



# ANOMALY DETECTION IN BIOSENSOR WAVEFORMS

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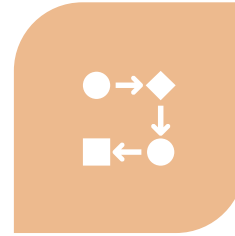




INTRODUCTION



PRE-PROCESSING  
STEPS



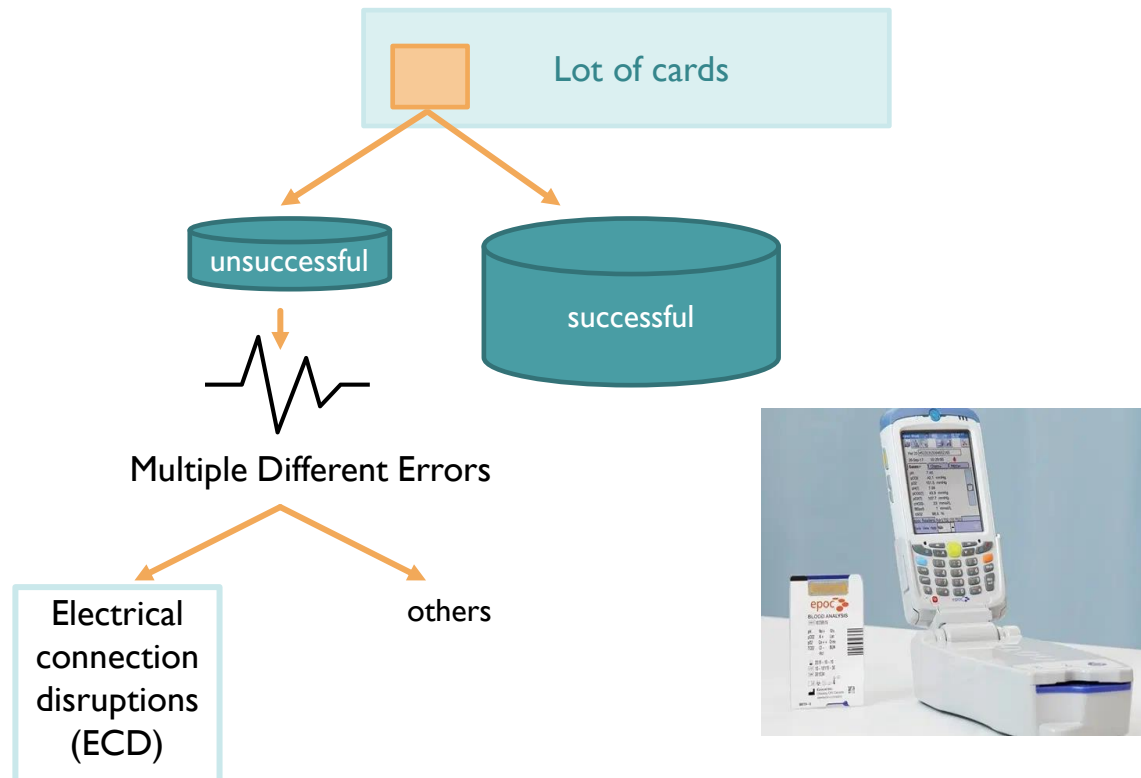
PROMISING  
PIPELINES



INTERPRETATIONS

# AGENDA

# BACKGROUND



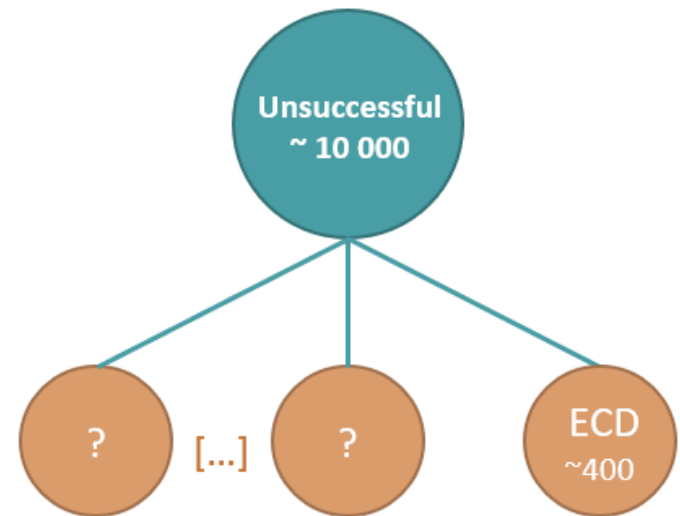
# AIMS AND OBJECTIVES

What :

- Characterize the unsuccessful readings into different groups

Why :

- Help identify possible root causes of failure

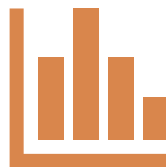


# RESEARCH GOALS

How :



