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METALS & MATERIALS

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4.0 Casting Specialist

Rio Tinto

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Enhancing Aluminum Cable Coiling Quality with a High-Level Indicator for Tangle Probability

Josée Colbert

4.0 Casting Specialist, Technical Services

Rio Tinto

Rio Tinto - Global Operations

- Aluminium
- Copper
- Iron Ore
- Minerals
- Commercial and Corporate

Icon key

- Mines
- Smelters, refineries, power facilities and processing plants remote from mine
- Projects
- Operations Centre, Research and Development, Offices, Sales and Marketing

Aluminum Production – Quebec Operation

Power Operation

Refinery

Carbone

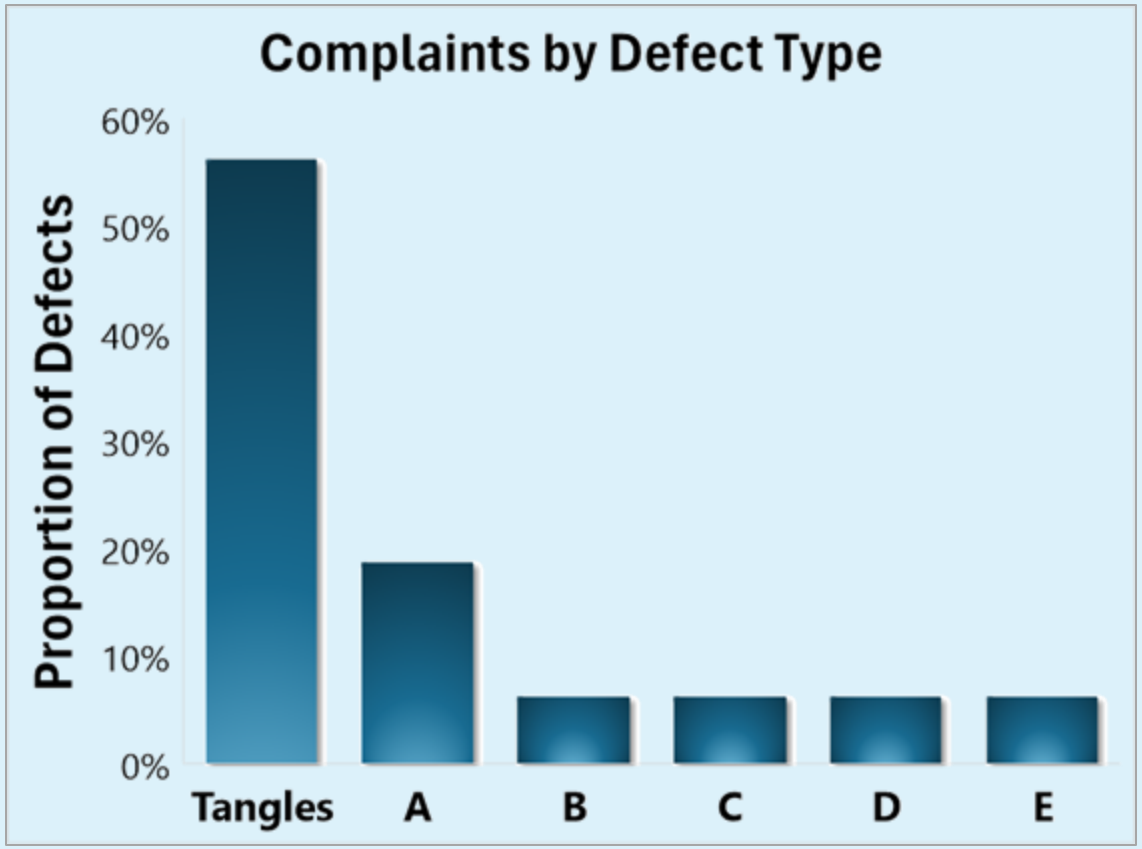
Reduction

Casting

Aluminum Rod Mill Process

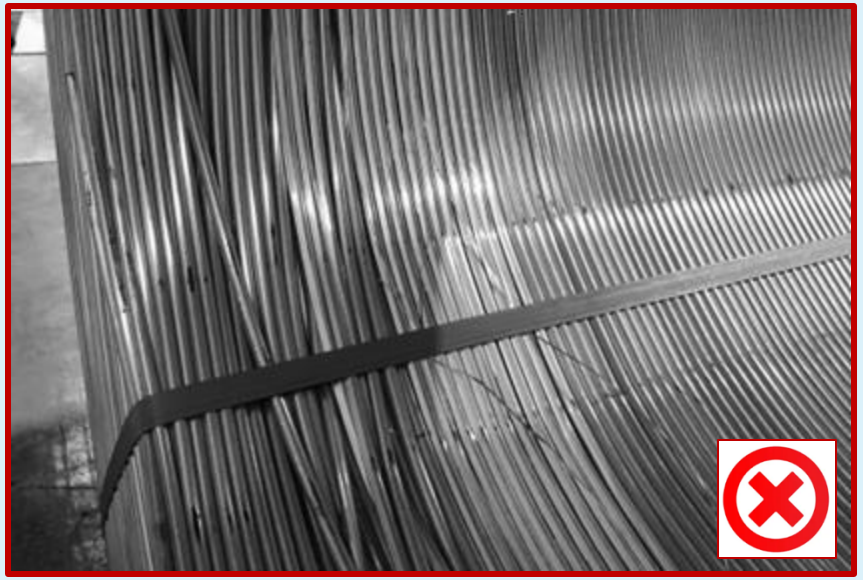
Challenge: Quality Issues Due to Tangle Defect on Coil

- **Main Complaint Cause**
  - The primary cause of complaints is tangles.
- **Impact:**
  - Compromises coil quality and causes productivity losses.
- **Importance:**
  - Essential to produce defect-free coils to meet client expectations and maintain efficiency.



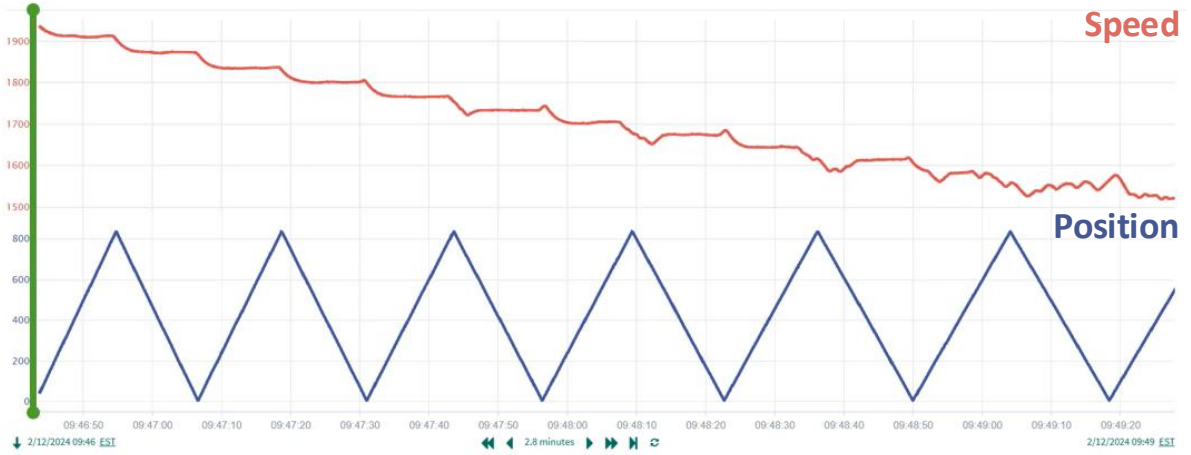
Challenge: Quality Issues Due to Tangle Defect on Coil

- **Tangle Defect**:
  - Irregular overlapping of wire turns causing disorganization.
- **Objectives:**
  - Develop a real-time method to detect tangles using process signals.



