Project Viva Voce

B.S. Abdur Rahman ™
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Fault Diagnosis Of Bucket Elevator - Drive Pulley Using Machine Learning Algorithm.

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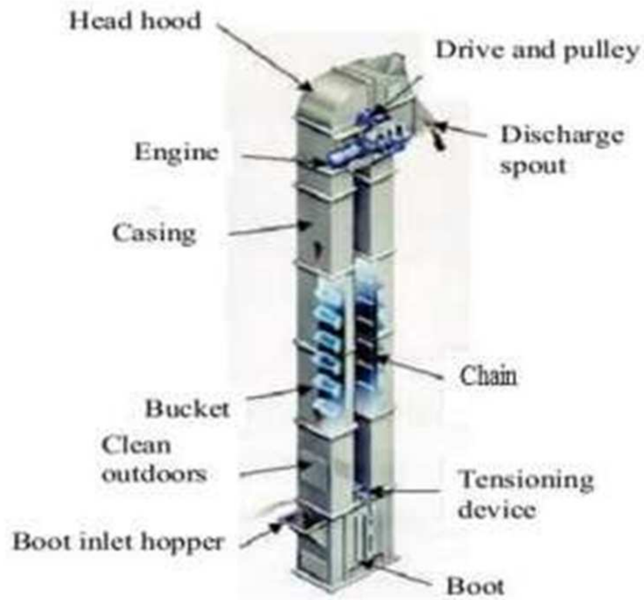
Contents

Introduction of Bucket Elevator

- A bucket elevator is a vertical conveying system.
- It used to elevate bulk materials such as grains, powders, and aggregates.
- It consists of buckets attached to a belt or chain that moves material vertically, allowing for efficient transport in various industries including agriculture, mining, and manufacturing.

Bucket Elevator parts

- Buckets
- Belt/Chain
- Drive pulley
- Tensioning device
- Casings
- Discharge port



Applications of Bucket Elevator

- Agriculture
- Mining
- Food Processing
- Construction
- Cement Industry

Importance of Drive pulley in bucket elevator

- The drive pulley transmits power from the motor to the elevator system.
- It helps maintain proper tension in the elevator belt.
- The drive pulley determines the direction of material movement within the bucket elevator.
- It regulates the speed of the elevator.

Literature survey

Name of the Author	Journal	Publication Year	Title	Insights
Fahad Alharbi , Suhuai Luo, Hongyu Zhang, Kamran Shaukat, Guang Yang, Craig A	Sensors	2023	Machine learning models for fault detection in belt conveyor idlers using acoustic and vibration signals.	It discusses major steps in the approaches, such as data collection, signal processing, feature extraction and selection, and ML model construction. It aims to enhance the reliability and efficiency of conveyor systems in industrial settings.
IA Baqer, AA Jaber, WA Soud	Journal of Intelligent & Fuzzy Systems	2023	Prediction of the belt drive contamination status based on vibration analysis and artificial neural network .	It uses time-domain signal analysis to extract key features like root mean square, kurtosis, and skewness from the vibration data. These features are then used in an artificial neural network (ANN) model to identify various operating conditions accurately.
P Sokolski	Energies	2023	Condition monitoring approach for Long-Term Operation of a Bucket Elevator.	It analyzing the intensity of vibrations in the drive unit of a large industrial bucket elevator. The time and frequency domain analysis of these vibration measurements served as the basis for evaluating the suitability of the drive, and thus the entire elevator, for long-term continuous operation.
JL Soares, TB Costa, LS Moura, WS Sousa, AL Mesquita, DS Mesquita	Diname	2023	Machine Learning Based Fault Detection on Belt Conveyor Idlers .	The method consists in applying wavelet transform to the measured vibration signals, extracting features from the processed signals and applying the Gradient Boosting method to classify the state of the idlers.

Name of the Author	Journal	Publication Year	Title	Insights
A Kulikov, A Loskutov, D Bezdushniy, I Petrov	Energies	2023	decision tree models and machine learning algorithms in the fault recognition on power lines with branches.	Explores a new approach to recognizing a faulted section of an electrical network with branches by concurrently analyzing several information features and applying machine learning methods: decision tree, random forest, and gradient boosting.
Z Chen, P Wang, B Li, E Zhao	Distributed Generation & Alternative Energy Journal	2023	Artificial neural networks-based fault diagnosis model for distribution network.	Principal component analysis (PCA) to extract features from transient data in a distribution network. These low-dimensional features are then utilized to update an artificial neural network model, which can identify the type of fault present.
B Ghasemkhani, O Aktas, D Birant	Machines	2023	Balanced K-Star approach for an explainable machine learning method for Internet-of-Things-enabled Predictive Maintenance in manufacturing	Experiments conducted on a PdM dataset showed that the Balanced K-Star method outperformed the standard K-Star method in terms of classification accuracy. It achieved higher accuracy .
NA Bakar, IS Chairul, S Ab Ghani	IAES International Journal of Artificial Intelligence	2023	j48 decision tree model for improvement of transformer dissolved gas analysis interpretation	Decision tree model using DGA results and key fault gases to classify transformer health into eight conditions. It employs the J48 algorithm for training and validation, comparing its performance with the Duval triangle method for transformer condition assessment.

