Data driven case-study of a wind turbine main-bearing failure

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Introduction

- Main bearing failures increasingly important
- Fault detection allows early warning and planning time
- Necessary to first understand data and possible learning features.

Fig 1: Main bearing failure due to bearing wear. (windpowerengineering.com)

This presentation: SCADA data and vibration analysis for a given fault example

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The Datasets

- Preliminary algorithmic development using OREC SCADA data.
- Case study data:
  - Supplied by Natural Power
  - Outer race main bearing fault on ~2MW wind turbine
  - 1+ year SCADA data
  - 1+ year 8kHz vibration data

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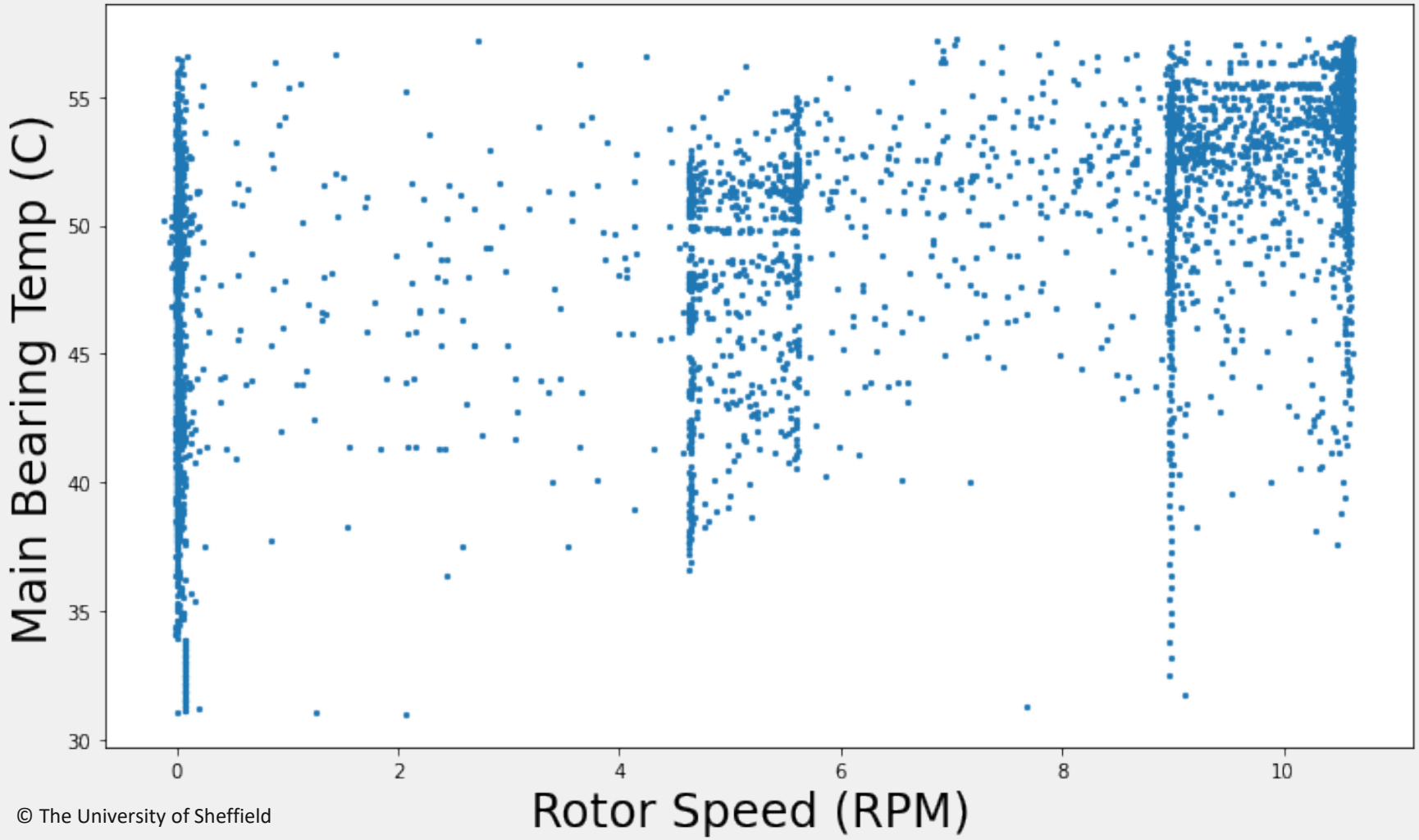
SCADA analysis- considering the data