**Build**

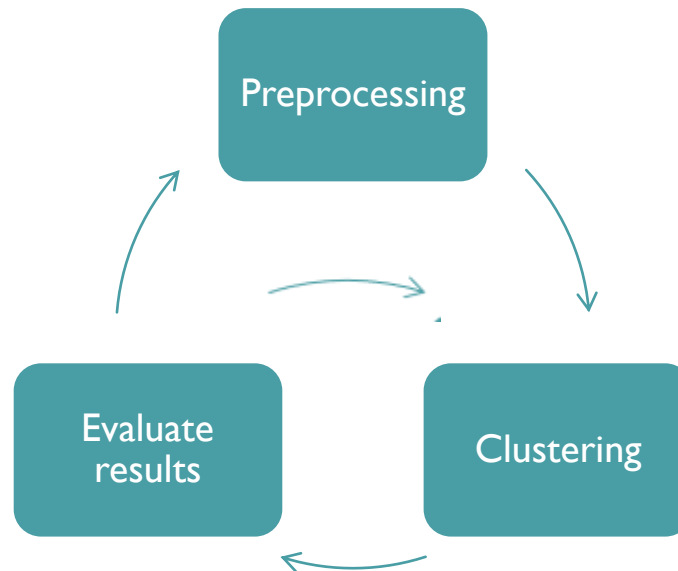


**Evaluate**

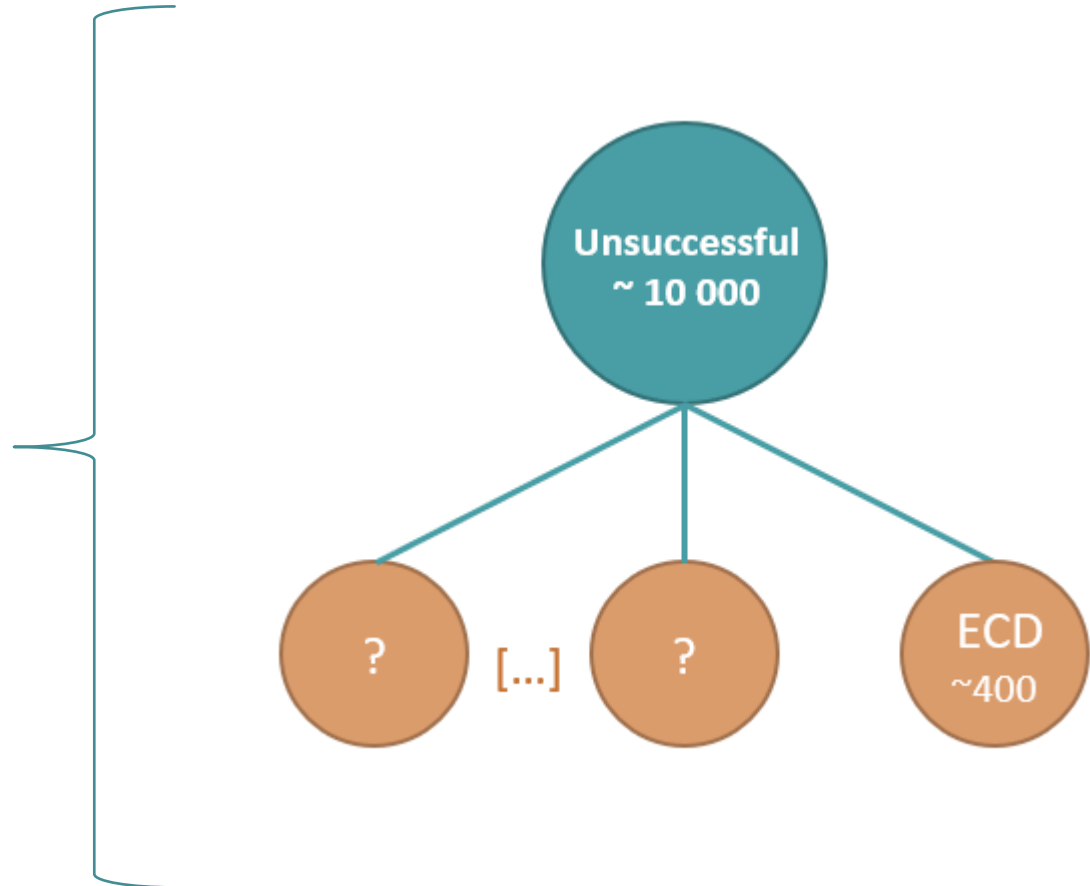
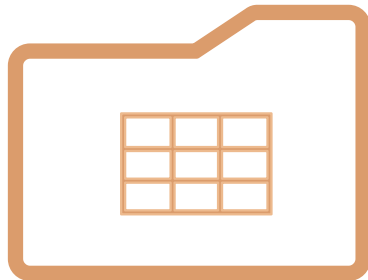