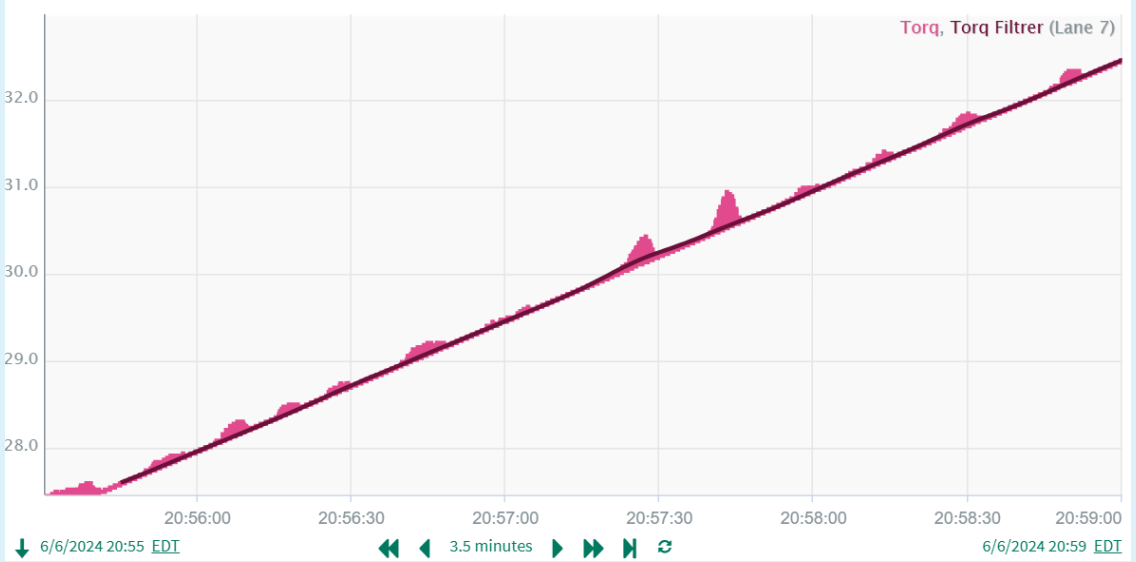
Challenge: Tangle Formation

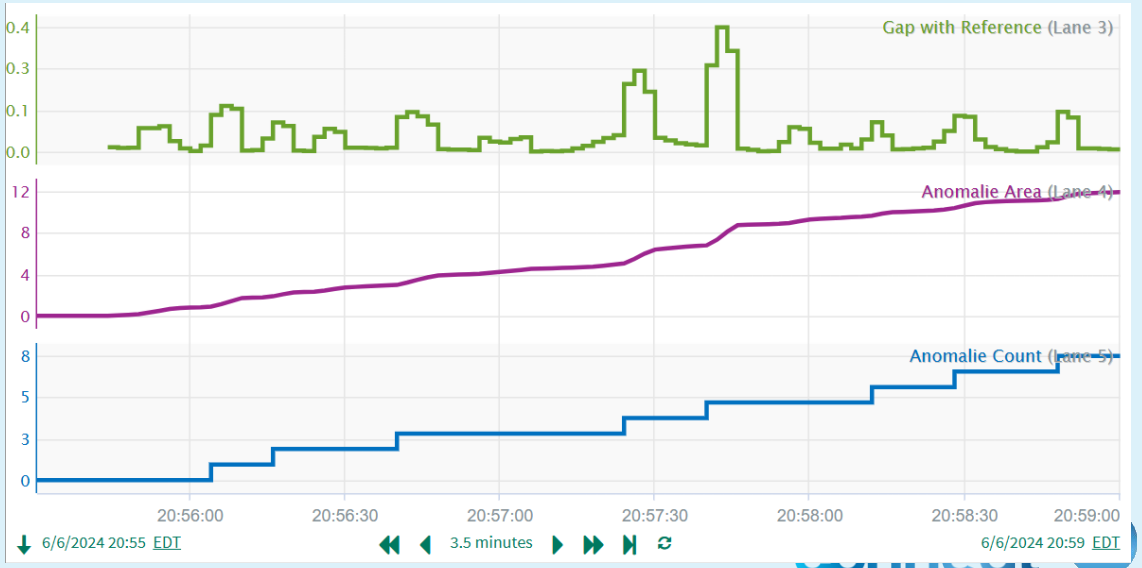
Tangle



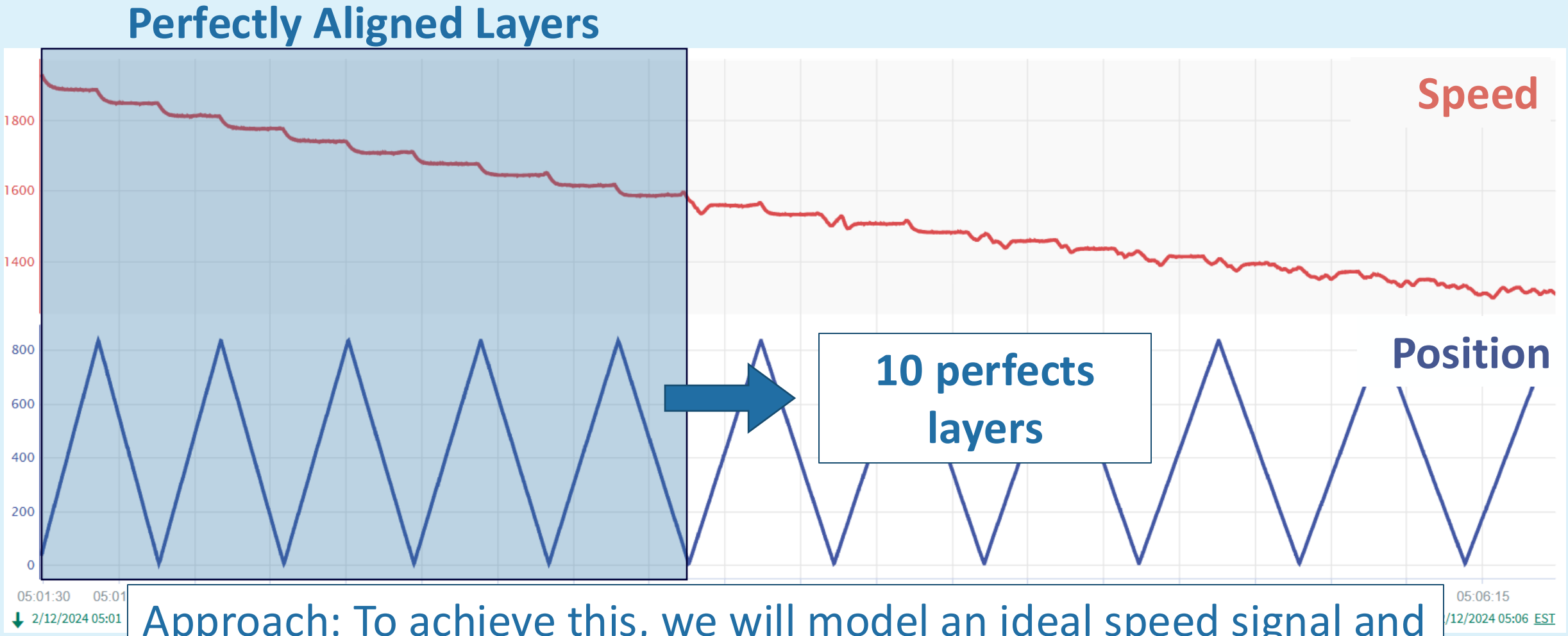
Exploration Phase: Narrowing Key Variables

- **Scope**
  - ~15 key process signals
  - Torque, Speed, Temperature, Current, Position, Product Type, and others
- **Dataset**
  - Over 13,000 coils analyzed
- **Key Insights**
  - Global statistics computed for all signals (mean, std, min/max)
  - Anomaly KPIs integrated into the analysis to highlight signal deviations
- **Outcome**
  - Speed signal is the most significant for tangles rate





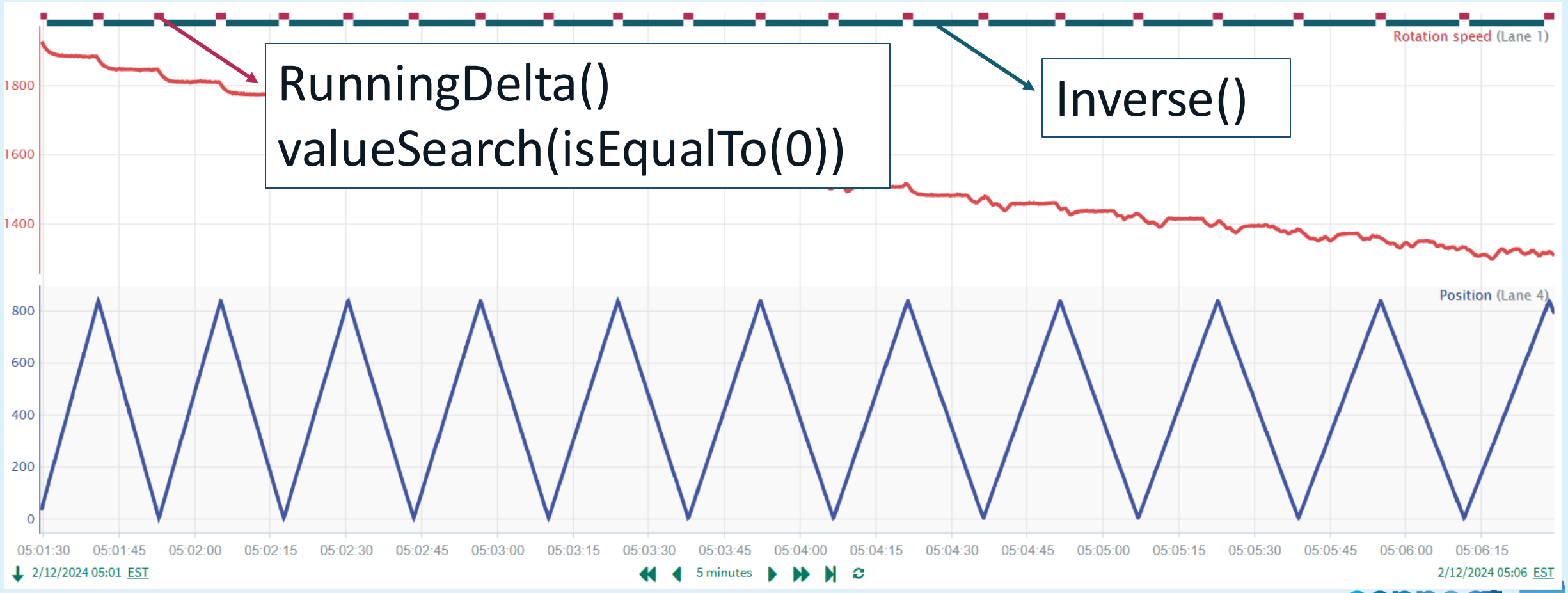
Solution: Modeling Speed Signal & Counting Perfect Wraps



Approach: To achieve this, we will model an ideal speed signal and assess deviations between the actual signal and the model.