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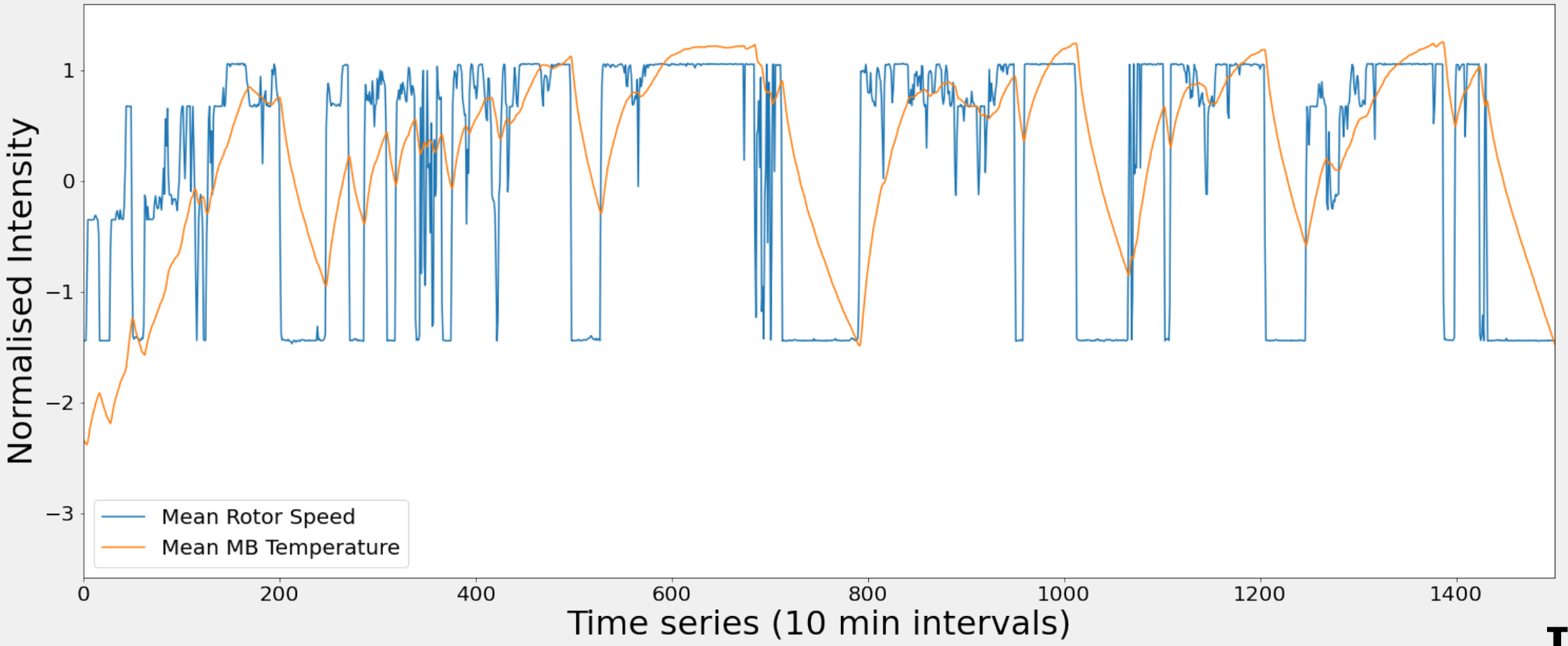
Thermal inertia evident in time series



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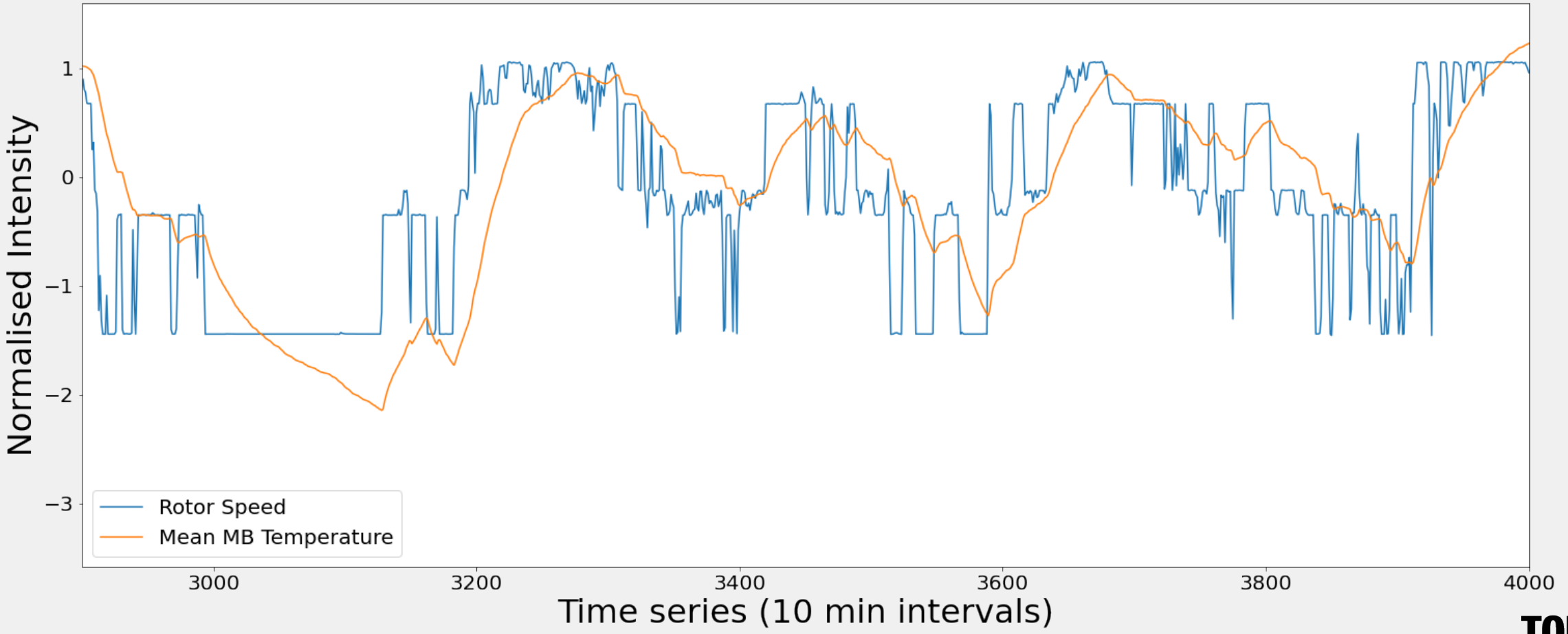
How might this be accounted for?



