IAIA Project #1

Drying Process Degradation RUL Estimation and Classification using ML

School of Mechanical and Control Engineering

Jin Kwak (21900031)

Sunwoo Kim (22000090)

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Industrial AI and Automation

Advisor: Prof. Young-Keun Kim

1. Background

1) Hot-Air Drying Process

- Ensures that the film and protective agents adhere stably to the metal surface after plating
- Completely dries moisture from the product surface.

2) Process Defects

- High power consumption using coil.

  → Overheating, Irregular temperature transmission → Poor product quality

3) Defects Detection

- Coil fault may cause issues with the cooling motor → Vibration patterns changes.
- The goal is to identify these changes to diagnose the issue early on.

2. Problem Statement

1) Goal of the Project

1) Development of a machine learning model for coil defect diagnosis using data in hot-air process equipment.

2) Analysis of the remaining useful life trend and set a **Prediction model for RUL**

3) Using important features, set a Classification model of 12 states(normal and 11 errors) through the process.

2) Specific Goals

1) Achieve detection(Normal/Error) accuracy up to 90%

2) Ensure the model performance with Feature Reduction and analyze the feature reduction

3) 80% < Probability of Predicted RUL within α bound after Train-Test Breakpoint

3. Dataset

1) Dataset name :

AI dataset for early detection of equipment abnormalities

2) Data Measurement

- PLC data (Sampling period: 5 [sec])
- Sound data

3) Data Categories

- Numerical Data : Temperature, Current
- Sound Data :

  185 data, 30sec per track.

  Subdivided into Error and Normal
- Error Lot list: Process number, Error Number

5) Data type

- Supervised Learning-Based Data
- Time series data
- Numerical(Float/ .csv) and Sound data(.wav)

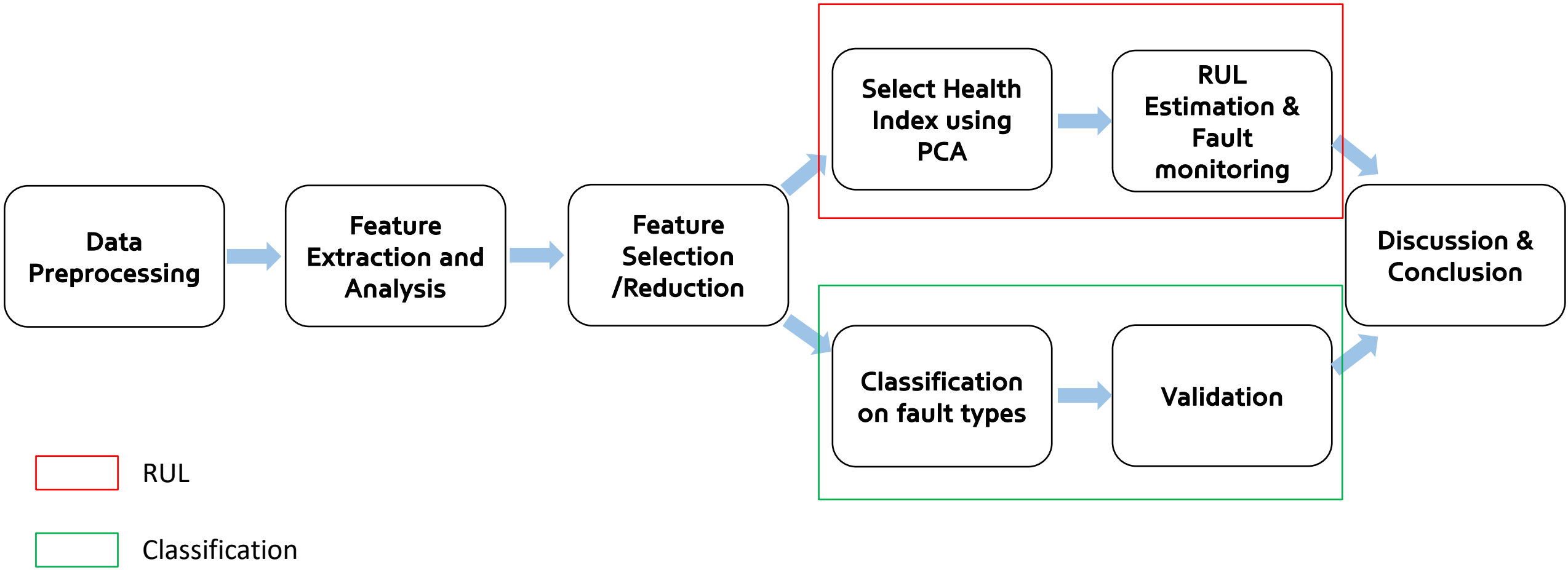
6) Data Output

- Classification: **Normal / 1~11 Error**

7) Data input

	Attribute	Explain
Input	Index	Auto-generated value when collecting data
	Process	Tracking the process by assigning the same number to the same process
	Time	Recording time down to seconds in the format (H:MM:SS)
	Temp	Temperature within the hot-air drying system
	Current	Current within the hot-air drying system
Error	1-11	Error Number