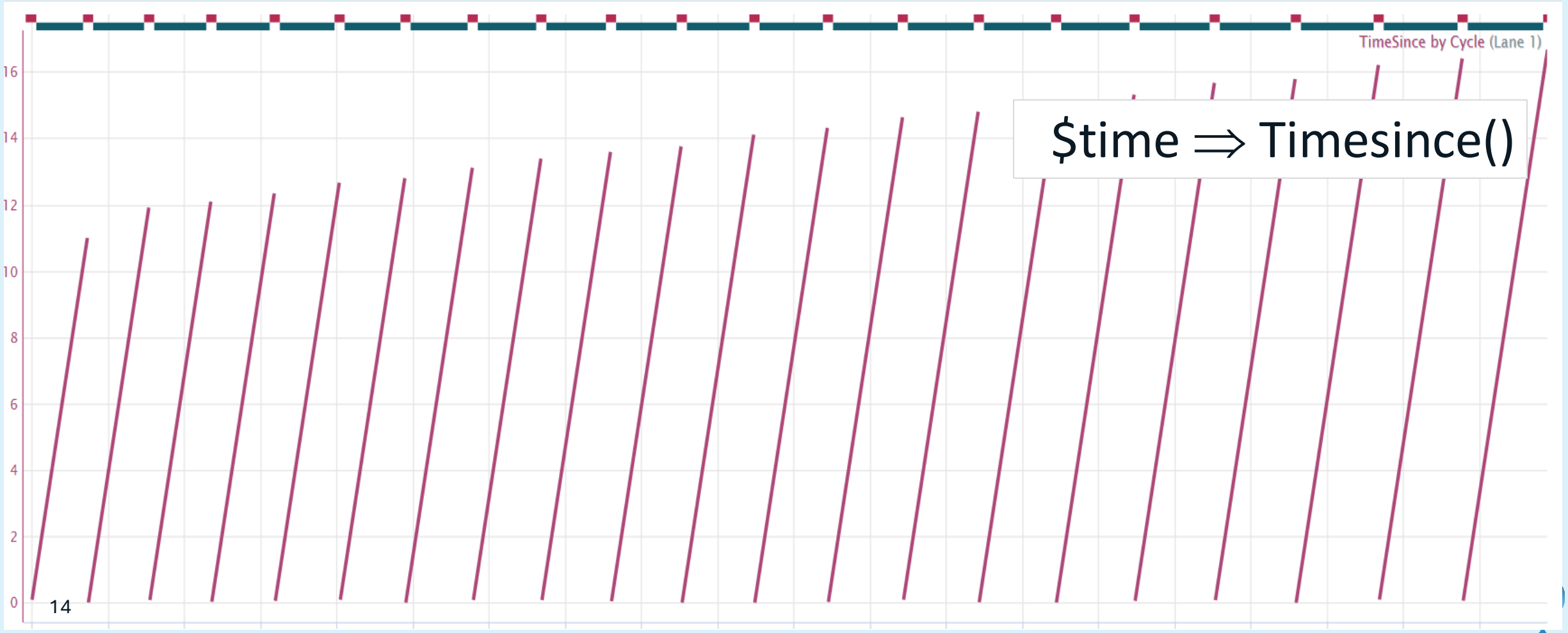
Solution: Modeling Speed Signal & Counting Perfect Wraps

- Step 1 : Define conditions to identify coil extremity and displacement step.



Solution: Modeling Speed Signal & Counting Perfect Wraps

- Step 2 : Calculate time since the start of each displacement cycle.



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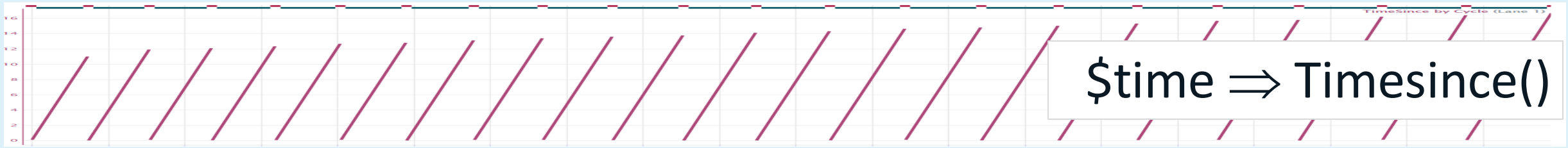
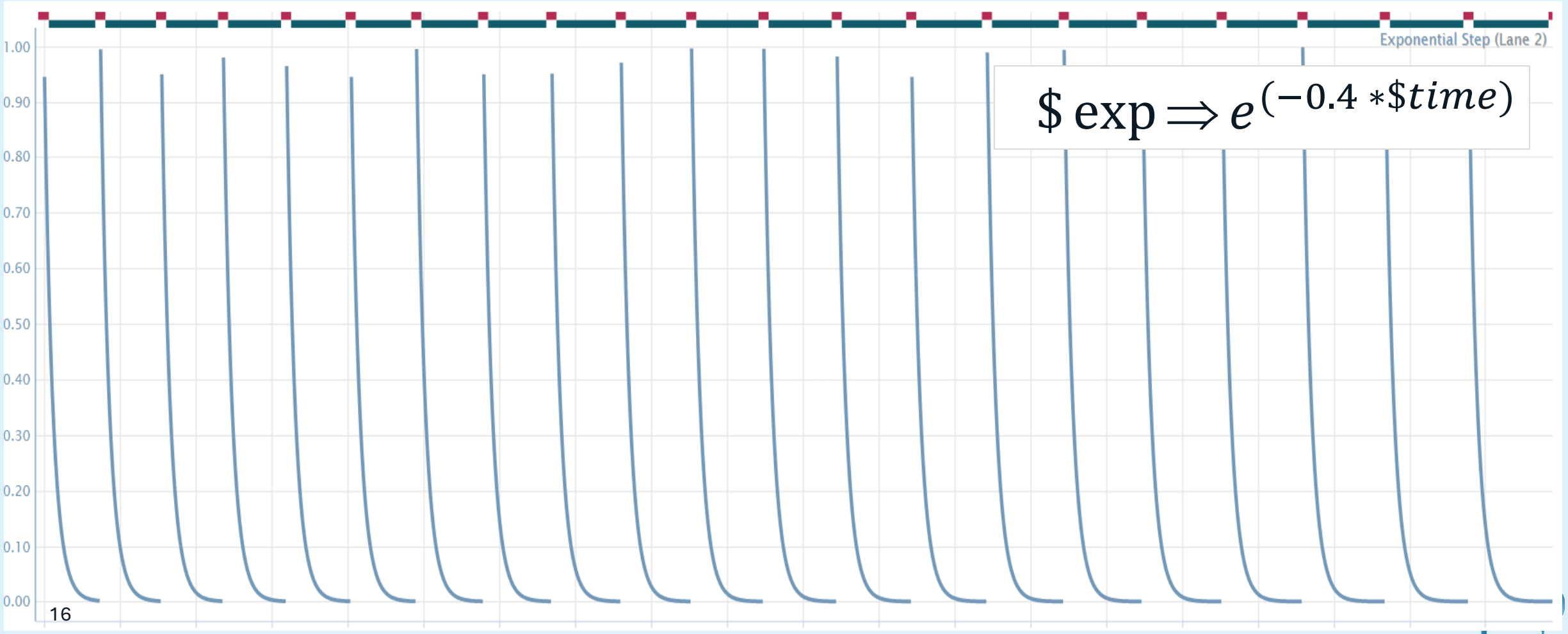


Solution: Modeling Speed Signal & Counting Perfect Wraps

- Step 3 : Create an exponentially decaying signal



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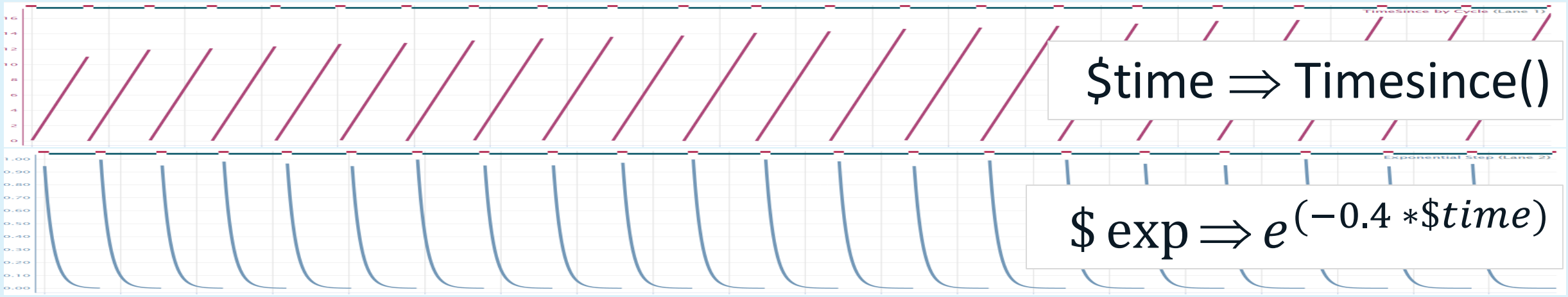