**Describe**

# METHODS OVERVIEW

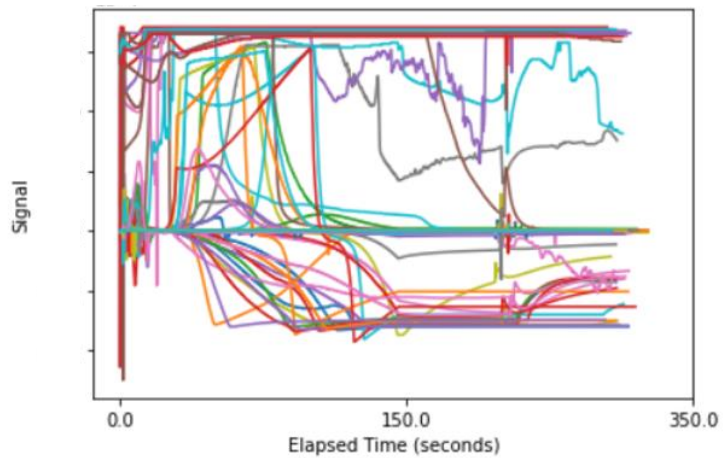


# DATA

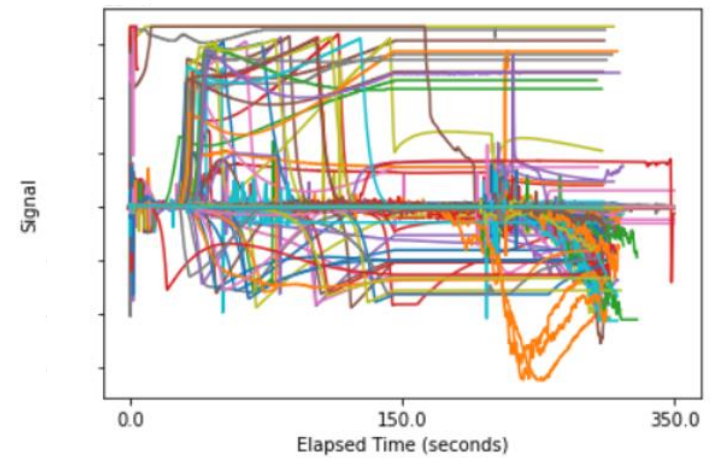


# DATA

ECD Errors



Other (Unlabelled) Unsuccessful







# PREPROCESSING

Aligned



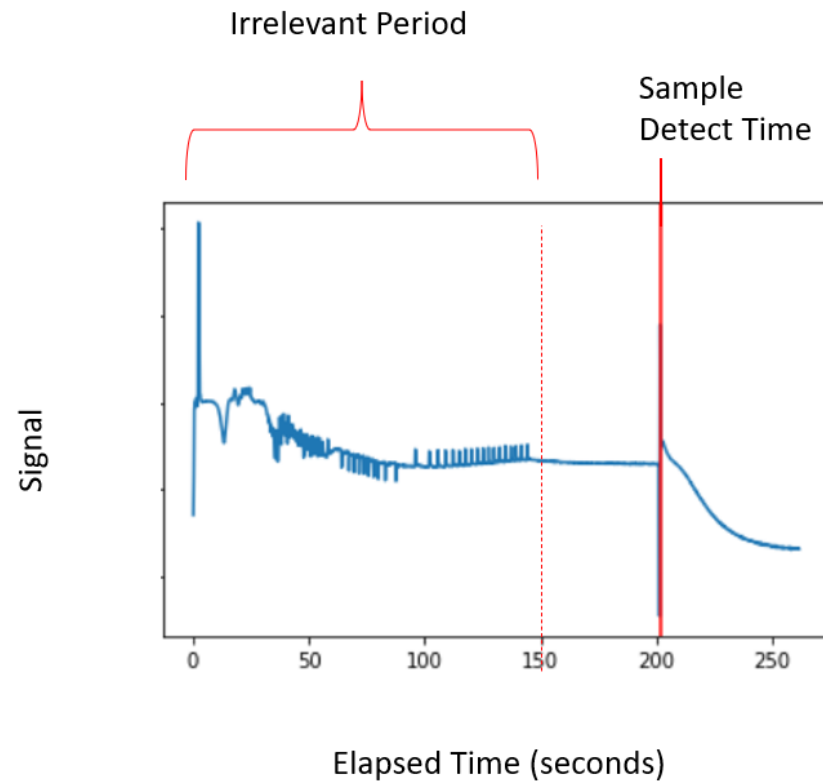
Subset



Scaled



Smoothed



Aligned