4. Method

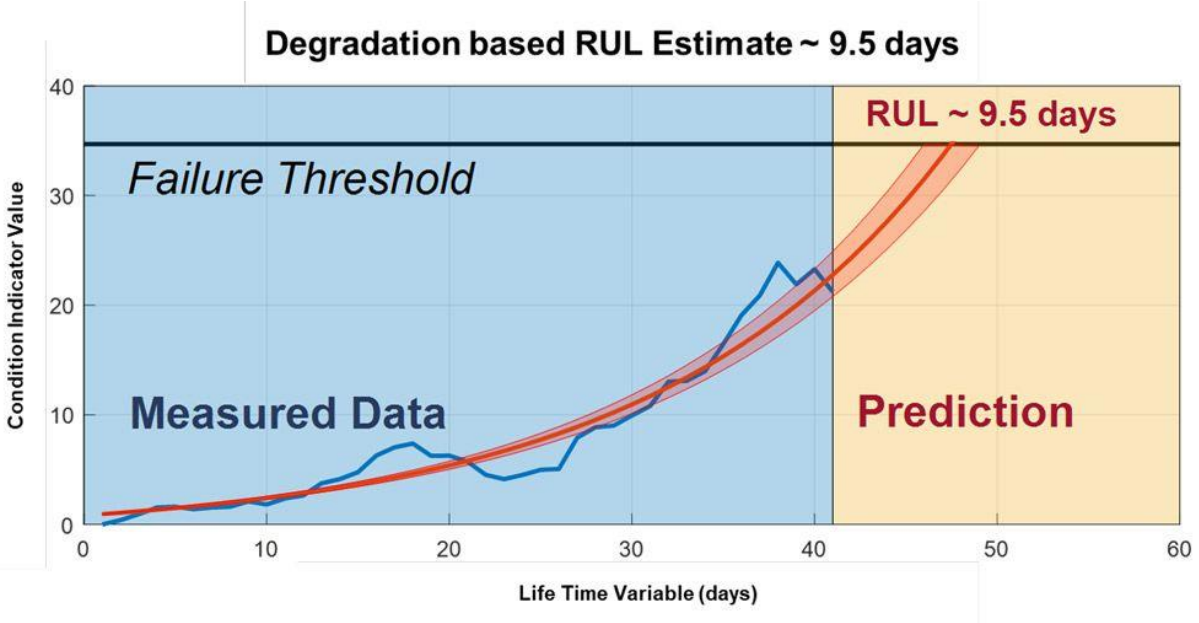

Data Preprocessing
Feature Extraction and Analysis
Feature Selection /Reduction
Select Health Index using PCA
RUL Estimation & Fault monitoring
Classification on fault types
Validation
Discussion & Conclusion
RUL
Classification