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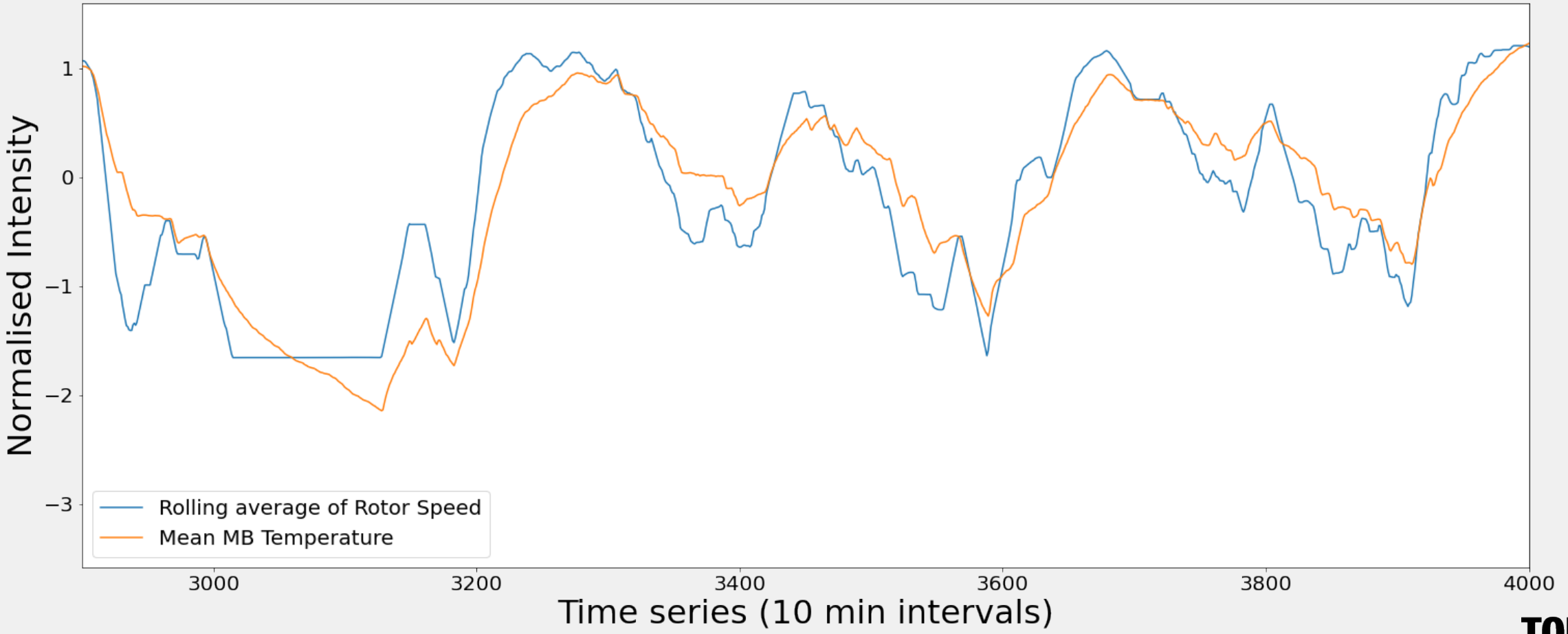
Step 1: rolling average



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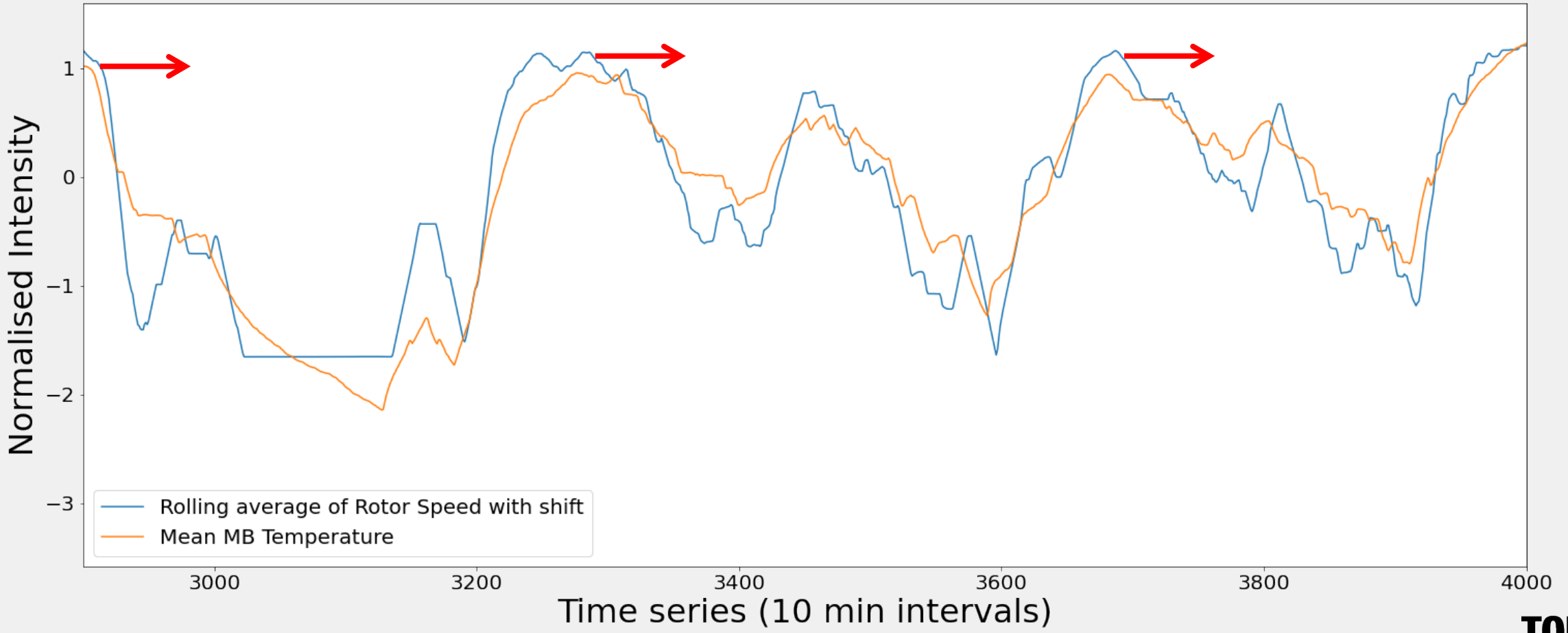
Step 2: time shift, maximising correlation