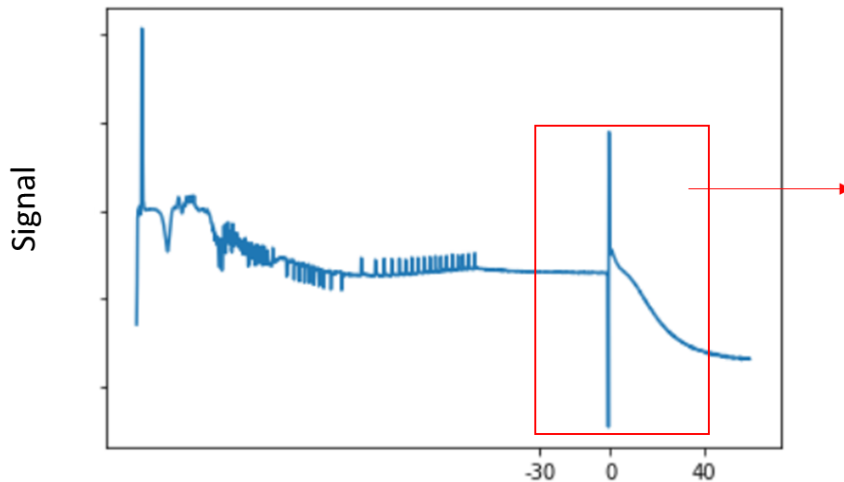
Subset



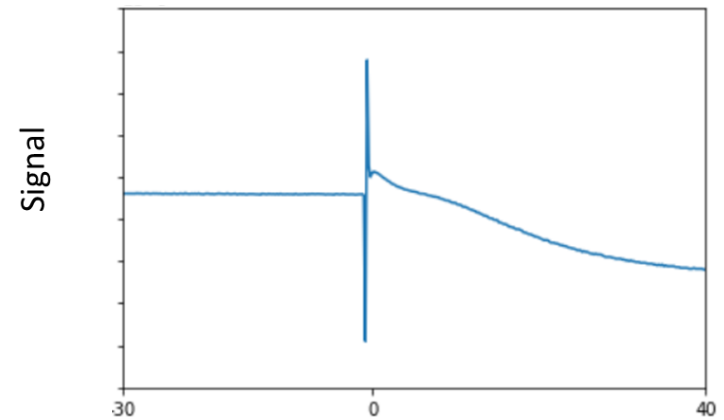
Scaled



Smoothed



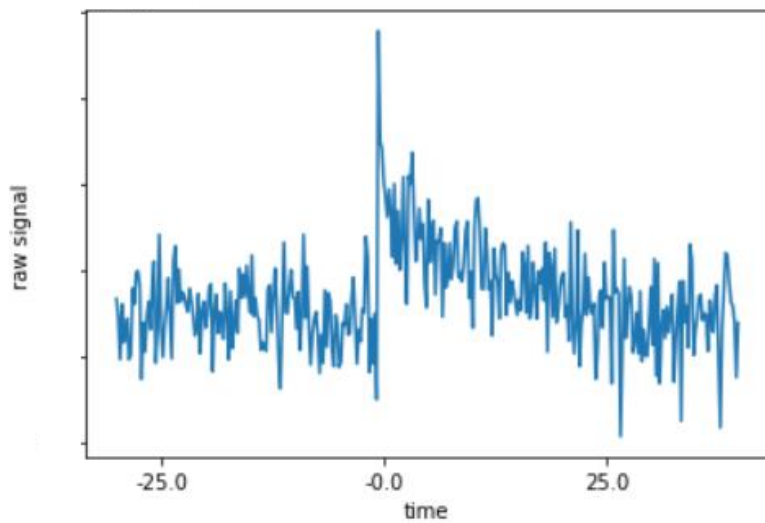
Elapsed Time (seconds with respect to consistent time point)



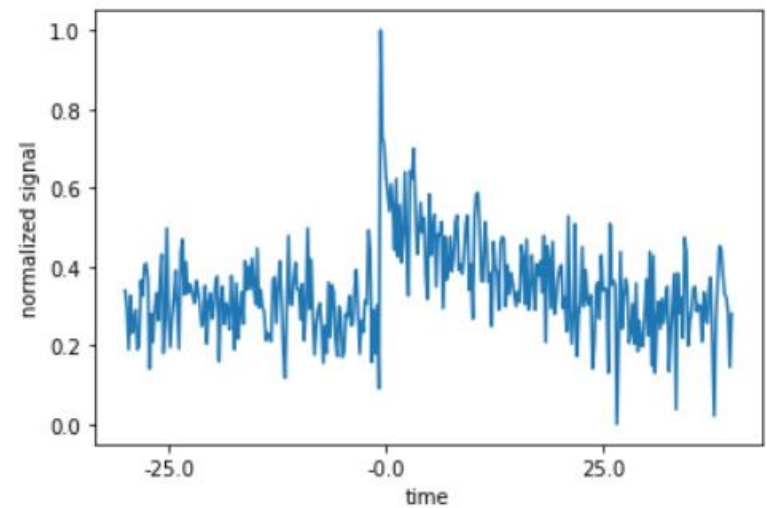
Elapsed Time (seconds with respect to consistent time point)