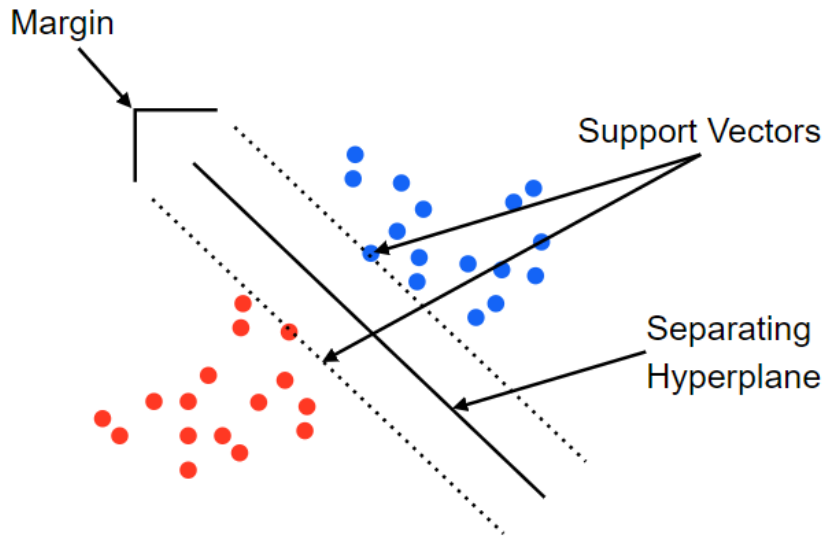
5. Expected outcome

1) RUL prediction would have 80% of accuracy after train-test breakpoint

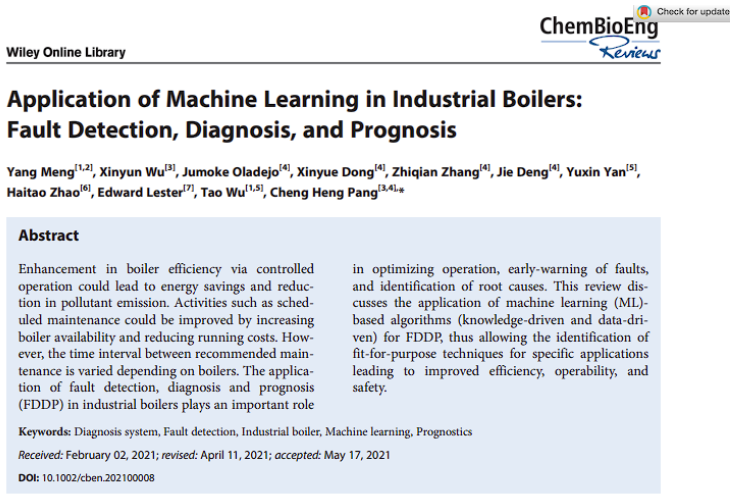
   → Precaution of process error and prevent upcoming accidents.

2) By using (90% F1 score) Classification models(KNN, SVM …etc), state types of errors(11 errors) in the equipment.





6. Paper Review



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ChemBioEng Reviews

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Application of Machine Learning in Industrial Boilers: Fault Detection, Diagnosis, and Prognosis

Yang Meng[1,2], Xinyun Wu[3], Jumoke Oladejo[4], Xinyue Dong[4], Zhiqian Zhang[4], Jie Deng[4], Yuxin Yan[5], Haitao Zhao[6], Edward Lester[7], Tao Wu[1,5], Cheng Heng Pang[3,4],*

Abstract

Enhancement in boiler efficiency via controlled operation could lead to energy savings and reduction in pollutant emission. Activities such as scheduled maintenance could be improved by increasing boiler availability and reducing running costs. However, the time interval between recommended maintenance is varied depending on boilers. The application of fault detection, diagnosis and prognosis (FDDP) in industrial boilers plays an important role in optimizing operation, early-warning of faults, and identification of root causes. This review discusses the application of machine learning (ML)-based algorithms (knowledge-driven and data-driven) for FDDP, thus allowing the identification of fit-for-purpose techniques for specific applications leading to improved efficiency, operability, and safety.

Keywords: Diagnosis system, Fault detection, Industrial boiler, Machine learning, Prognostics

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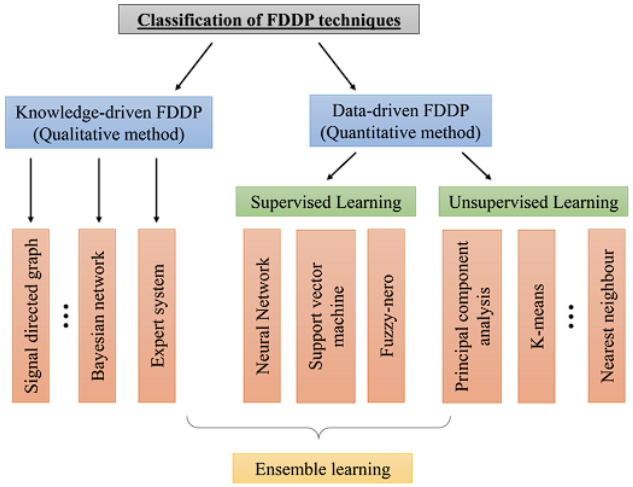


1) Paper information

- Yang Meng, Xinyun Wu, Jumoke Oladejo, Xinyue Dong, Zhiqian Zhang, Jie Deng, Yuxin Yan, Haitao Zhao, Edward Lester, Tao Wu, Cheng Heng PanYang Meng, Xinyun Wu, Jumoke Oladejo, Xinyue Dong, Zhiqian Zhang, Jie Deng, Yuxin Yan, Haitao Zhao, Edward Lester, Tao Wu, Cheng Heng Pangg. "Application of Machine Learning in Industrial Boilers: Fault Detection, Diagnosis, and Prognosis." ChemBioEng Rev 2021, 8, No.5, 1-10