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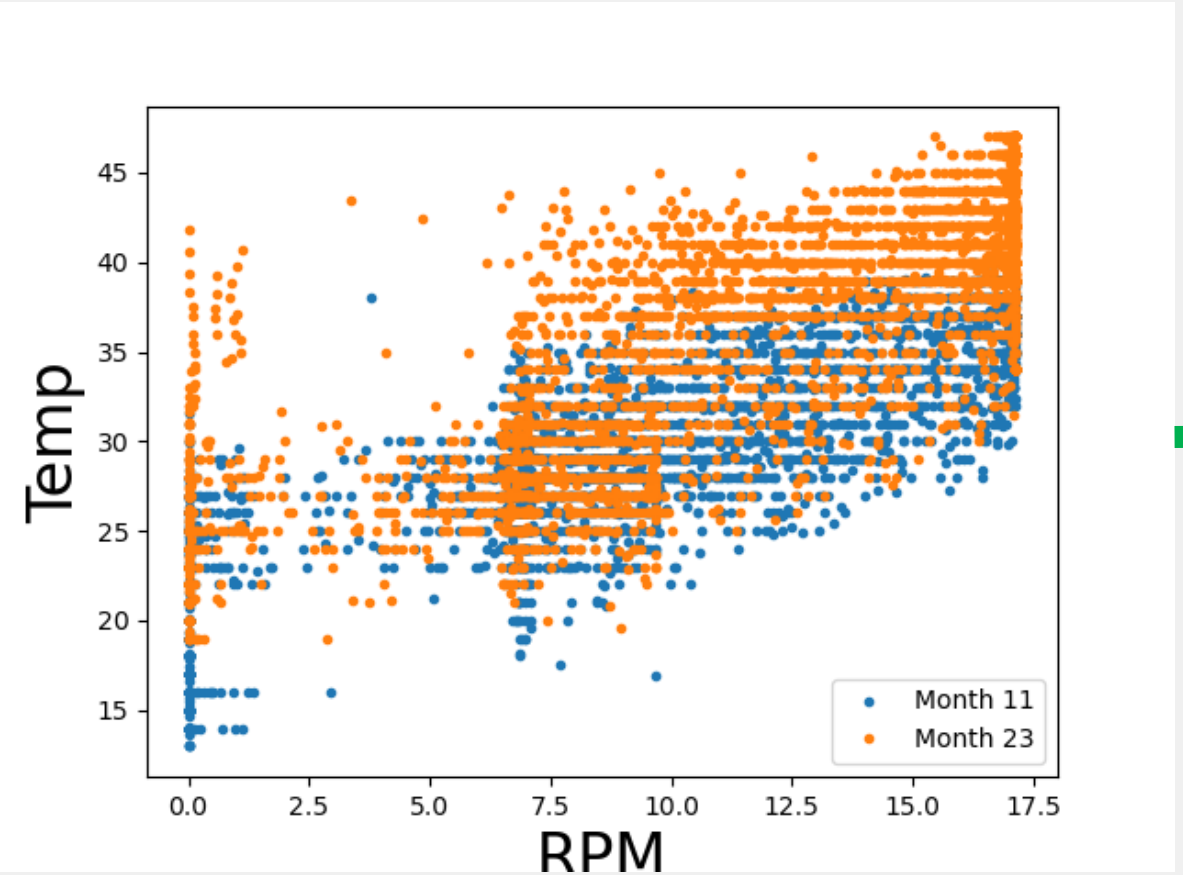
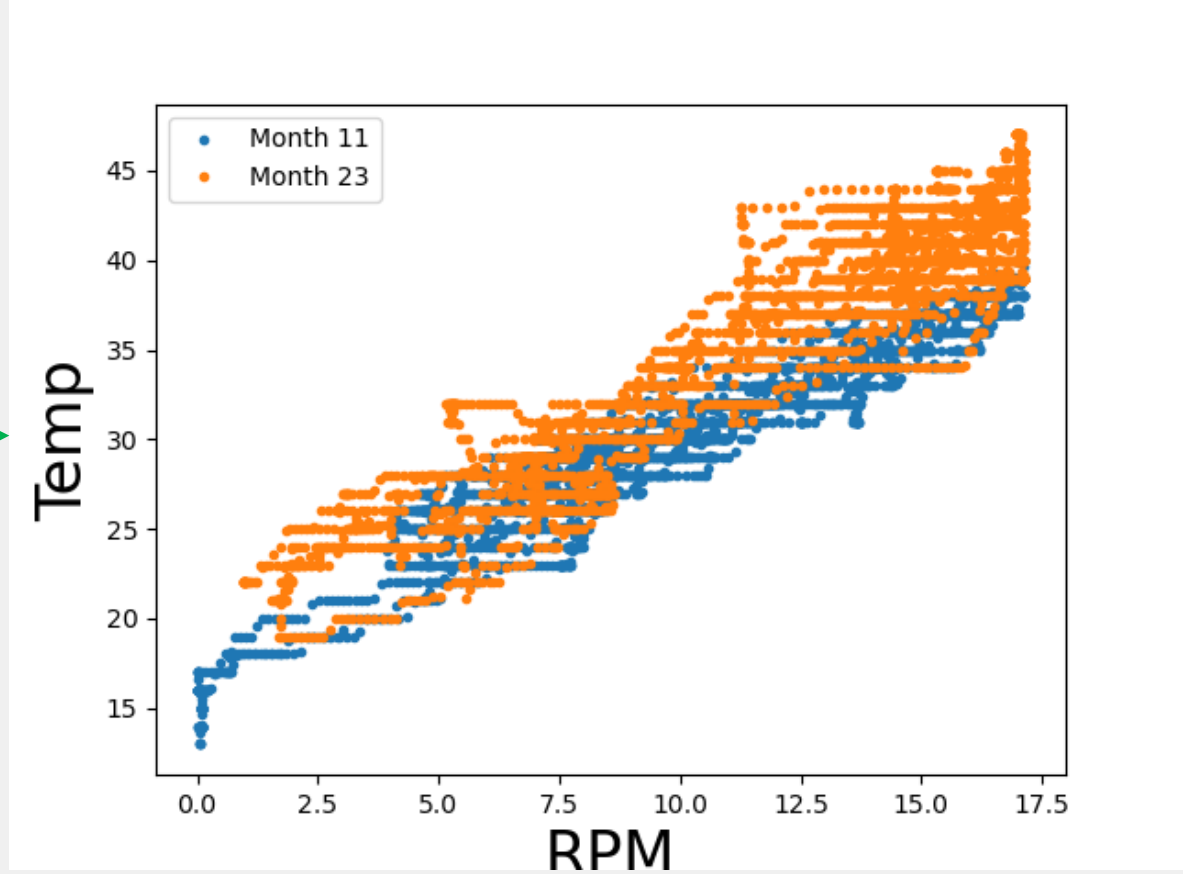
Effects of pre-processing