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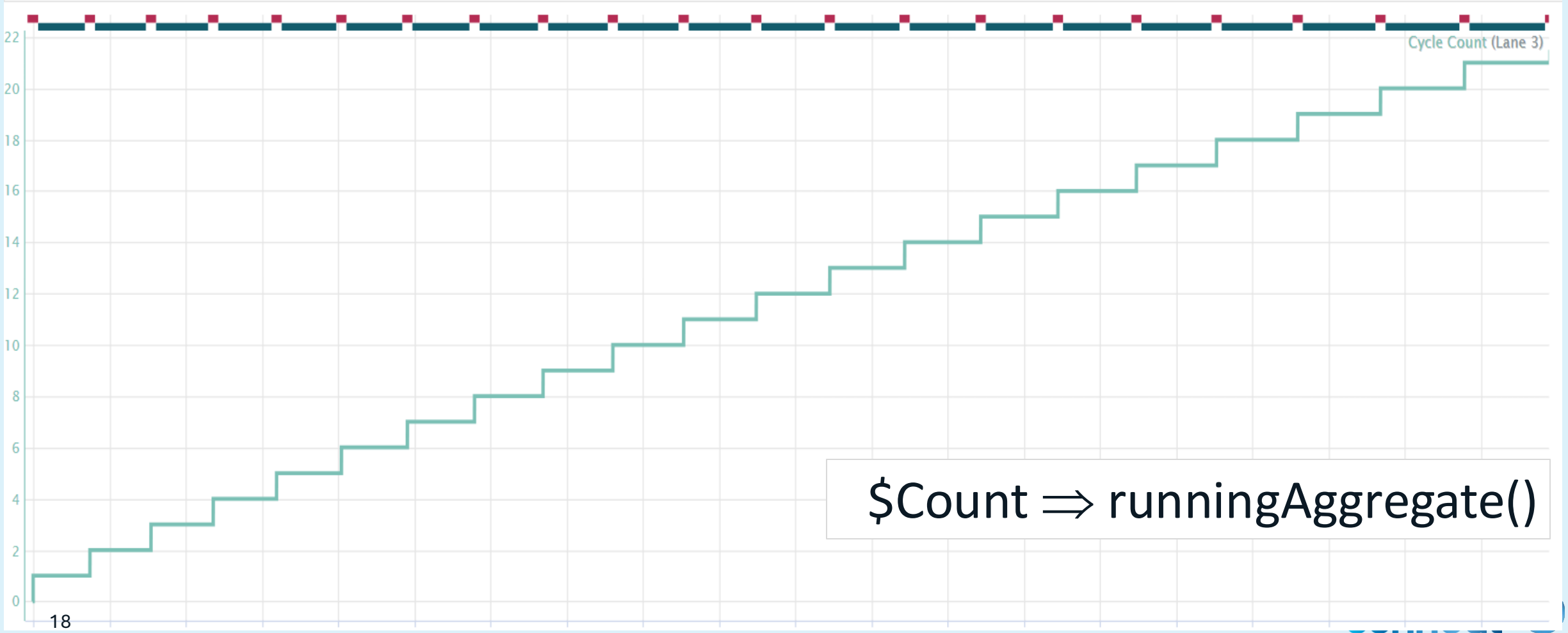
Solution: Modeling Speed Signal & Counting Perfect Wraps

- Step 4 : Create a step signal that increments at each cycle



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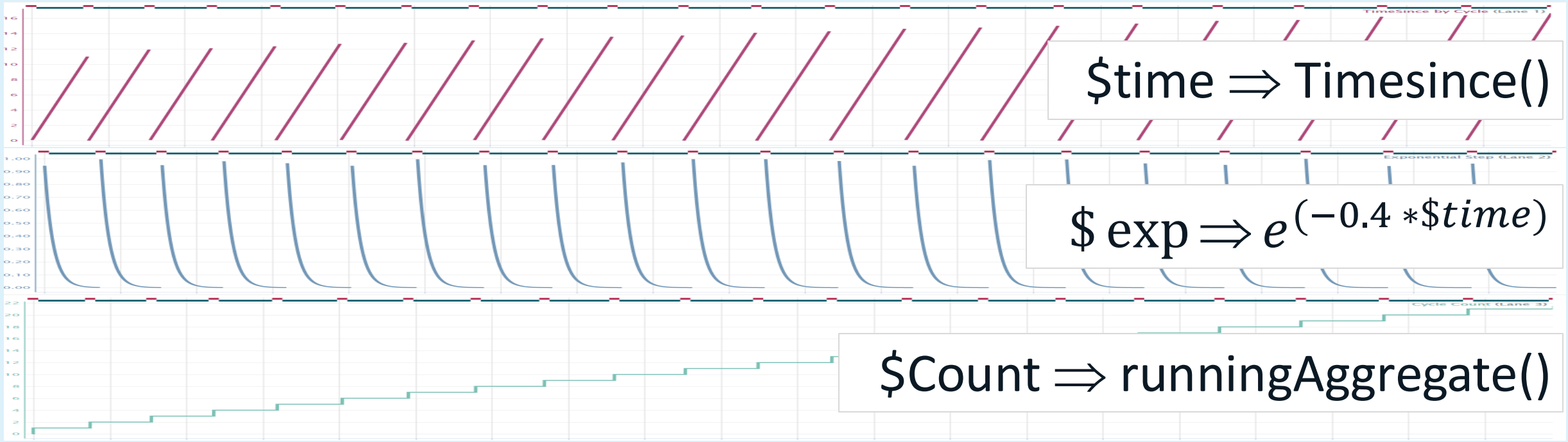

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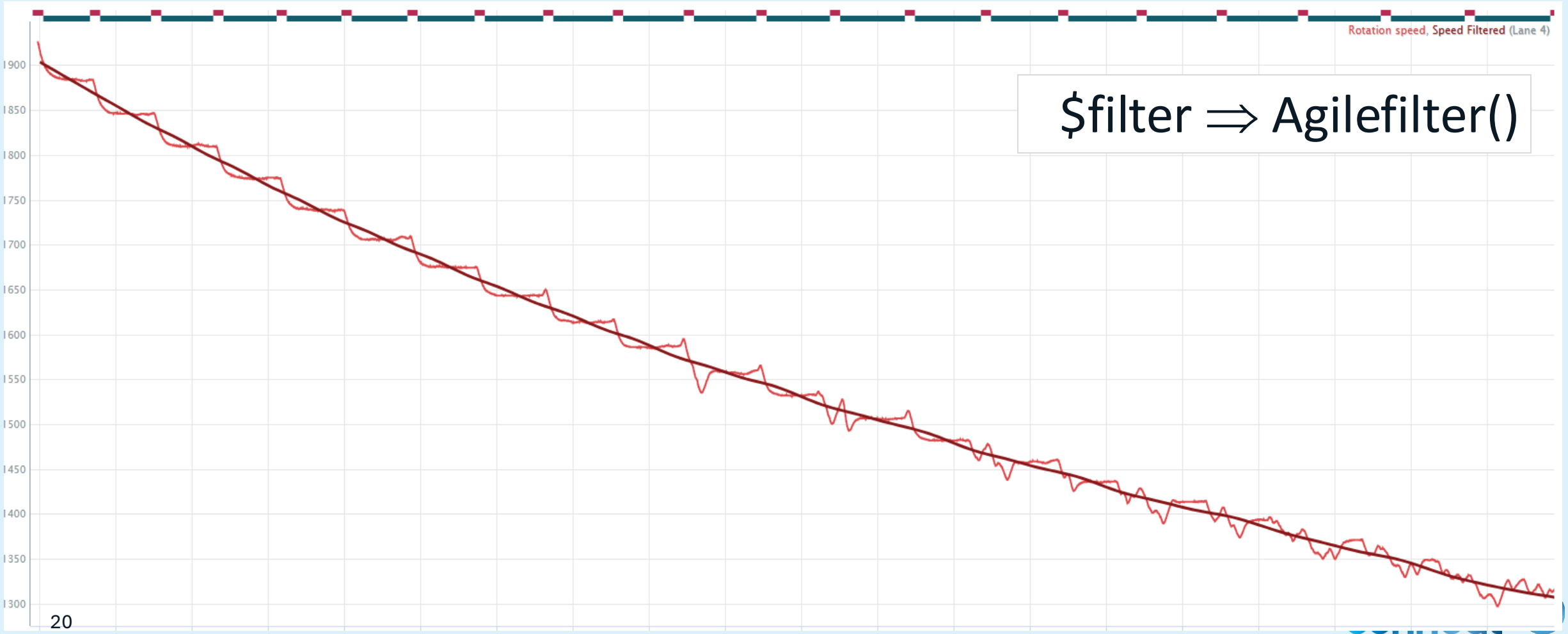
Solution: Modeling Speed Signal & Counting Perfect Wraps

- Step 5 : Create a filtered signal from the speed signal.



