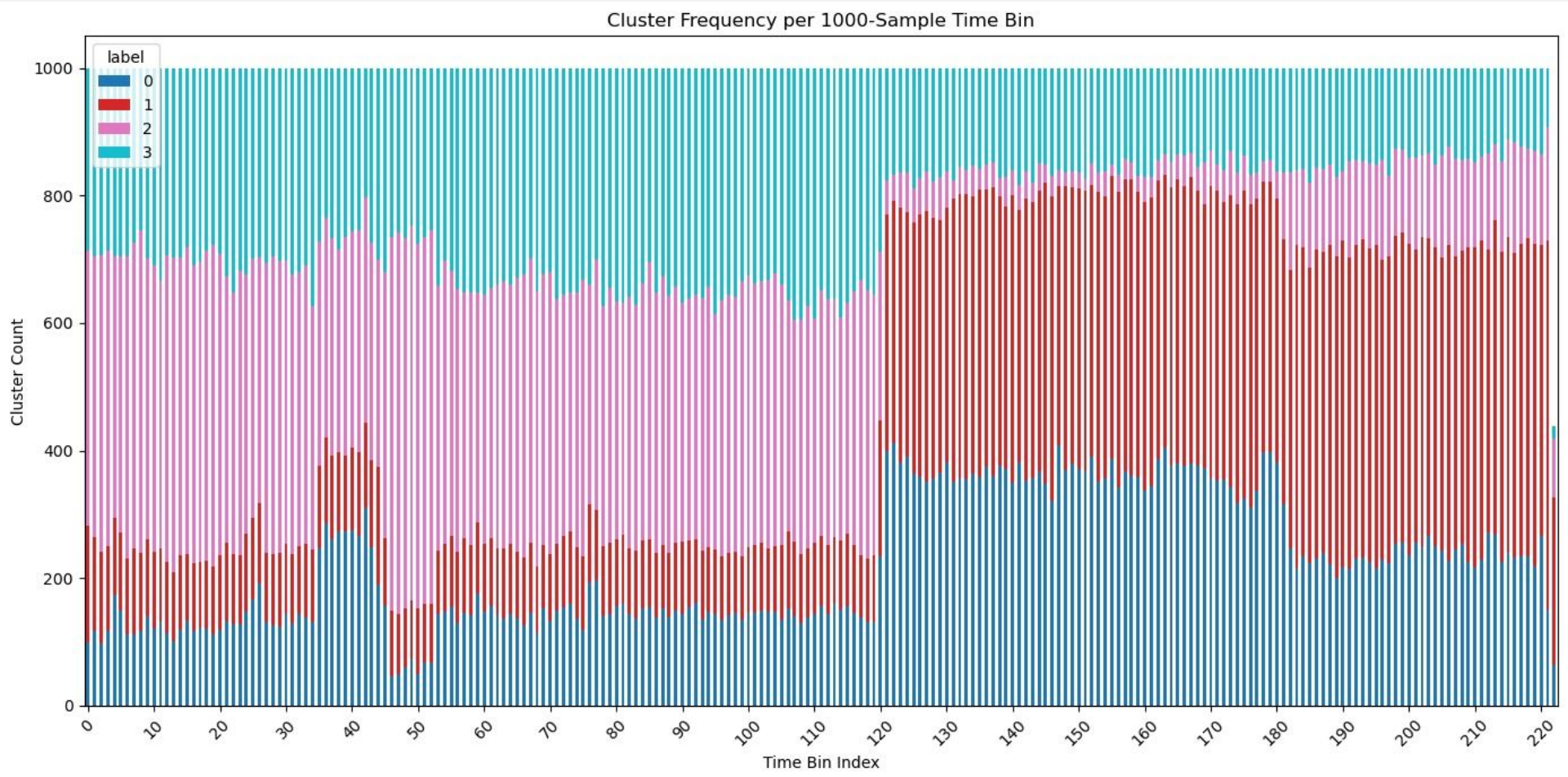


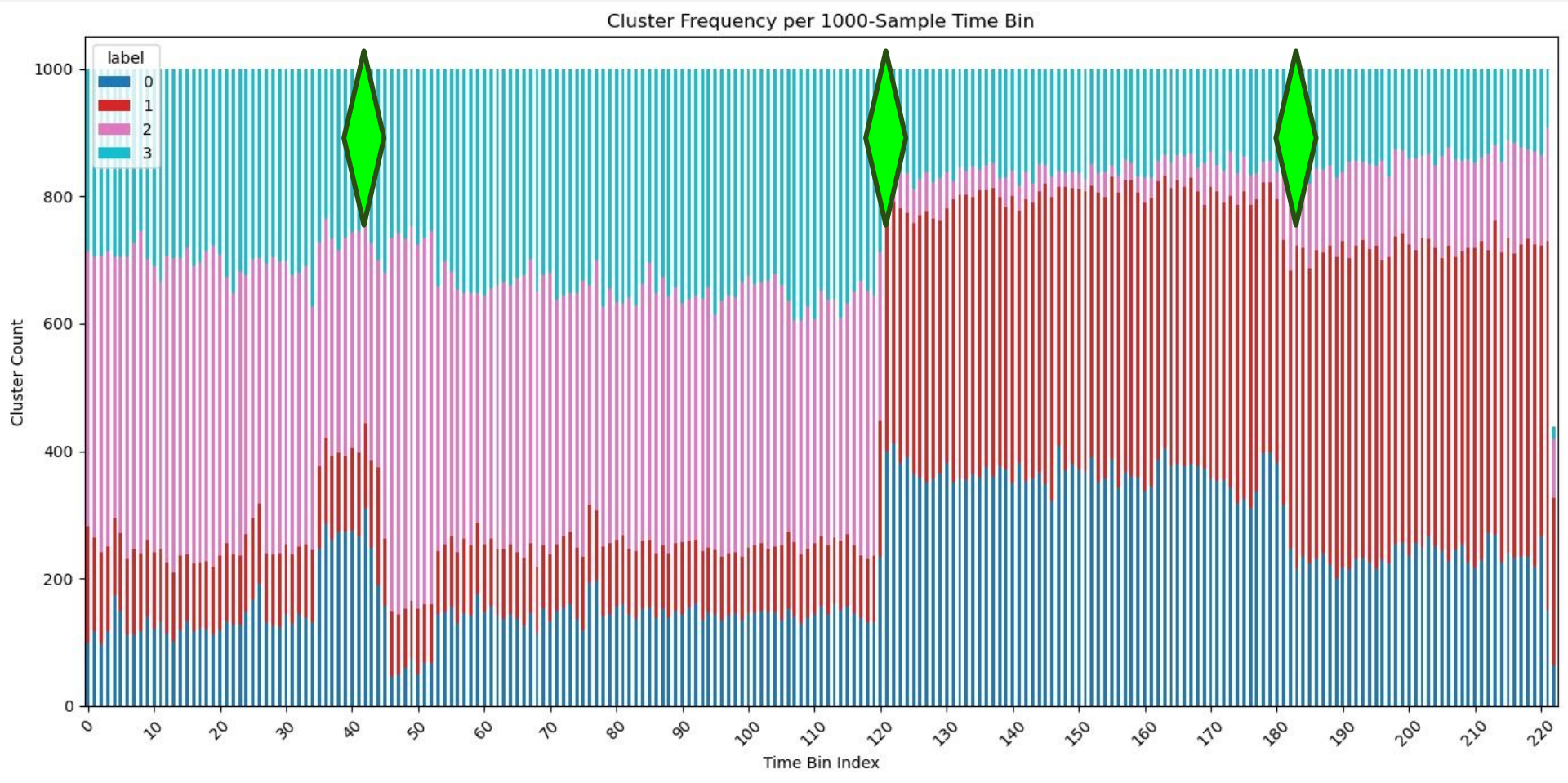

Outlier — Global Index: 60623 — Anomaly Score: 0.967
Motor 1 [mA]
Motor 2 [mA]
Feature Window
Outlier Center
Current [mA]
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Time


Outlier — Global Index: 60623 — Anomaly Score: 0.967
Motor 1 [mA]
Motor 2 [mA]
Feature Window
Outlier Center
Current [mA]
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Time


Outlier — Global Index: 211263 — Anomaly Score: 0.948
Current [mA]
Time
Motor 1 [mA]
Motor 2 [mA]
Feature Window
Outlier Center


Outlier — Global Index: 69179 — Anomaly Score: 0.945
Current [mA]
Time
Motor 1 [mA]
Motor 2 [mA]
Feature Window
Outlier Center
No filling!!!


Cluster Frequency per 1000-Sample Time Bin
label
0
1
2
3
Cluster Count
Time Bin Index
0
200
400
600
800
1000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220


Cluster Frequency per 1000-Sample Time Bin
label
0
1
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Cluster Count
Time Bin Index
0
200
400
600
800
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0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220

Hardware Outlook

Closed loop

Nvidia Jetson Nano to run modern AI workloads directly on devices.
Versatile and affordable for closed loops

Outlook

- **Possible correlations between motors**
- **Add analysis via camera sensors in setup**
- **Label data for further improvements**

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Thank you! :)

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References

https://www.youtube.com/watch?v=ubEiAir5wBU (30.07.2025)

https://www.researchgate.net/publication/324182043/figure/fig2/AS:611534271168512@1522812540433/Latent-space-visualization-of-the-10-MNIST-digits-in-2-dimensions-of-both-N-VAE-left.png (31.07.2025)

https://www.vernetzte-adaptive-produktion.de/de/jcr:content/contentPar/sectioncomponent_cop/sectionParsys/textwithinlinedimage/imageComponent1/image.img.png/1666003437162/icnap-logo-10x15.png (31.07.2025)

https://www.kaggle.com/code/lucfrachon/anomaly-detection-using-vaes (31.07.2025)