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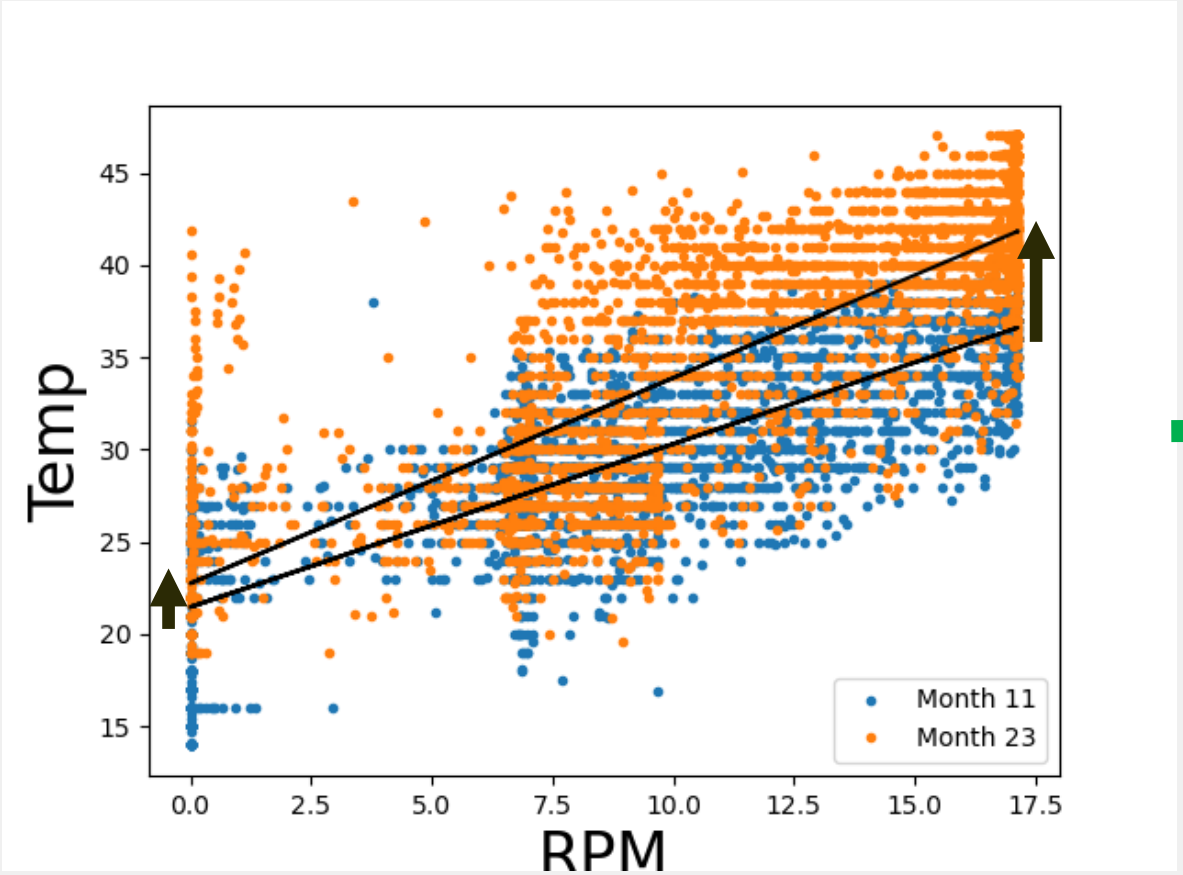
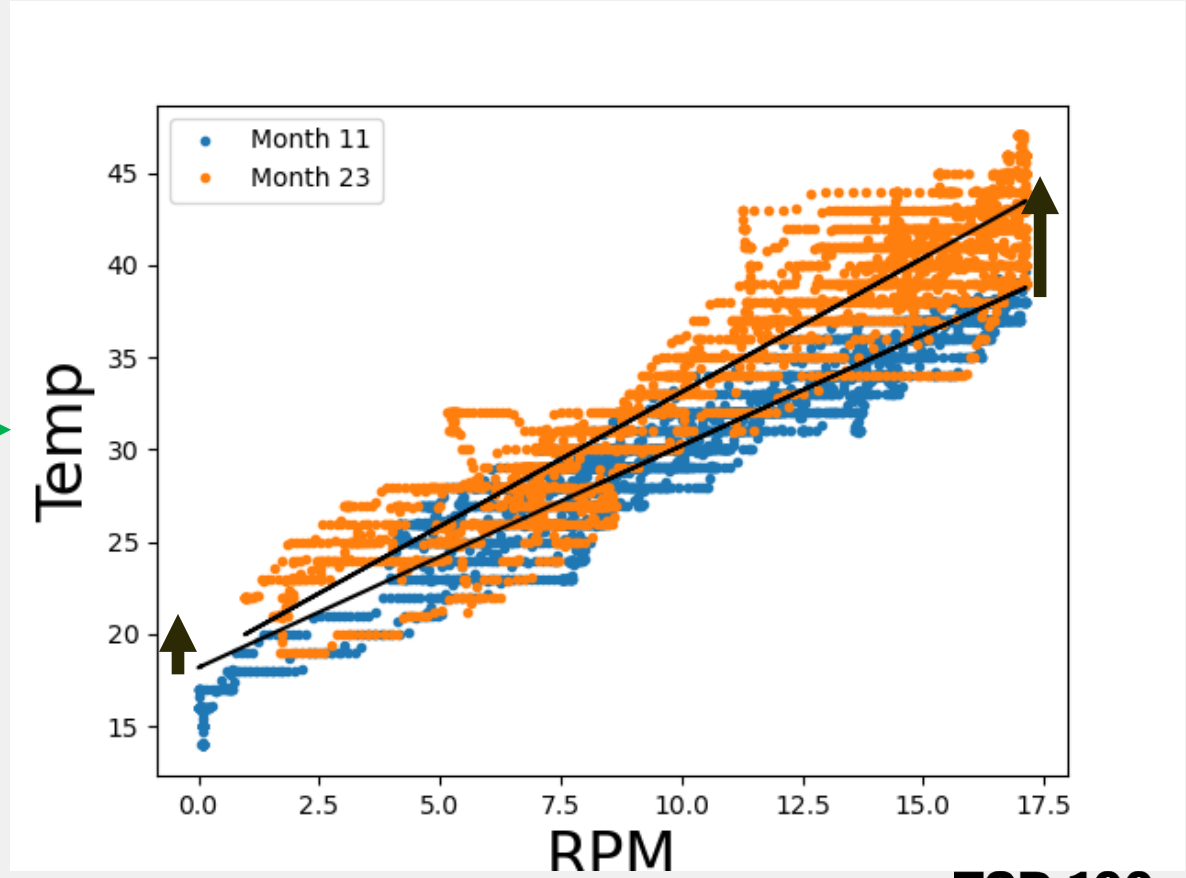
$$\frac{shift}{data\ variance}$$ improvement of ~40%





