

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	0.9196	0.9323
Test Train Split	0.9244	0.9278

432	14
36	180

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	0.6871	0.7092
Test Train Split	0.72	0.73

294	0
14	133

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	0.9569	0.9569

288	6
13	134

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

* SVM

Model	Accuracy	Precision
k-fold cross validation	0.9241	0.9423
Test Train Split	0.9244	0.9278

432	14
36	180

Table 6: 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	1.0	0.9705

294	0
13	134

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	0.9111	0.9222
Test Train Split	0.9000	0.8676

419	27
39	177

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	0.6797	0.4981
Test Train Split	0.73	0.78

287	7
112	35

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