Monitoring the Performance of Flow Meters Through Advanced Modelling Techniques

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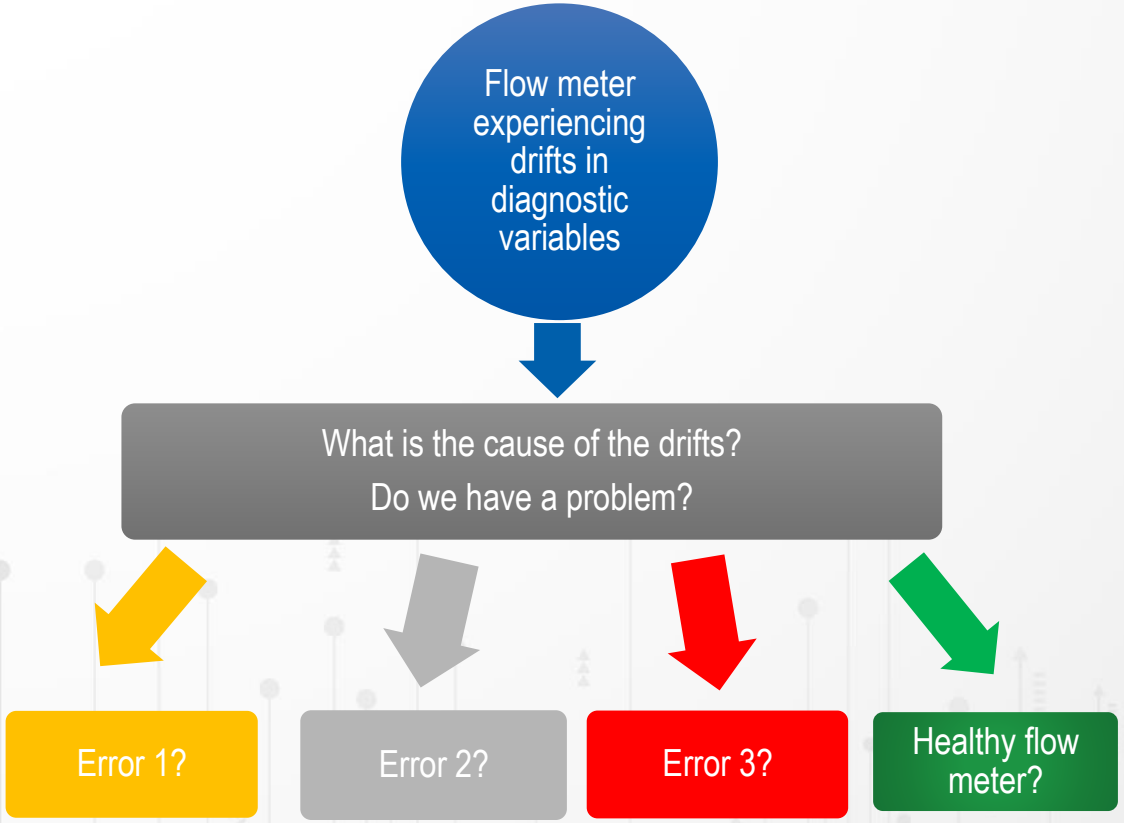
Content

Introduction

- Potential measurement errors can be detected by drifts in both individual and combinations of digital process values.
- Challenge of being able to distinguish between errors as some errors can incur the same types of drifts in the same variables.
- Without using modelling techniques, it is difficult to fully understand the correlation between different variables.
- Data driven models can be constructed to analyse the relationship between process variables under different conditions.
- Future predictions can be made using those models to aid decision making and improve our efficiency.