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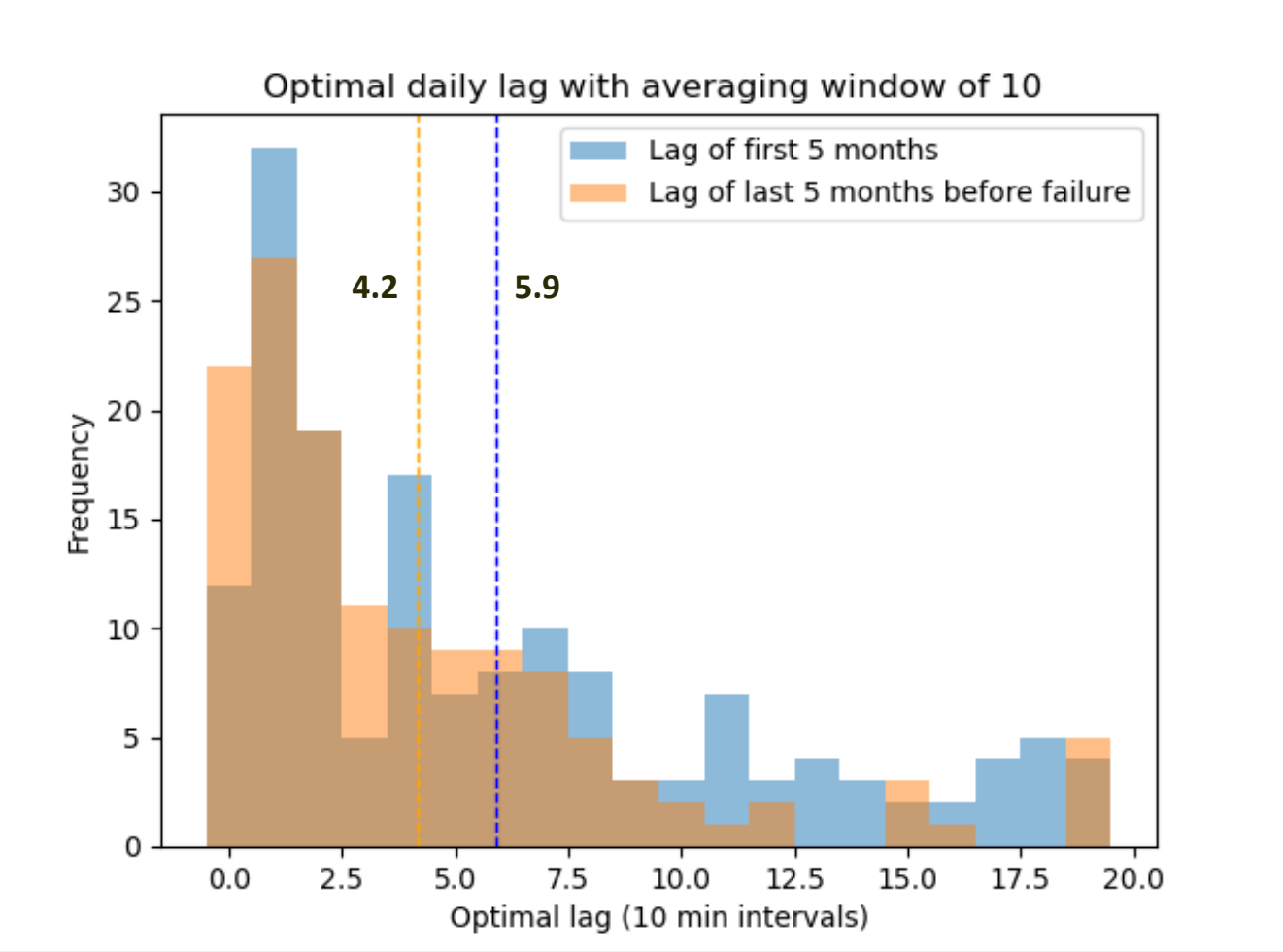
Optimal lags as learning features?



