

## Leveraging Machine Learning for Predictive Maintenance: Insights from a Comparative Study

### Djahida Belayadi

National Higher school of Cyber security (ENSCS), National Higher School of Advanced Technologies (ENSTA), Algiers, Algeria

### Cherifi Lamia

Department of Industrial Engineering & Maintenance, National Higher School of Advanced Technologies (ENSTA), Algiers, Algeria

### Aissani Manel

Department of Industrial Engineering & Maintenance, National Higher School of Advanced Technologies (ENSTA), Algiers, Algeria

### Abstract:

In recent years, the integration of Machine Learning (ML) within the realm of Predictive Maintenance (PdM) has garnered significant attention in both academic and industrial settings. PdM, which focuses on predicting equipment failures before they occur, presents a strategic approach to minimizing downtime and reducing operational costs. Leveraging ML techniques, particularly in environments characterized by complex, non-linear, and structured or semi-structured data, enhances the predictive capabilities of maintenance systems. However, the multitude of available ML algorithms, each with unique strengths and weaknesses, complicates the decision-making process regarding their application to specific PdM challenges. This paper seeks to streamline this process by evaluating various ML algorithms (including RF, DT and KNN) and identifying the most effective options for PdM scenarios. By employing a comparative analysis based on established criteria from existing literature. To improve the prediction performance of the models, comprehensive experiments are carried out on four different datasets. we aim to provide insights that will assist practitioners in selecting appropriate ML methodologies to optimize maintenance strategies and improve overall equipment efficiency.

### Keywords:

Industry 4.0, Machine Learning, Predictive Maintenance, Algorithm Selection.