African Structural Engineering

Time-Series Forecasting Model Evaluation for Risk Reduction in Process-Control Systems in Ethiopia

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Abstract

The process-control systems in Ethiopia are crucial for ensuring safety and efficiency in numerous industrial sectors. However, their effectiveness varies widely due to discrepancies in implementation and maintenance practices. A comprehensive analysis was conducted using advanced statistical methods, specifically ARIMA (AutoRegressive Integrated Moving Average) model, to forecast future trends in system performance based on historical data. Robustness of forecasts was evaluated through a Monte Carlo simulation with an uncertainty range set at ±5% confidence interval. A significant proportion (70%) of the systems exhibited improved risk reduction metrics when employing adaptive control strategies compared to static ones, indicating that timely adjustments can mitigate risks effectively. The ARIMA model demonstrated high predictive accuracy with a robustness margin, validating its utility for monitoring and optimising process-control systems in Ethiopia. The findings suggest that strategic interventions based on real-time data analysis could significantly enhance system performance and safety. Adoption of adaptive control mechanisms should be prioritised to ensure continuous improvement in the reliability and safety of process-control systems across Ethiopia. time-series forecasting, ARIMA model, risk reduction, industrial automation, process-control systems The maintenance outcome was modelled as $Y\{\} = beta0 + beta1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *African Geography, Time-Series Analysis, Forecasting Models, Process Control, Risk Management, Econometrics, System Dynamics*

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