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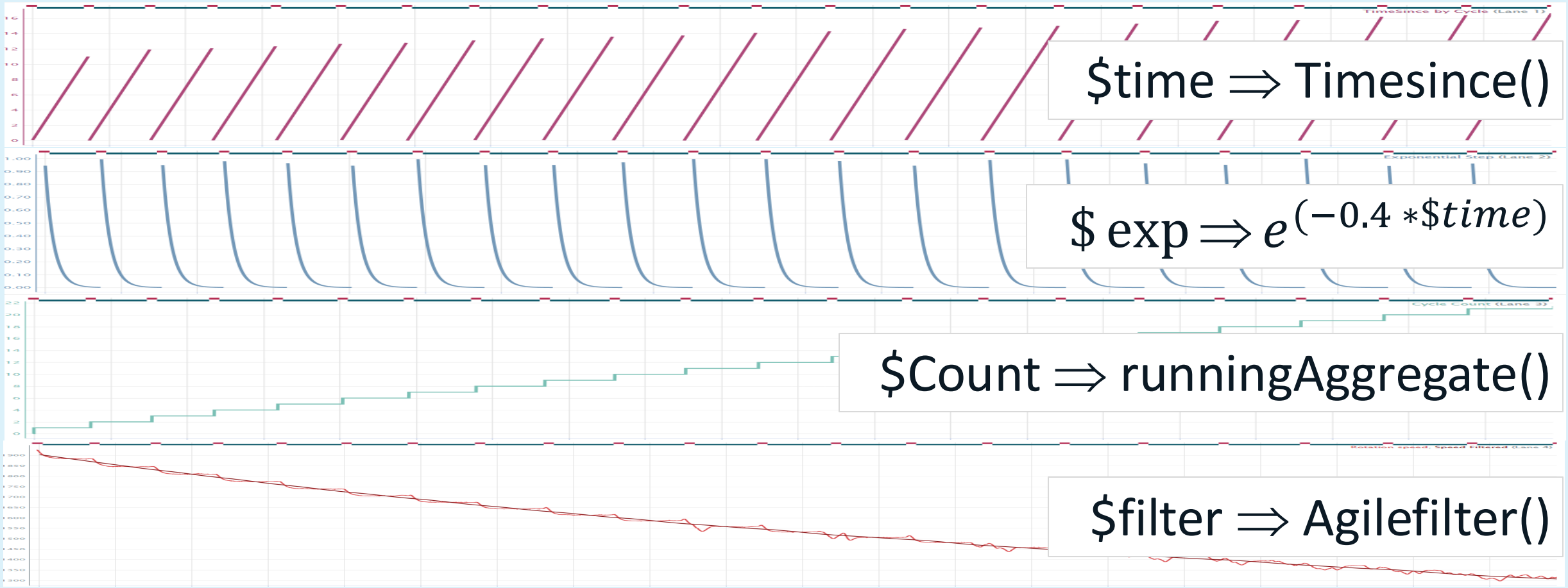

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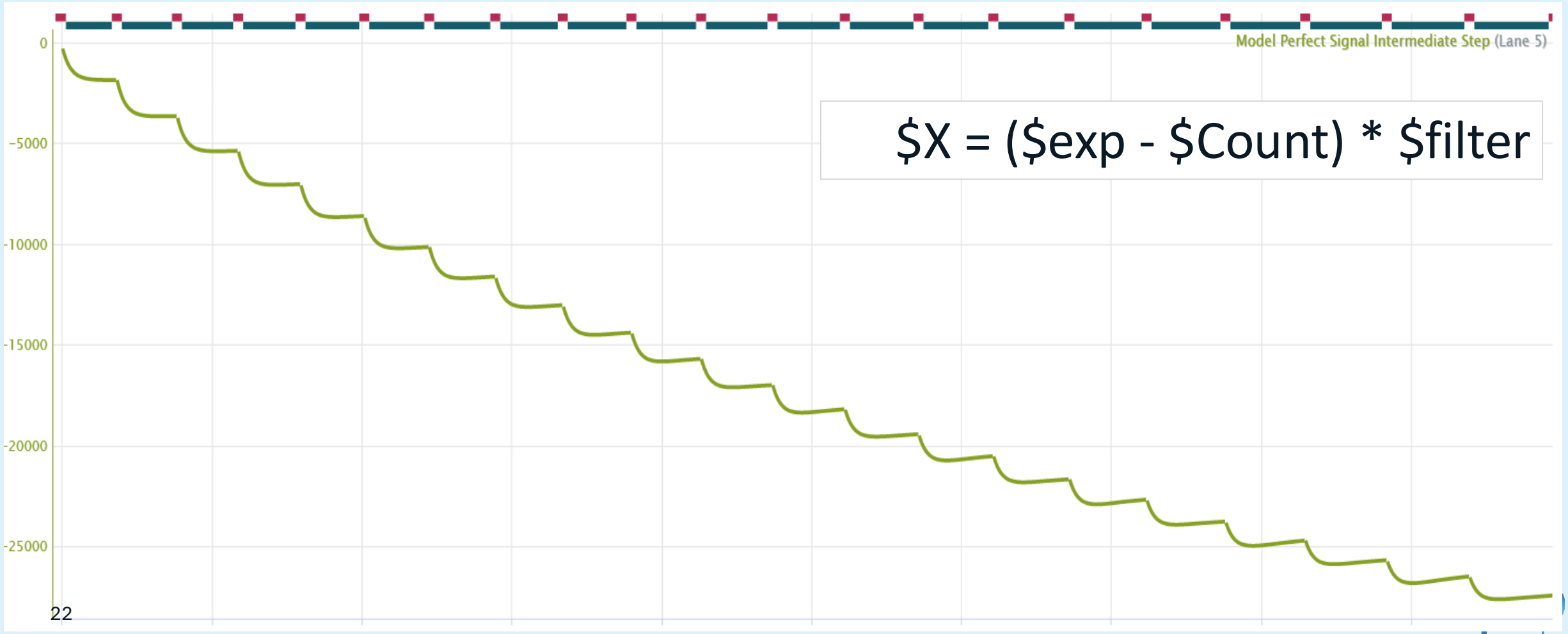
Solution: Modeling Speed Signal & Counting Perfect Wraps

- Step 6 : Create an intermediate signal matching the perfect shape, excluding the y-axis.