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Vibration analysis

- Analysis of failed turbine with outer race fault against healthy sets of data
- Vibration measurements available for over a year before failure
- Considering standard fault indicators and possible learning features

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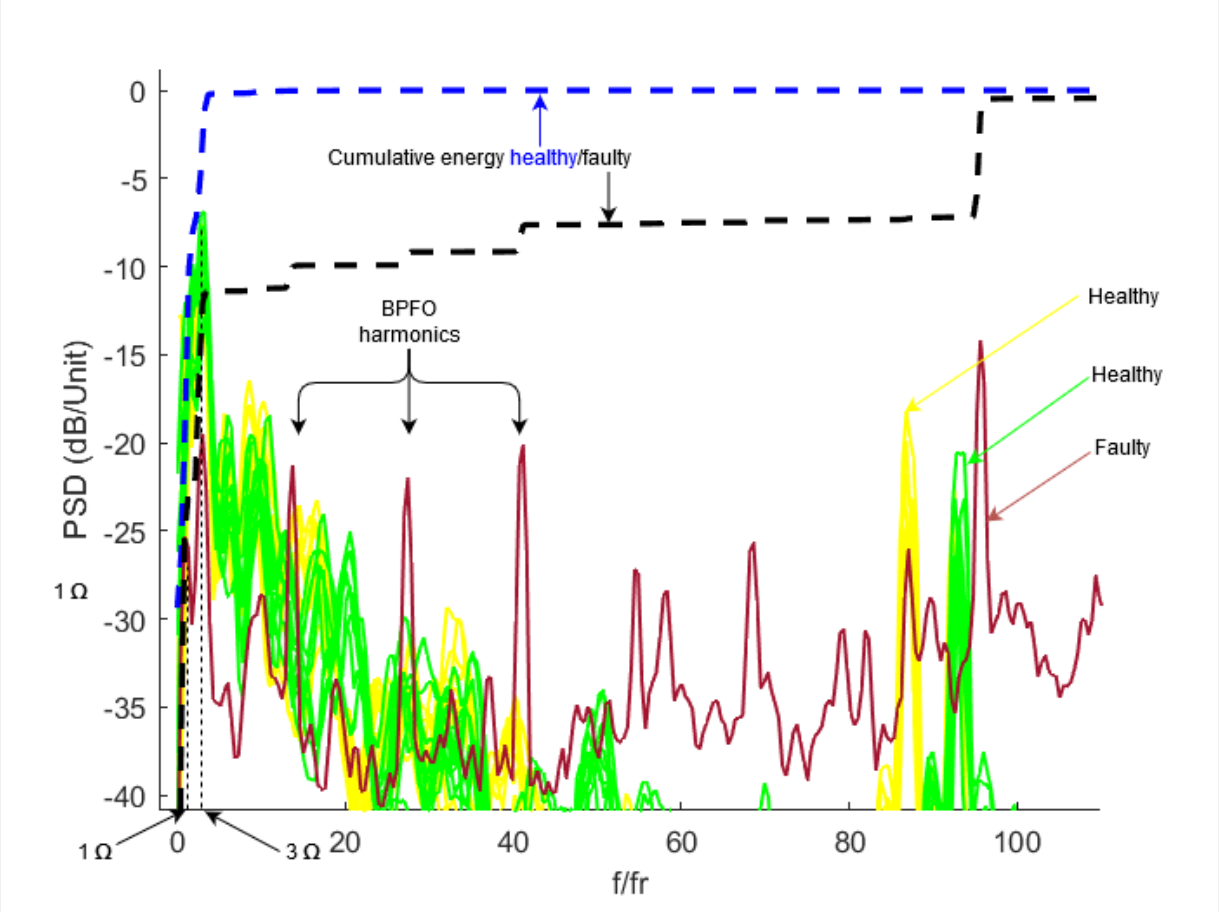
Power spectrum analysis



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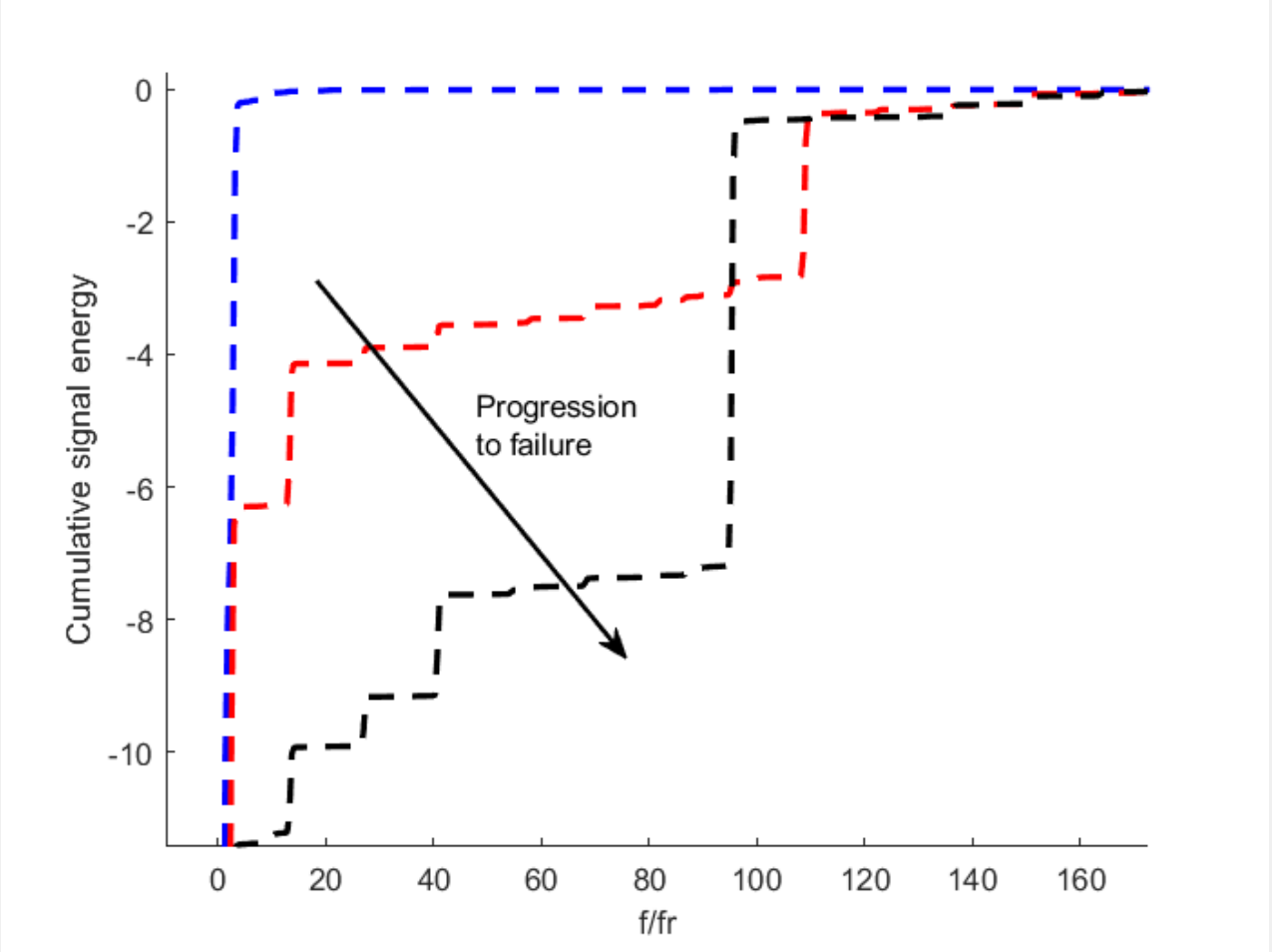
Cumulative energy trends