Predict the Cause of Drifts in USMs

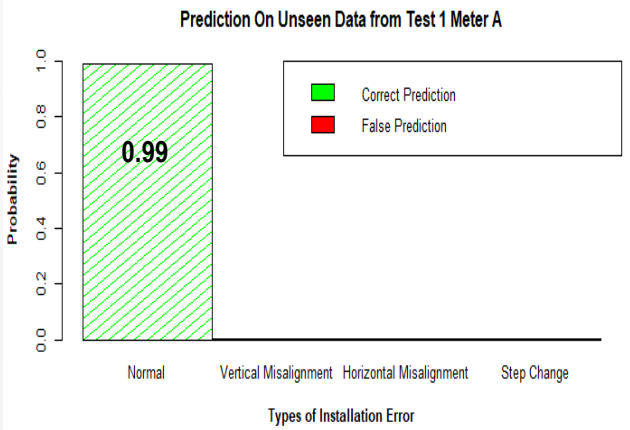
Case Study 1: Installation Error

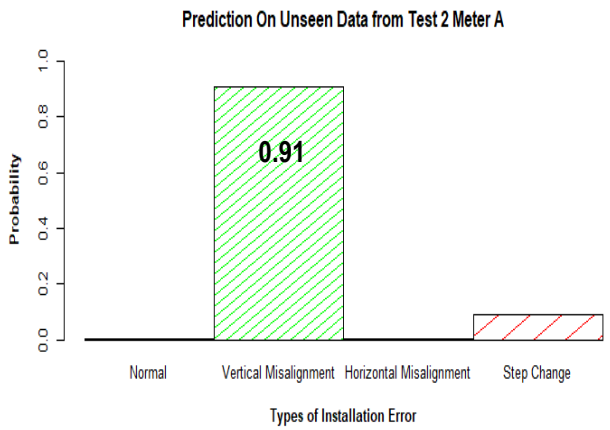
- We consider 4 conditions:
  - Normal Ideal Set up
  - Horizontal Misalignment
  - Vertical Misalignment
  - Step Change
- **Aim**: Use machine learning models to predict the types of installation error based on drifts and patterns seen in diagnostic variables.

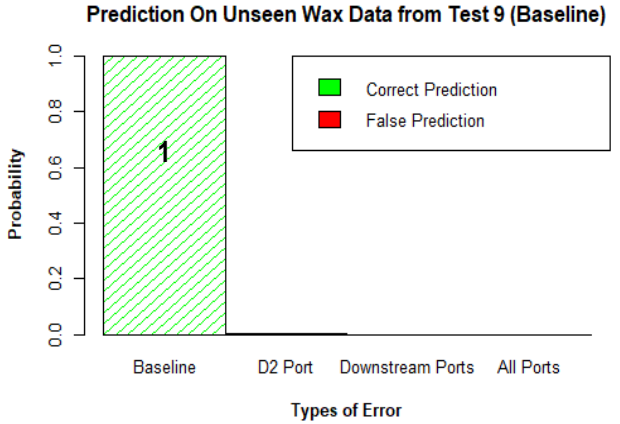
Case Study 2: Wax deposition

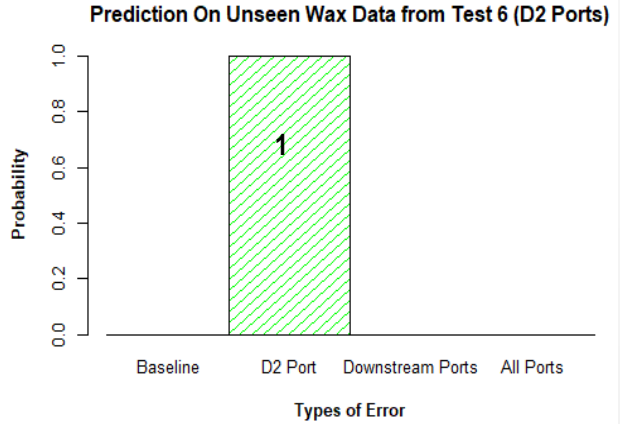
- We consider 4 different conditions:
  - No wax present
  - Wax in 1 downstream port
  - Wax in all downstream ports
  - Wax in all ports
- **Aim**: Use machine learning models to predict the location of wax build up based on drifts and patterns seen in diagnostic variables.