2) Explaination

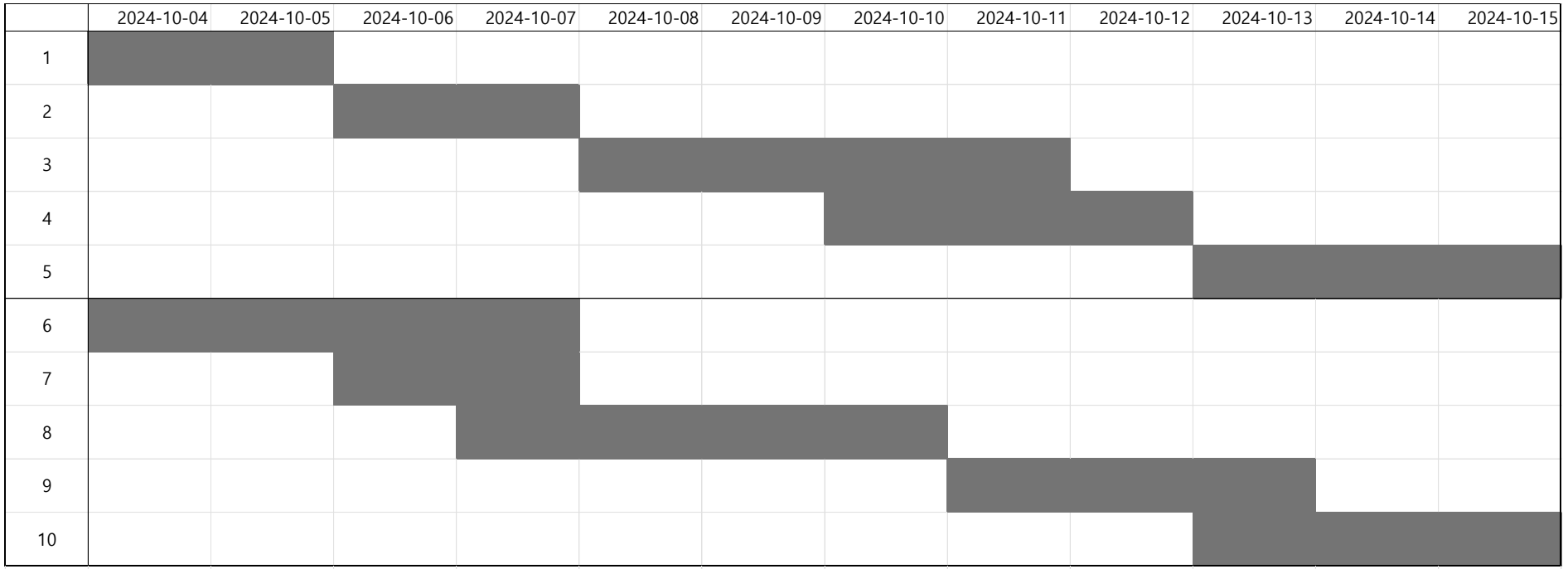
- Sensor data of boiler :
  pressure, Flow Rate, temperature etc.
- Boiler monitoring using machine learning techniques(SVM, ANN .etc) to build fault detection, diagnosis, and prognosiss (FDDT) system.

3) Application on the Project

Predicting the RUL of a facility using:

- Temperature
- Power(counterpart of current) data

7. Schedule



		To do
Jin	1	Data Review
	2	Data Processing
	3	Feature Extraction/Selection& Health Index Selection
	4	RUL estimation and Degradation Model analysis
	5	Discussion and Conclusion
Sunwoo	6	Related Work Search
	7	Related Open Source Search
	8	Open Source Set up and Train model
	9	Compare with Our Model
	10	Discussion and Conclusion

8. References

[1] (주) KEMP, *Innozinc 세라믹 아연도금,* http://kempkorea.com/

[2] Yang Meng, Xinyun Wu, Jumoke Oladejo, Xinyue Dong, Zhiqian Zhang, Jie Deng, Yuxin Yan, Haitao Zhao, Edward Lester, Tao Wu, Cheng Heng PanYang Meng, Xinyun Wu, Jumoke Oladejo, Xinyue Dong, Zhiqian Zhang, Jie Deng, Yuxin Yan, Haitao Zhao, Edward Lester, Tao Wu, Cheng Heng Pangg. "Application of Machine Learning in Industrial Boilers: Fault Detection, Diagnosis, and Prognosis." ChemBioEng Rev 2021, 8, No.5, 1-10