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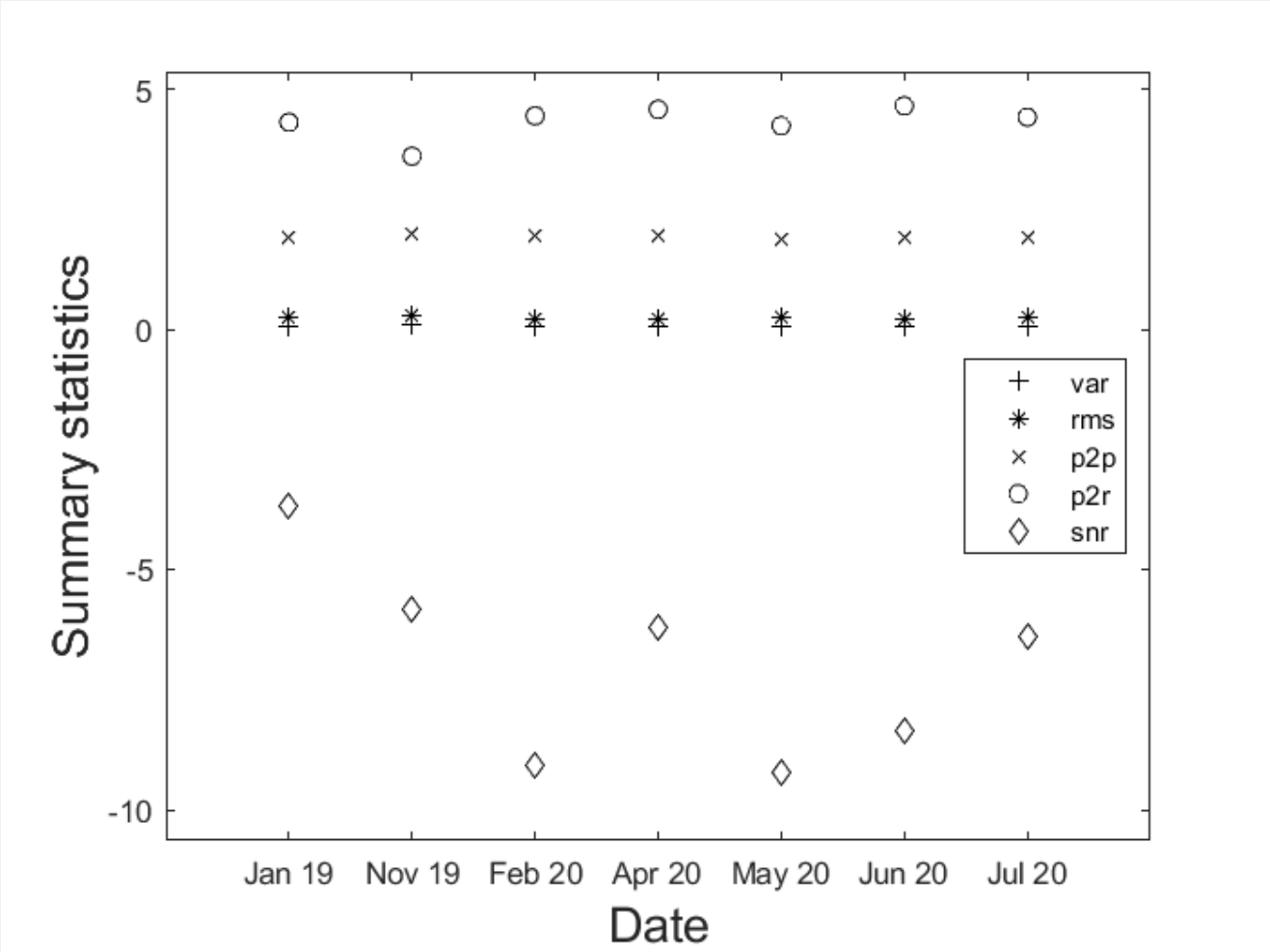
Time domain analysis



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Next steps

- Perform similar analysis for additional turbines
- Explore utility of uncovered features for fault prediction
- Comparisons with existing state of the art methods

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Thanks to project partners:

natural power

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Any questions?

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