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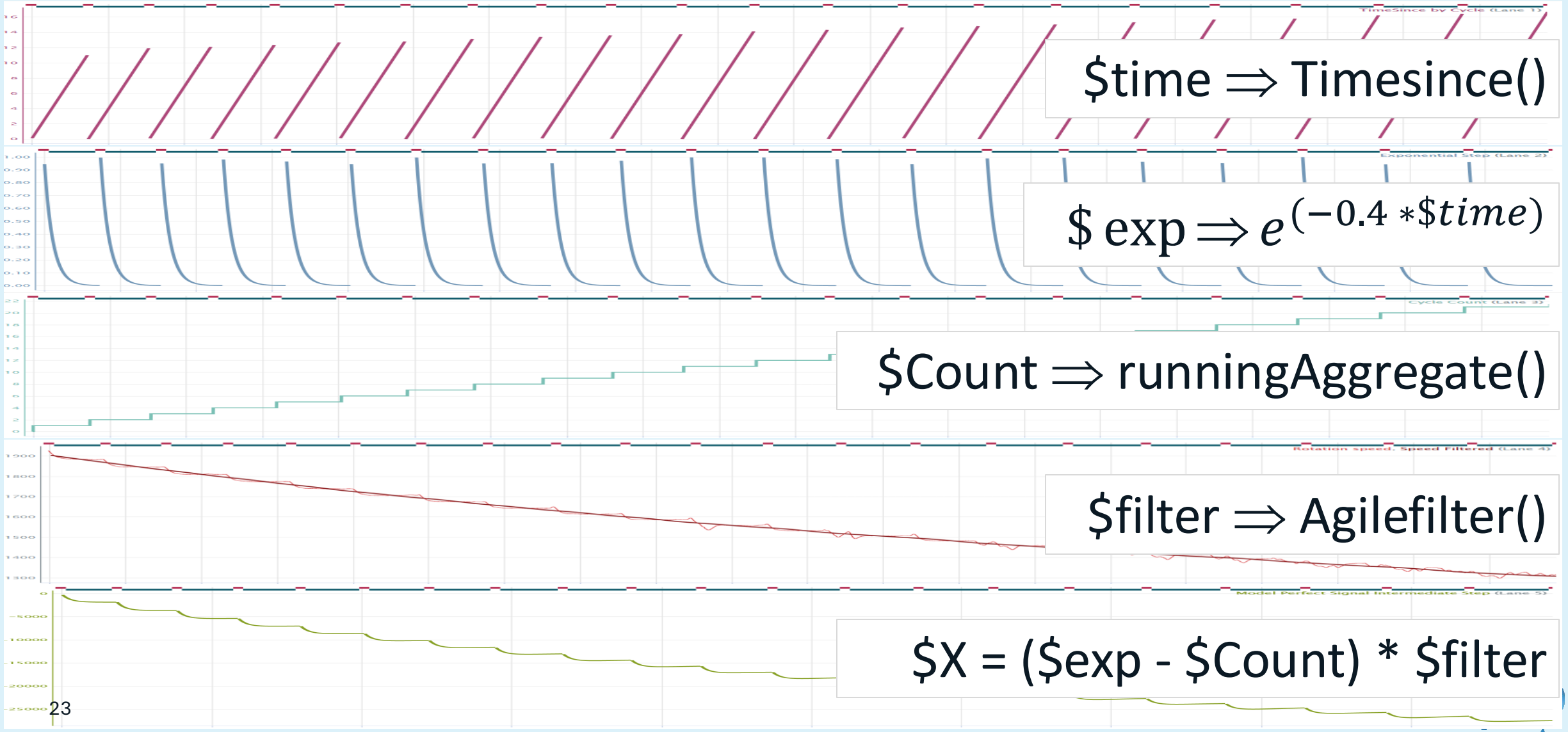
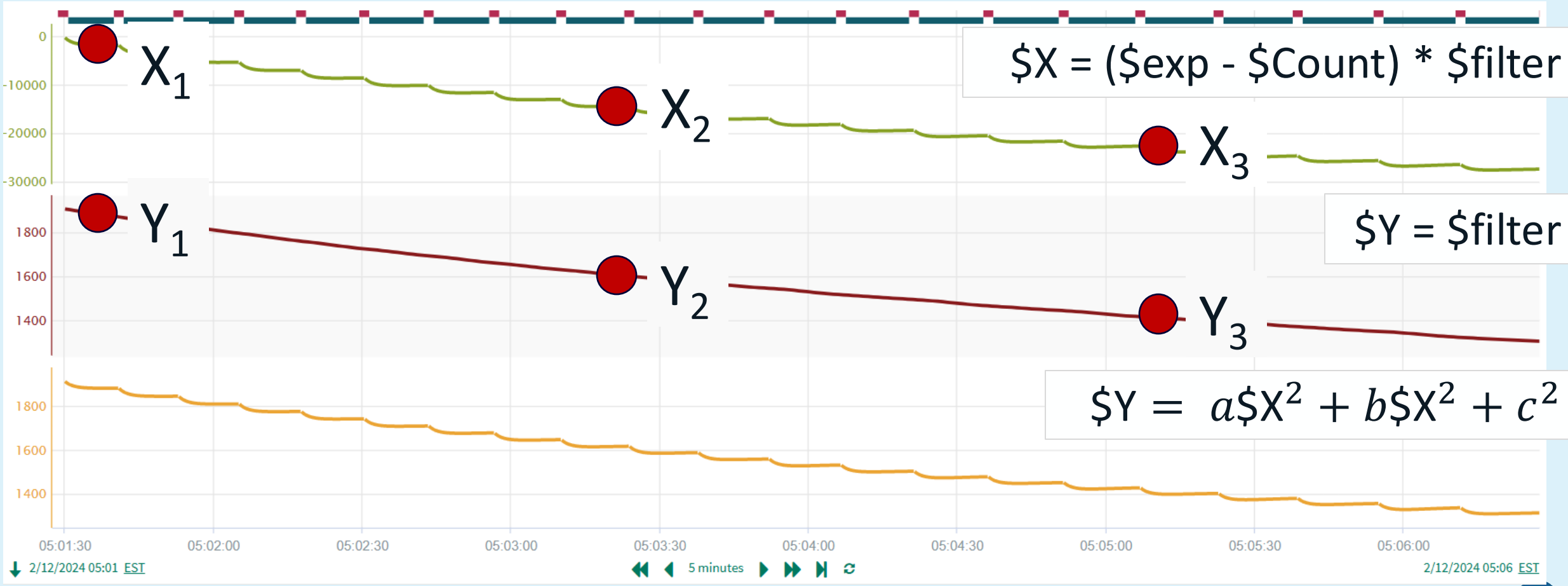


Solution: Modeling Speed Signal & Counting Perfect Wraps

- Step 7 : Align the intermediate signal with the measured signal using quadratic fitting.



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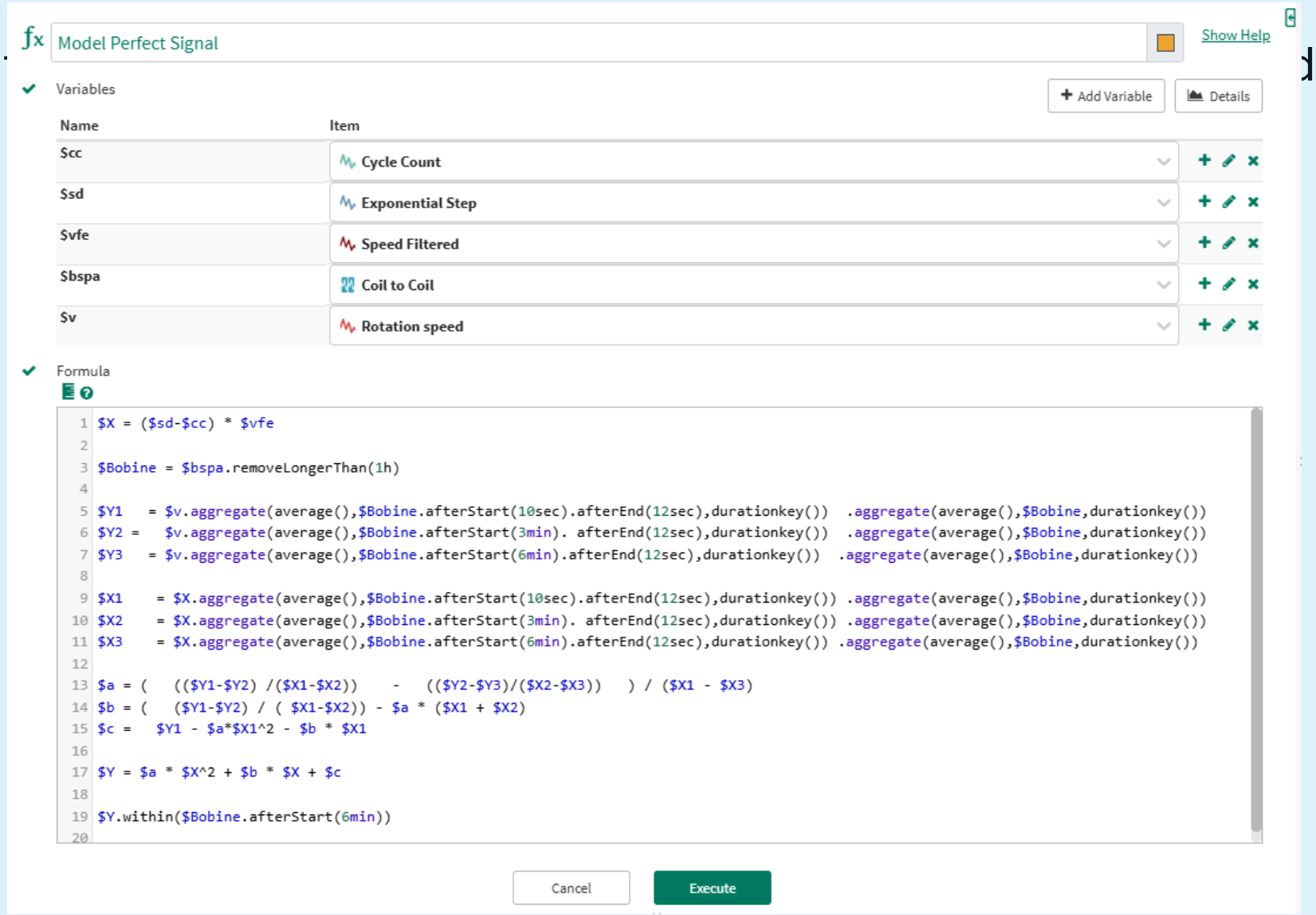

