A Short Report On Predictive Models for Condition Monitoring of Hydraulic Systems

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1 Introduction

- Dataset used to train the models - https://www.kaggle.com/datasets/jjacostupa/condition-monitoring-of-hydraulic-systems
- Features:- PS1, PS2, PS3, PS4, PS5, PS6, FS1, FS2, TS1, TS2, TS3, TS4, EPS1, VS1, CE, CP, SE
  Targets:- profile : stableFlag
- Approaches used to balance the dataset
  - Approach 1 - Downsampling to 1hz
  - Approach 2 - Upsampling and Downsampling to 10hz
  - Approach 3 - Mean of a cycle for each sensor value
- Models Trained:
  - XGB
  - Random forest
  - SVM
  - Neural Network
- Approaches used to train the Models
  - k-fold cross validation
  - Test-Train-Split

2 Pre-processing

- Upsampling - Upsampled the 1hz sensor values to 10hz
- Downsampling - Downsampled the 10hz/100hz sensor values to 1hz/10hz
- Min Max Scaling - Normalized the features to improve the model performance

3 Results

Note : The Given Accuracy, Precision, Recall score for the k-fold method are the average taken from all the folds

- Approach 1 - Downsampling to 1hz
  - XGB

Model	Accuracy	Precision
k-fold cross validation	0.9655	0.9656
Test Train Split	0.9615	0.9615

289	5
12	135

Table 1: Model Performance and Confusion Matrix of Test Train Split - XGB

  - SVM

Model	Accuracy	Precision
k-fold cross validation	0.8301	0.7949
Test Train Split	0.8301	0.7345

378	68
25	191

Table 2: Model Performance and Confusion Matrix of Test Train Split - SVM

  - Random Forest

Model	Accuracy	Precision
k-fold cross validation	0.9784	1.0
Test Train Split	0.9682	1.0

294	0
14	133

Table 3: Model Performance and Confusion Matrix of Test Train Split - Random Forest

  - Neural Network

Model	Accuracy	Precision
k-fold cross validation	0.9218	0.9264
Test Train Split	0.94	0.93

282	12
16	131

Table 4: Model Performance and Confusion Matrix of Test Train Split - Neural Network

- Approach 2 - Upsampling and Downsampling to 10hz
  - XGB

Model	Accuracy	Precision
k-fold cross validation	0.9642	0.9642
Test Train Split	0.9615	0.9617

290	4
13	134

Table 5: Model Performance and Confusion Matrix of Test Train Split - XGB

  - SVM

Model	Accuracy	Precision
k-fold cross validation	0.7621	0.8428
Test Train Split	0.9018	0.8296

407	39
26	190

Table 6: Model Performance and Confusion Matrix of Test Train Split - SVM

  - Random Forest

Model	Accuracy	Precision
k-fold cross validation	0.9801	0.9930
Test Train Split	0.9705	0.9926

293	1
12	135

Table 7: Model Performance and Confusion Matrix of Test Train Split - Random Forest

  - Neural Network

Model	Accuracy	Precision
k-fold cross validation	0.9172	0.9217
Test Train Split	0.95	0.94

284	10
13	134

Table 8: Model Performance and Confusion Matrix of Test Train Split - Neural Network

- Approach 3 - Mean of a cycle for each sensor value
  - XGB

Model	Accuracy	Precision
k-fold cross validation	0.9673	0.9681
Test Train Split	0.9637	0.9650

293	1
15	132

Table 9: Model Performance and Confusion Matrix of Test Train Split - XGB

  - SVM

Model	Accuracy	Precision
k-fold cross validation	0.7290	0.9524
Test Train Split	0.7507	0.9180

441	5
160	56

Table 10: Model Performance and Confusion Matrix of Test Train Split - SVM

  - Random Forest

Model	Accuracy	Precision
k-fold cross validation	0.9676	0.9945
Test Train Split	0.9705	1.0

294	0
13	134

Table 11: Model Performance and Confusion Matrix of Test Train Split - Random Forest

  - Neural Network

Model	Accuracy	Precision
k-fold cross validation	0.7574	0.7102
Test Train Split	0.73	0.78

269	25
81	66

Table 12: Model Performance and Confusion Matrix of Test Train Split - Neural Network