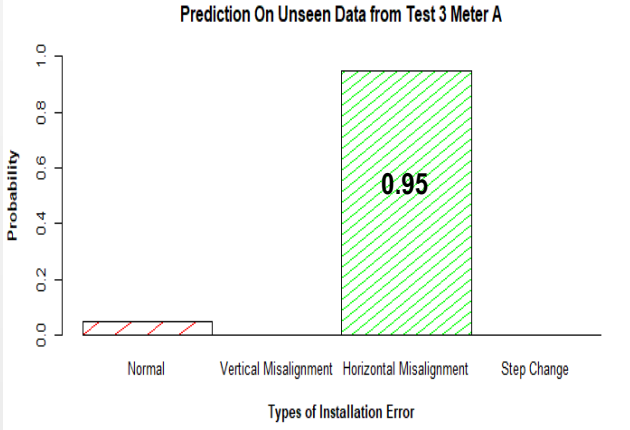
Prediction Results: Case Studies 1 and 2

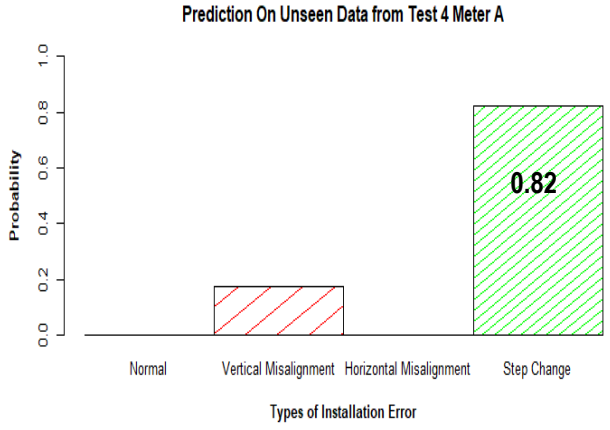


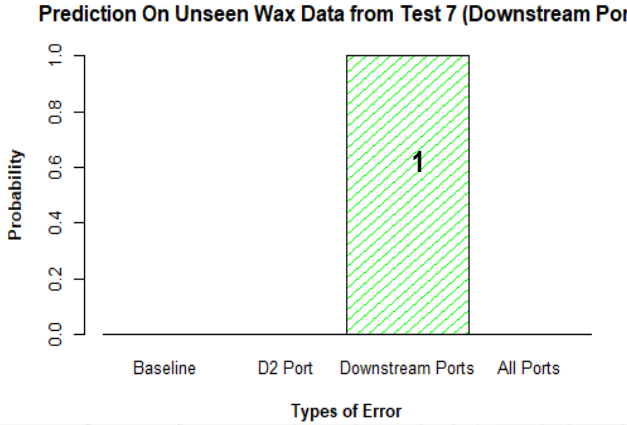


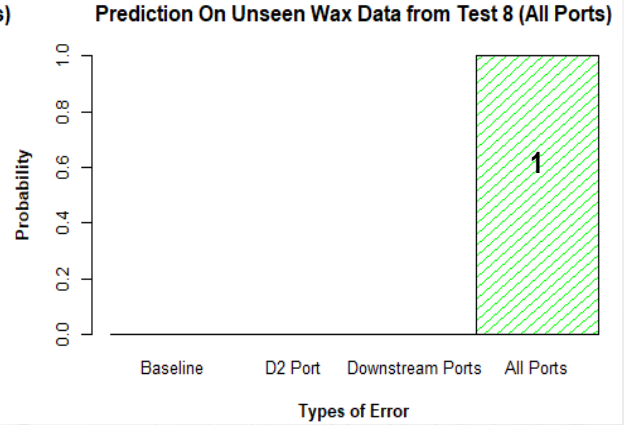