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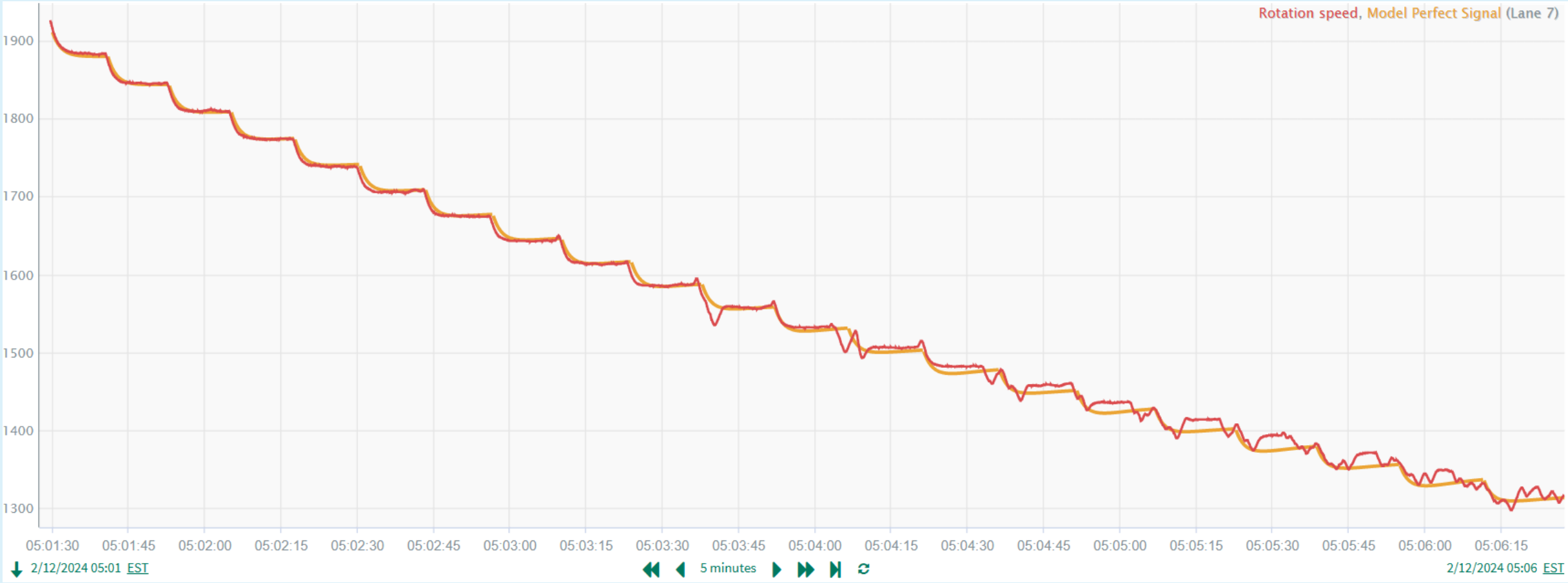
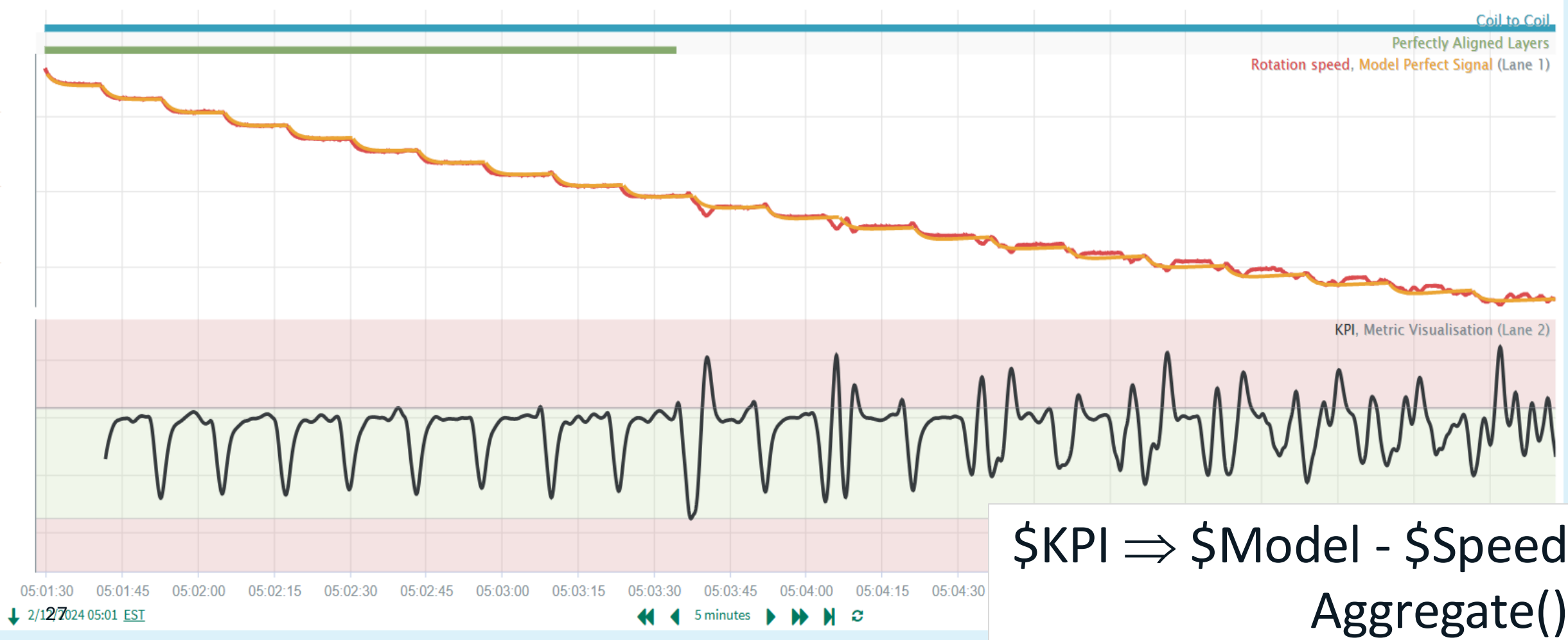


Solution: Modeling Speed Signal & Counting Perfect Wraps

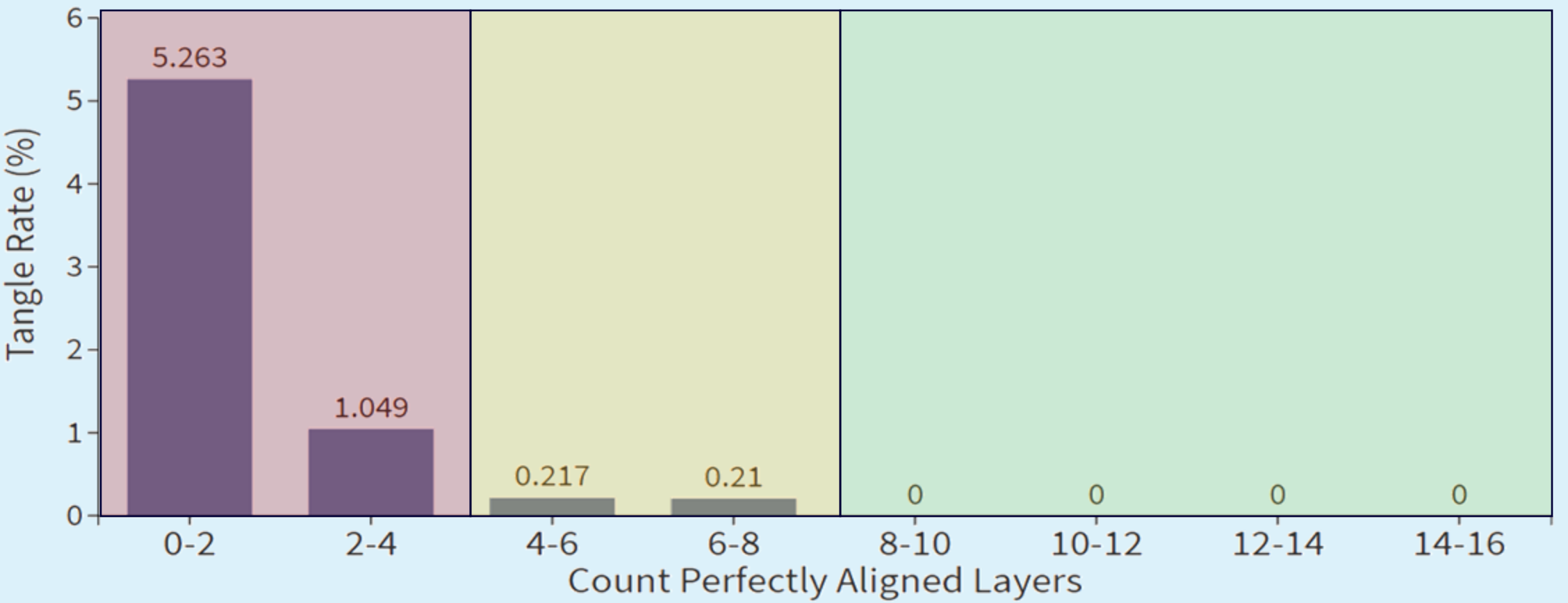
- Step 8 : Develop a KPI and set thresholds to identify when the winding is perfect.