Raw



Scaled



Aligned



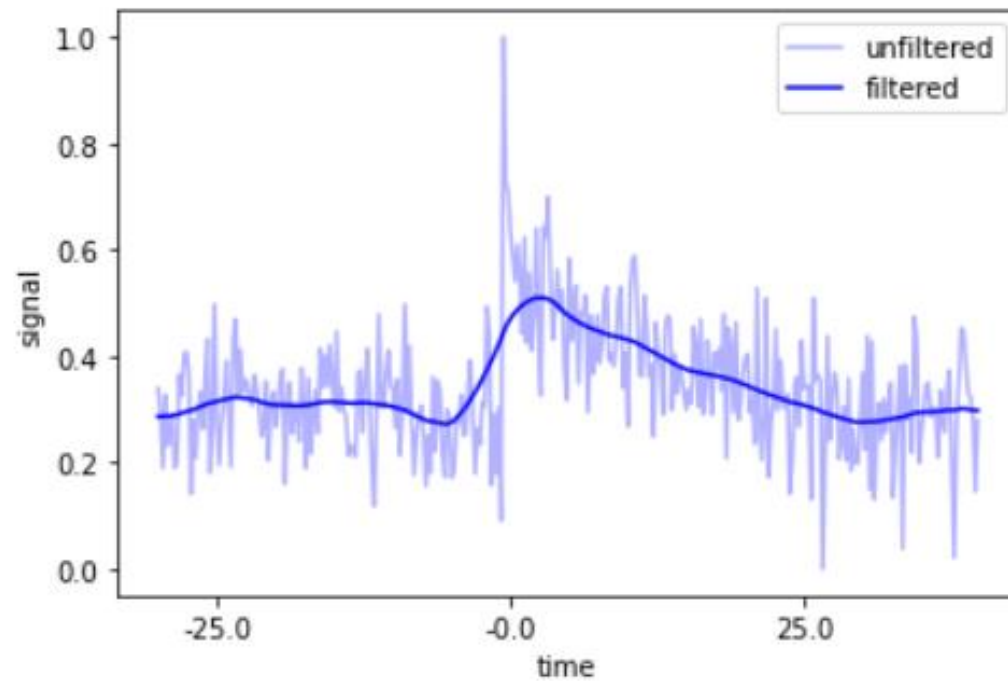
Subset

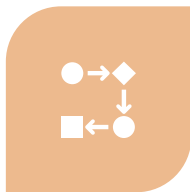


Scaled



Smoothed

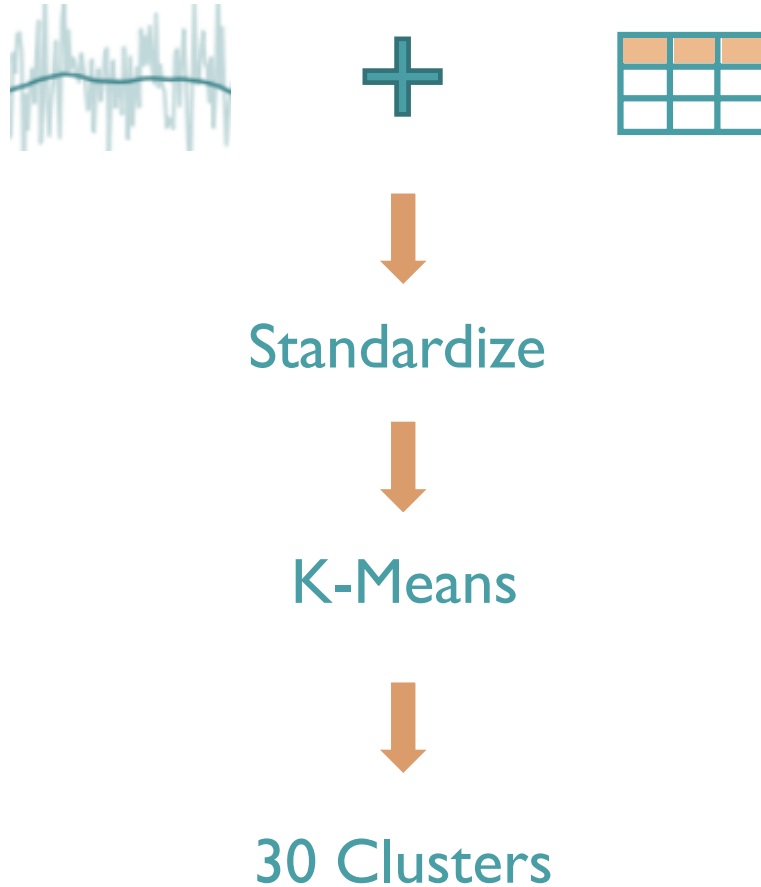




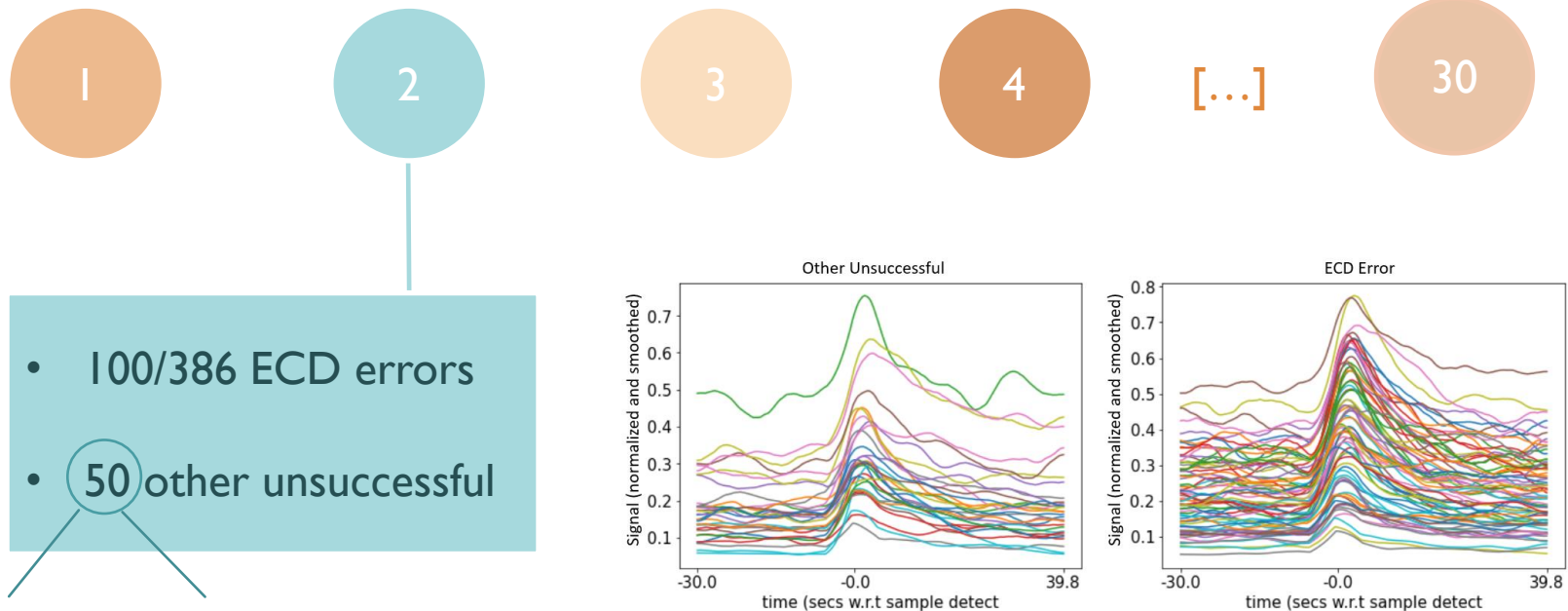
# PIPELINES

Pipeline	Aggregate Predictors Used	Feature Extraction	Clustering
1	3	None	K-Means (EUC)
2	12	None	K-Shape
