

**Abstract:** With the increasing reliance on data-driven decision systems in financial and cyber-physical infrastructures, detecting anomalous and high-risk events has become a critical challenge. Traditional statistical methods and static machine learning models often fail to adapt to evolving data distributions, rare events, and adversarial behaviors. This paper proposes an optimization-driven adaptive anomaly detection framework that integrates deep learning, evolutionary parameter optimization, and robust decision mechanisms. The approach is evaluated through MATLAB-based simulations on multivariate time-series data representing financial transactions and system activity patterns. The proposed architecture combines deep autoencoder-based feature extraction with adaptive threshold optimization, enhancing detection accuracy and robustness in non-stationary environments. Experimental results demonstrate superior performance over baseline models in terms of accuracy, precision, recall, and false alarm rate. The findings highlight the effectiveness of optimization-based adaptive learning for sensitive risk monitoring systems and suggest future directions for large-scale and real-time deployment.

**Keywords:** Anomaly Detection; Adaptive Artificial Intelligence; Optimization-Driven Learning; MATLAB Simulation; Financial Analytics; Cyber-Physical Systems