ADAPTIVE WINDOWING FOR CONCEPT DRIFT IN STREAMING SENSOR NETWORKS

Ada Lovelace and Second Author

August 27, 2026

Abstract. Streaming sensor deployments in industrial settings degrade silently as equipment ages and operating conditions shift, and fixed-threshold monitors miss this drift until a fault has already occurred. We instrument three years of vibration and temperature readings from a mid-size bottling line with an adaptive windowing detector, comparing its alarms against maintenance logs and a fixed-window baseline. The adaptive detector flags 92% of confirmed faults a median of 11 days earlier than the fixed-window baseline, at a false-alarm rate the maintenance team judged acceptable in a two-week pilot. We give a worst-case bound on detection delay under a stationary noise model.

Keywords. concept drift, streaming algorithms, online change detection

Subject classification. 68W27 (Online algorithms), 68W40 (Analysis of algorithms)

1. Introduction

State the problem, why it matters, and what this paper contributes. Cite prior work like this Knuth (1984).

2. Model and Problem Statement

Define the streaming model, the drift-detection problem, and the adaptive windowing detector formally.

Theorem 2.1. *Under a stationary noise model, the adaptive detector's expected detection delay is bounded above by the fixed-window detector's, for any window size $w \geq w_{\min}$.*

Proof. Sketch the argument here. □

3. Empirical Evaluation

Describe the evaluation protocol. Table 3.1 summarises detection lead time by fault class.

Table 3.1: Median detection lead time by fault class, adaptive windowing versus the fixed-window baseline.

Fault class	Adaptive (days)	Fixed (days)
Bearing wear	14	3
Belt slippage	9	2
Motor overheat	11	4

4. Conclusion

Summarise the contribution and point to future work on per-sensor window-size tuning.

Acknowledgements

We thank the bottling line's maintenance team for access to three years of service logs.

References

Donald E. Knuth (1984). *The TEXbook*. Addison-Wesley, Reading, Massachusetts. ISBN 0-201-13447-0.

Manuscript received 27 August 2026

Ada Lovelace
Institute of Analytical Engines
Bogotá, Colombia
ada@example.edu

Second Author
Another University
Springfield, USA
second@example.org