3	22	Autoencoder + PCA	GMM
4	22	None	K-Shape

# PIPELINE I



# PIPELINE I



35 unlabelled ECDs    15 ECDs from another analyte



# PIPELINE I

1

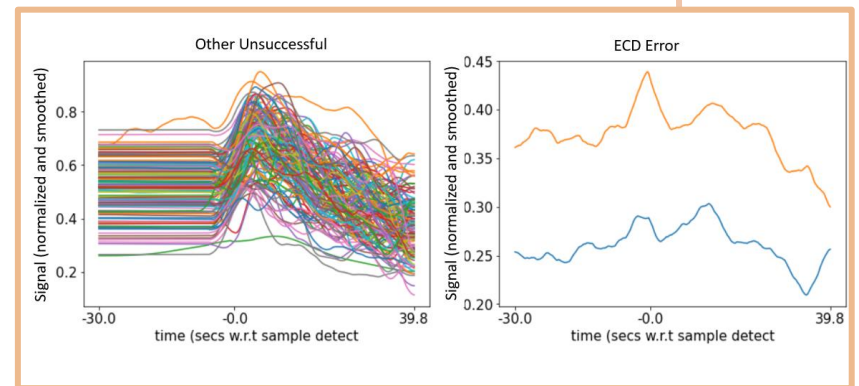
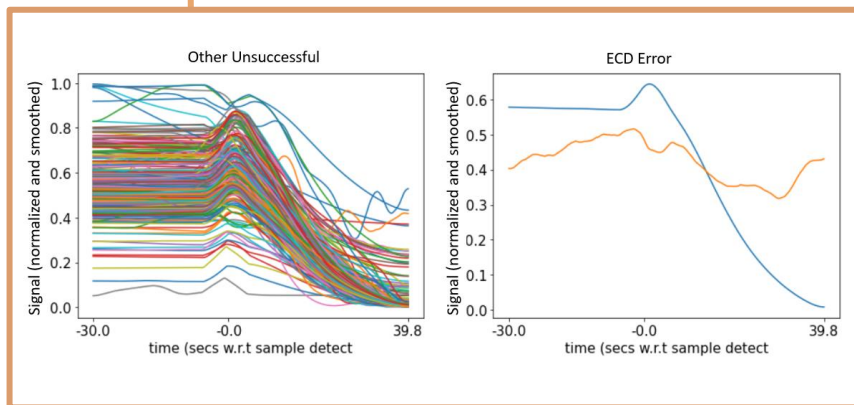
2

3

4

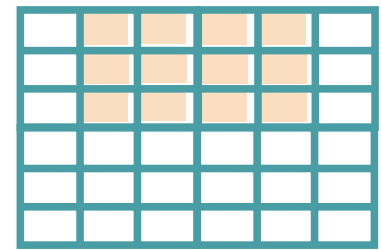
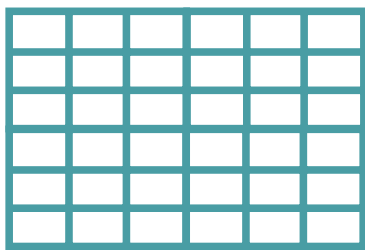
[...]