$KPI ⇒ $Model - $Speed
Aggregate()

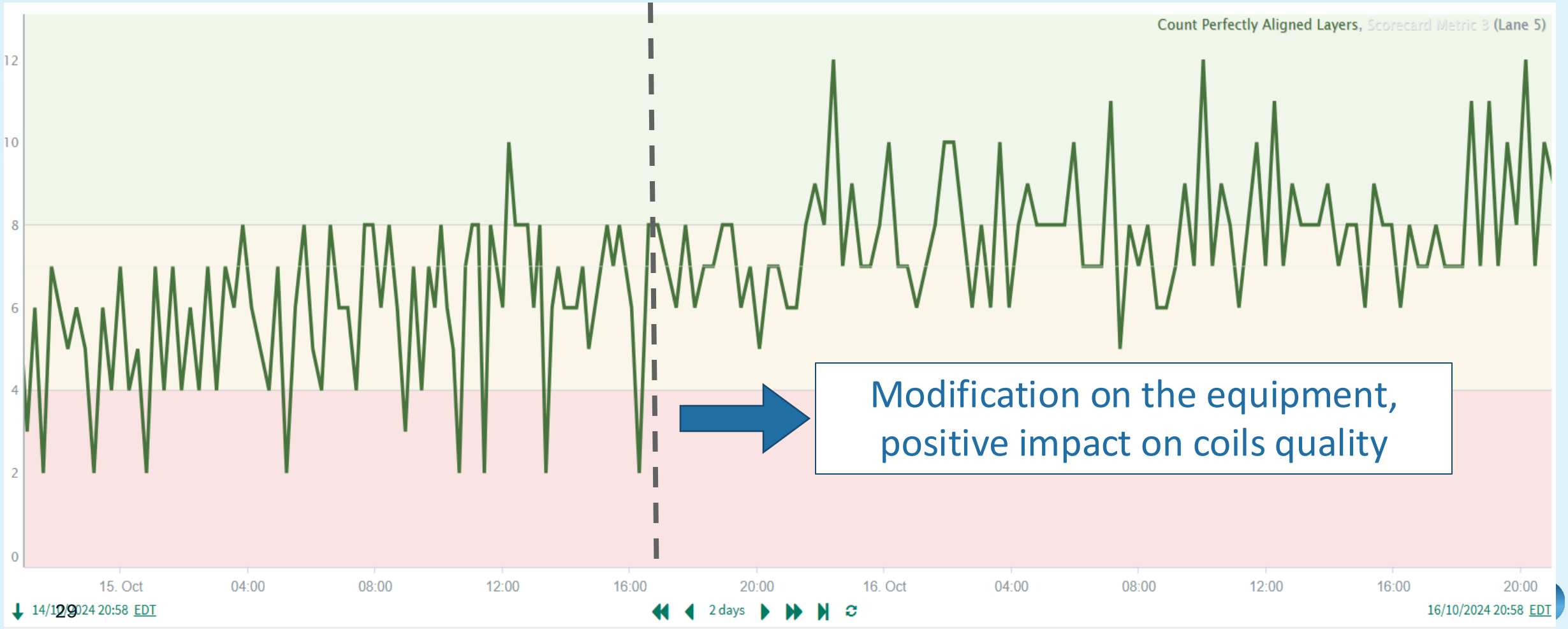
Results: Wrap Quality & Tangle Rate Correlation

- Validation of correlation between perfect layers and tangle rate.



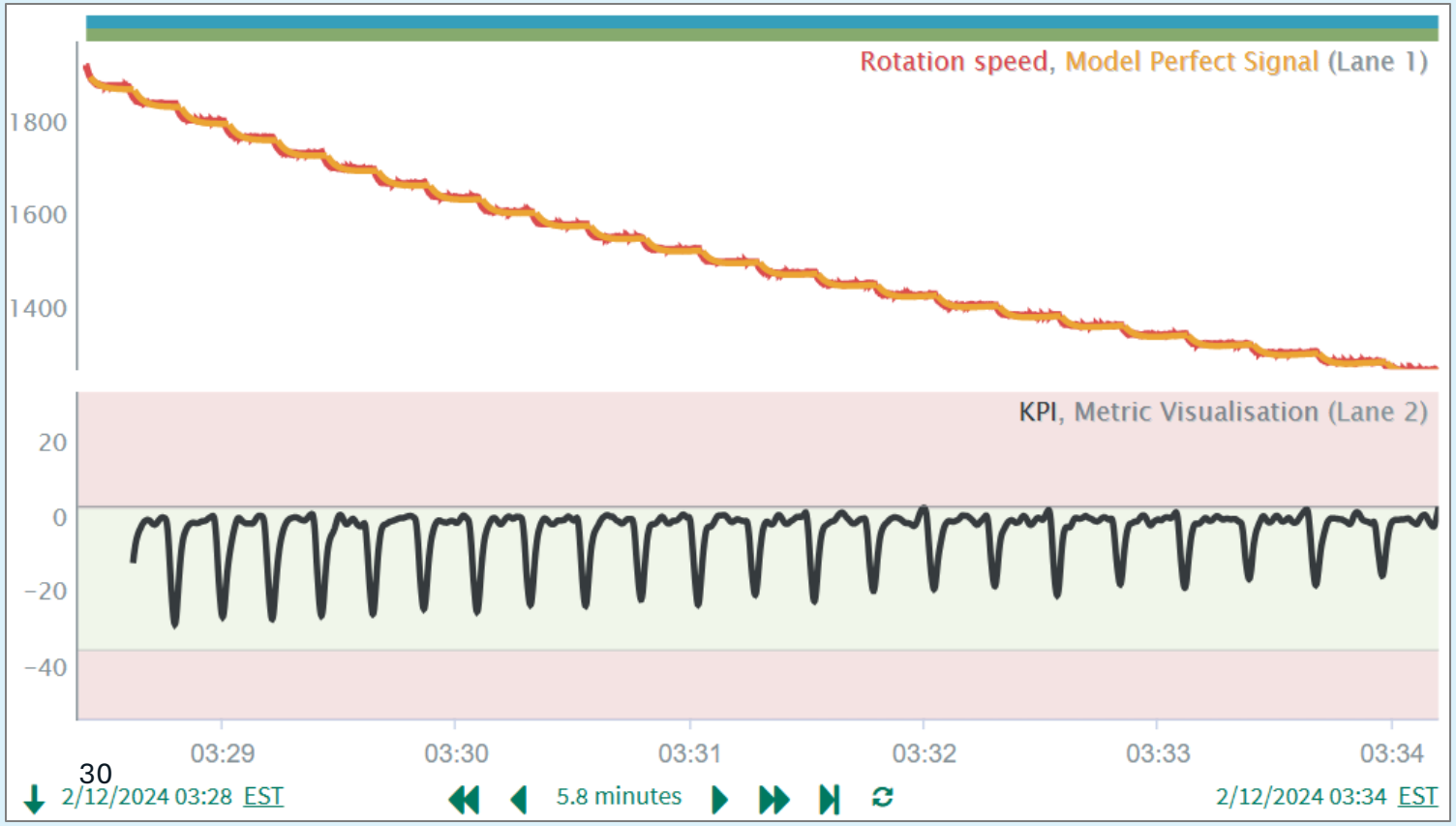
Results: Control Chart – Perfect Wrap Count

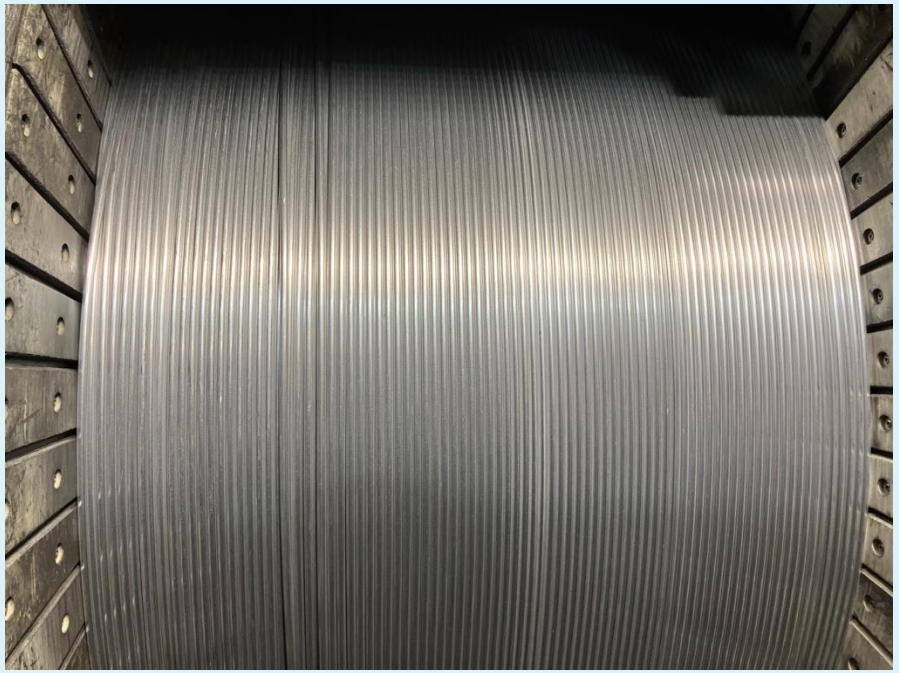
- The KPI tracks coil quality in real-time and quickly assesses the impact of changes.



Results : The perfect coil

- A perfect coil was produced following process variation.
- Measured speed signal perfectly aligns with the model.
- Probability of tangle on this coil is zero.





Internal Deployment – User Adoption Strategy

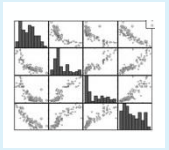
- Centralized SharePoint hub (guides, use cases, key links)
- Active user group + local champion network
- In-person training sessions, in French, tailored to internal context
  - 12 sessions offered until June — all fully booked within 48 hours
- Accessible and responsive user support

Wrap-up

- **Tangle detection in real time is now a reality through speed signal modeling.**
  - As our top customer complaint, this issue is being tackled head-on.
  - Major progress has been achieved, with solutions already underway.

- **Seeq transforms complexity into clarity.**
  - It enables intuitive signal visualization and reveals key process steps.
  - Collaboration with technical teams is smoother through a shared platform.

- **Empowered users, smarter decisions.**
  - The no-code interface accelerates KPI-driven root cause analysis.
  - Switching to a continuous Y-axis unlocks deeper insight and greater sensitivity.

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Questions?

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Thank You