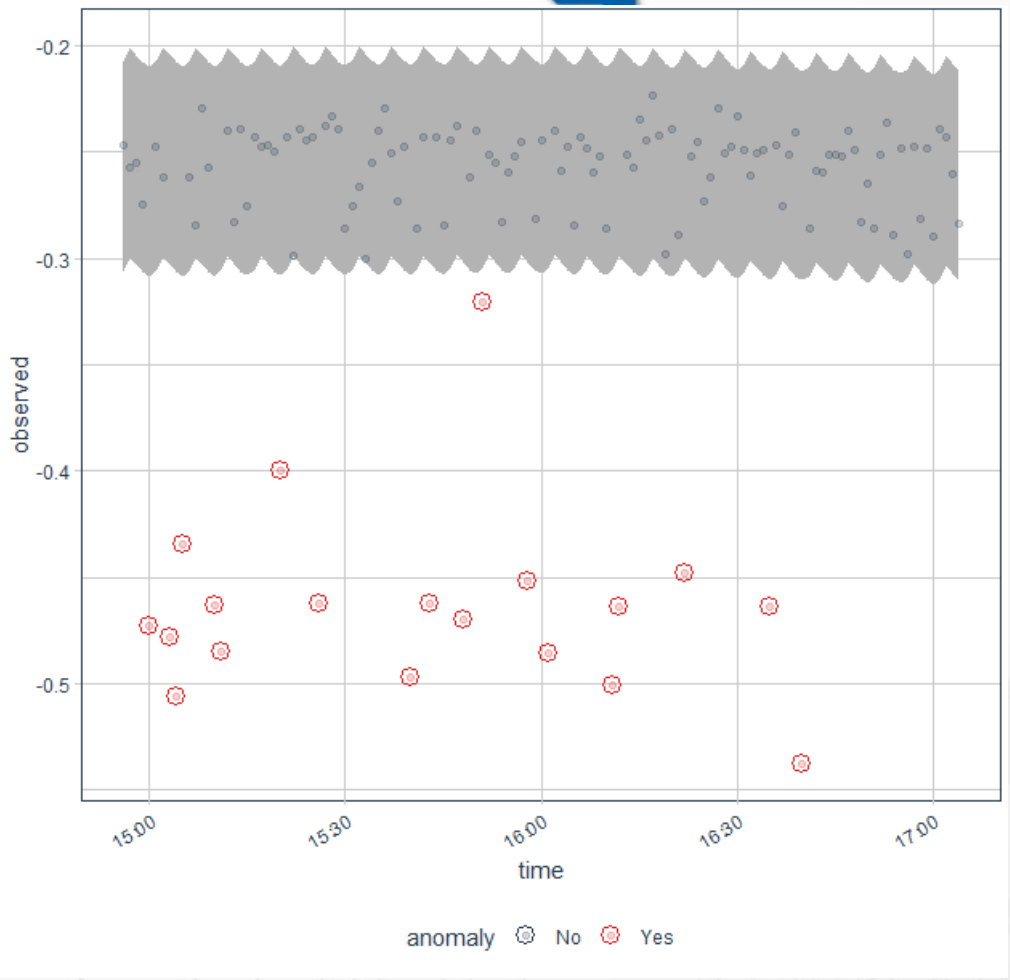




Case Study 3: Anomaly Detection Model on USM Data

- Examine the trend of data and alert end-users to the presence of anomalies which could indicate potential problems in flow meters.