30

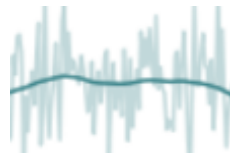


PIPELINE 1 → PIPELINE 2

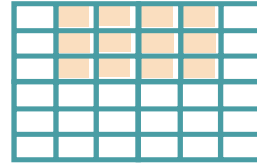
# PIPELINE 2



# PIPELINE 2



+



Standardize

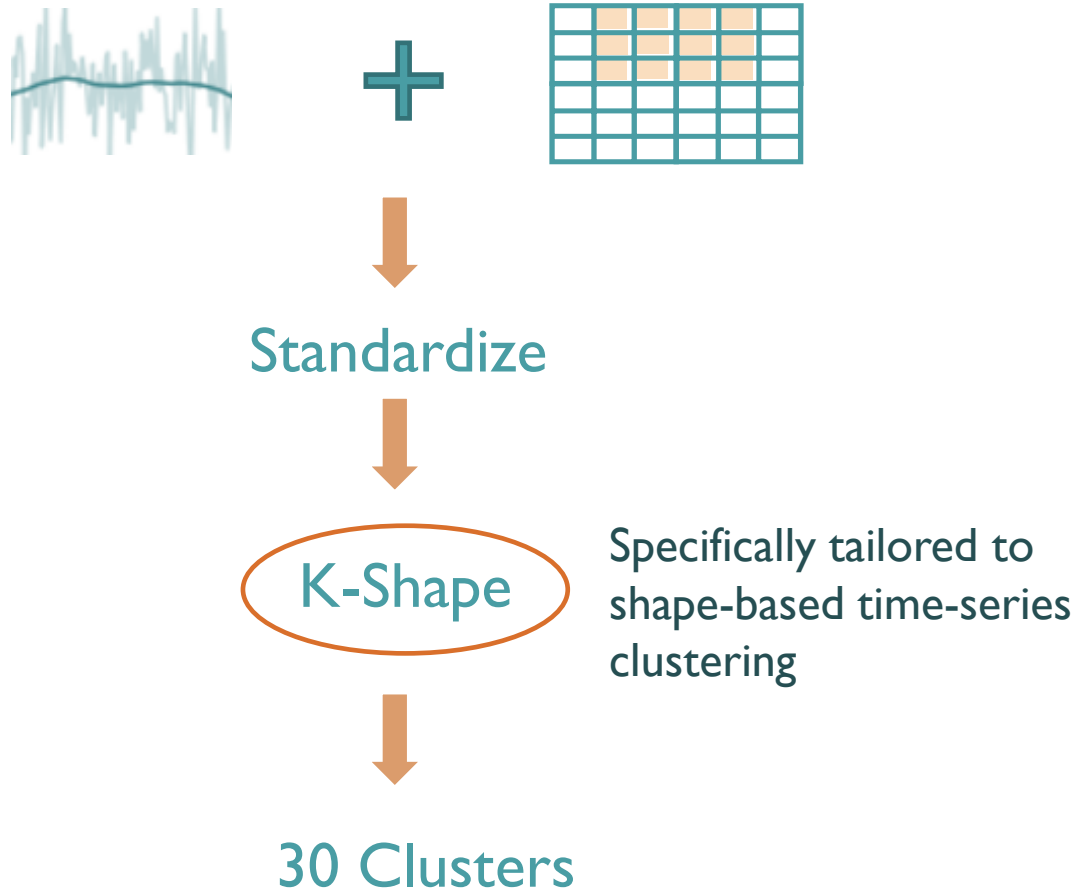


K-Shape



30 Clusters

# PIPELINE 2



# PIPELINE 2

1

2

3

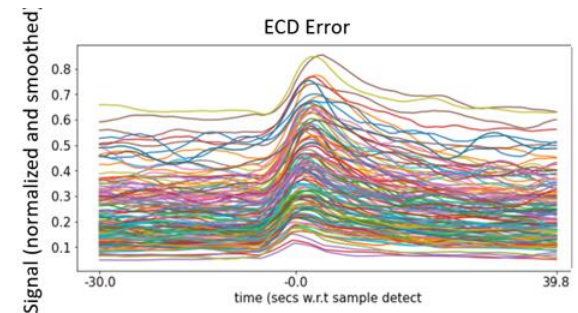
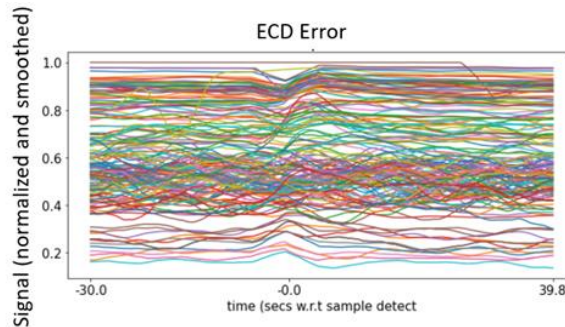
4

[...]

30

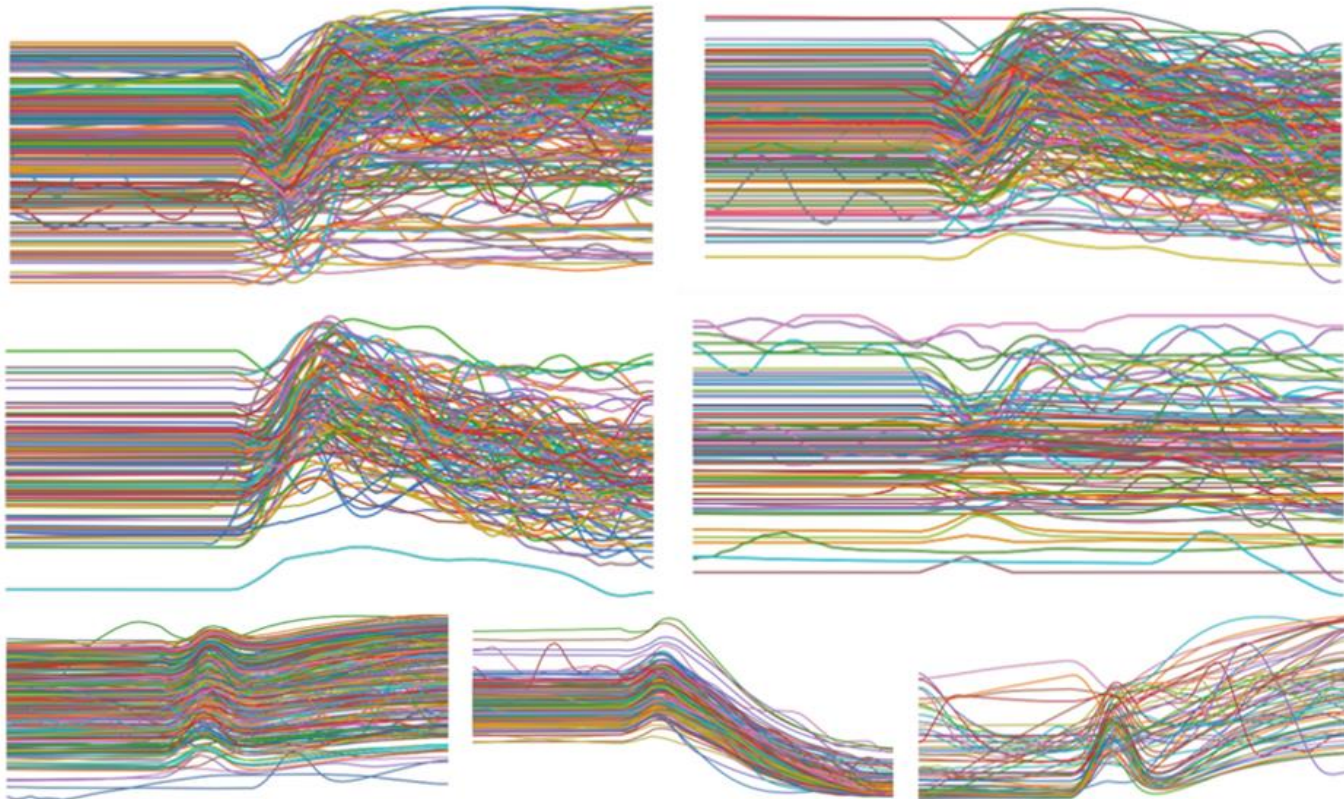
- 177/421 ECD
- 280 other unsuccessful

- 160/421 ECD
- 22 other unsuccessful



# PIPELINE 2

## ECD FREE CLUSTERS

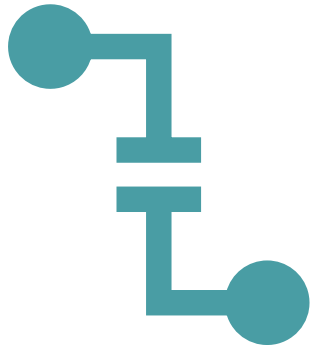




# INTERPRETATIONS



# WHICH PIPELINE IS THE BEST?



- We found pipelines which can
  - Somewhat isolate ECD errors
  - Cluster other similar waveform shapes together

## POTENTIAL IMPACT MOVING FORWARD



↑ ability to **identify** ECD errors



**Link** unsuccessful **waveforms** to **manufacturing** changes over time

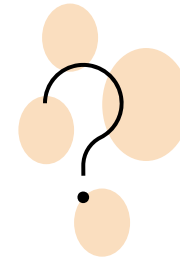


Tools to **process**, **cluster**, and **visualize** waveforms

# CONCERNS



Overfitting on  
ECD Labels



Evaluating the other  
clusters

# SUGGESTIONS FOR FUTURE WORK

1

Filter errors with  
other sensors  
first

2

Reduce the  
number of  
clusters

3

Change  
preprocessing  
steps

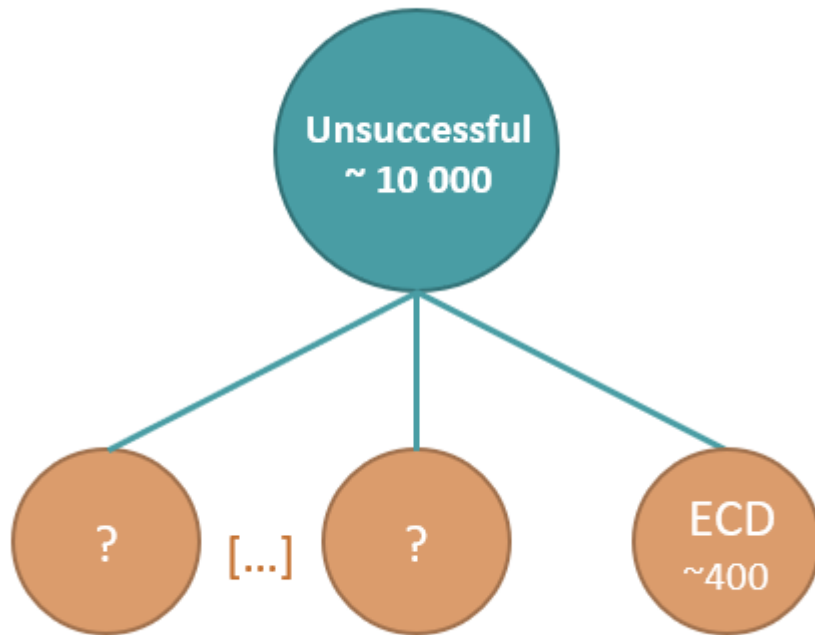
4

Other metrics  
for cluster  
evaluation

# ACKNOWLEDGMENTS



- Thank you so much to:
  - Siemens Healthineers
    - Levannia Lildhar
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    - Dr. Moosvi
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# SUMMARY