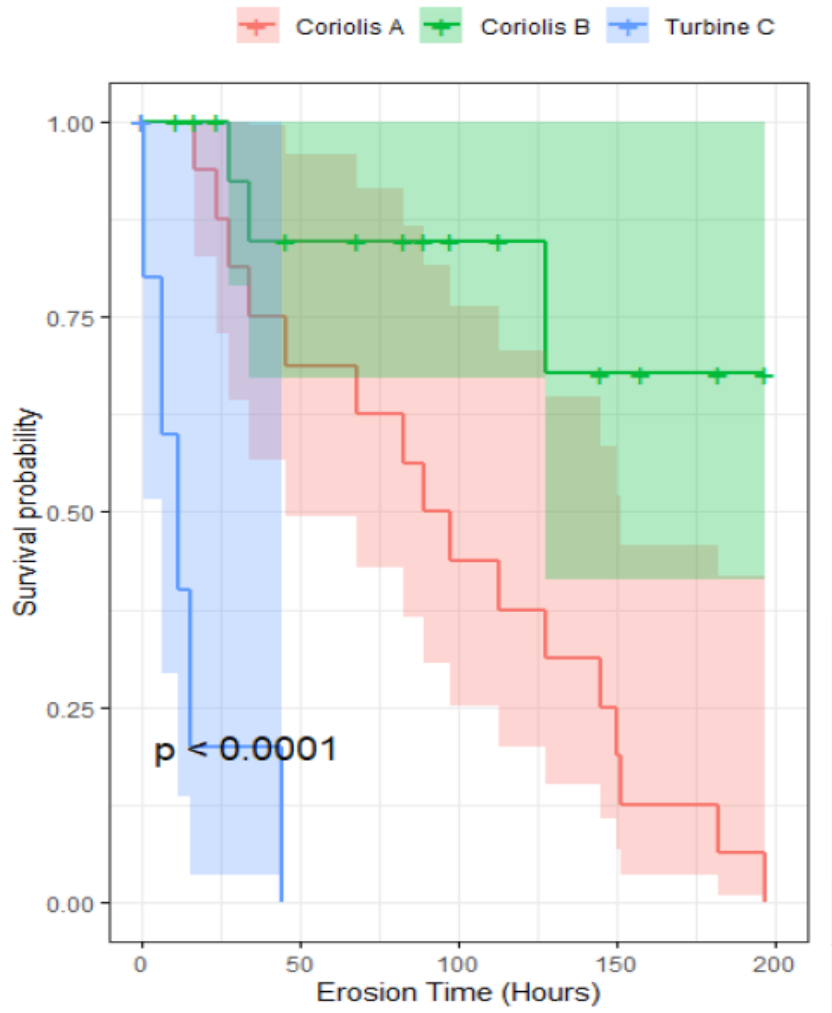
- Red dots: anomalies
- Black dots: healthy data
- Grey region: anomalies threshold



Case Study 4: Predict the Remaining Useful Life of Flow Meters

- In hydrocarbon recovery, the presence of sand within fluid is inevitable.
- Predict the failure rates of flow meters at certain time period through advanced probability analysis when exposed to sand-water with 5% silica sand (180-250 microns) by weight.
- Aid decision-making process by estimating the remaining useful life of flow meters.
- **Aim**: Predicting the remaining useful life of Coriolis meters and turbine meter when exposed to sand erosion.

Case Study 4: Remaining Useful Life of Flow Meters



- Coriolis Meter B was more resistant towards sand erosion.
- Turbine Meter C was the worst affected by sand erosion.
- After 120 hours of sand erosion:
  - Meter A : 63% chance would fail.
  - Meter B: 16% chance would fail.
  - Meter C: Failed

Conclusion

- Additional insights can be extracted from data using advanced data-driven models
  - ✓ Enable condition-based monitoring and predictive maintenance
  - ✓ Improve fault diagnosis process, reduce unexpected downtime.
  - ✓ Errors can be rectified promptly.
  - ✓ Reduce operating costs.

- 4 case studies were mentioned:
  - **High accuracy prediction** achieved in determining the exact cause of drifts. Overcome ambiguity problem in drifts.
  - **Anomalies detected** in data when end-users might not expect any anomalies.
  - **Remaining useful life of flow meters was predicted** when exposed to erosive flow. Better decision can be made in selecting the most suitable meter and when to replace meter.

Collecting and storing data are not enough. Valuable insight and opportunities can only be unlocked if appropriate modelling strategies are used to extract the underlying values in data.

NORTH SEA FLOW MEASUREMENT WORKSHOP

measuring for the energy transition

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