Fault Diagnosis

- Fault Diagnosis, or fault isolation, refers to the system monitoring and identifying faults when they occur.
- Then, pinpointing the type of fault and its location.
- It helps where corrective action to take.

Machine Learning

- Machine learning is a subset of AI.
- Machine learning employs algorithms to enable computers to learn from data and make predictions or decisions.
- It encompasses supervised, unsupervised, and reinforcement learning techniques for different types of data and tasks.
- It can train on lesser(10-20%) data.
- It takes less time to train.
- Trains on CPU.

Problem definition

➢ **<u>Fault occur on Drive pulley(main focus)</u>:-**

- Wear on pulley shaft.
- Wear on pulley outer layer.

➢ **<u>Social issues on Drive pulley in Bucket Elevator</u>:-**

- Excessive wear can lead to unscheduled maintenance, breakdown & accidents.

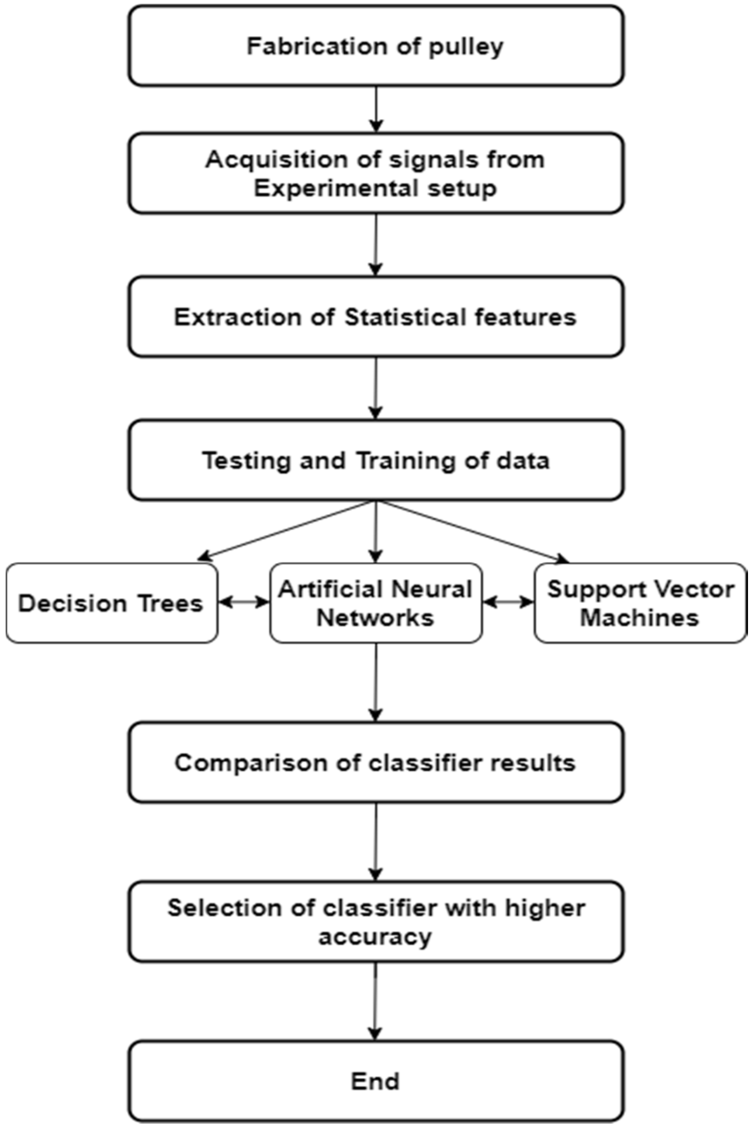
➢ **<u>Environmental issues on Drive pulley in Bucket Elevator:-</u>**

- Wear on the drive pulley can lead to reduced efficiency & increased energy consumption.
- Material waste will be generated from repeated wear , which can face environmental consequences.

Objectives

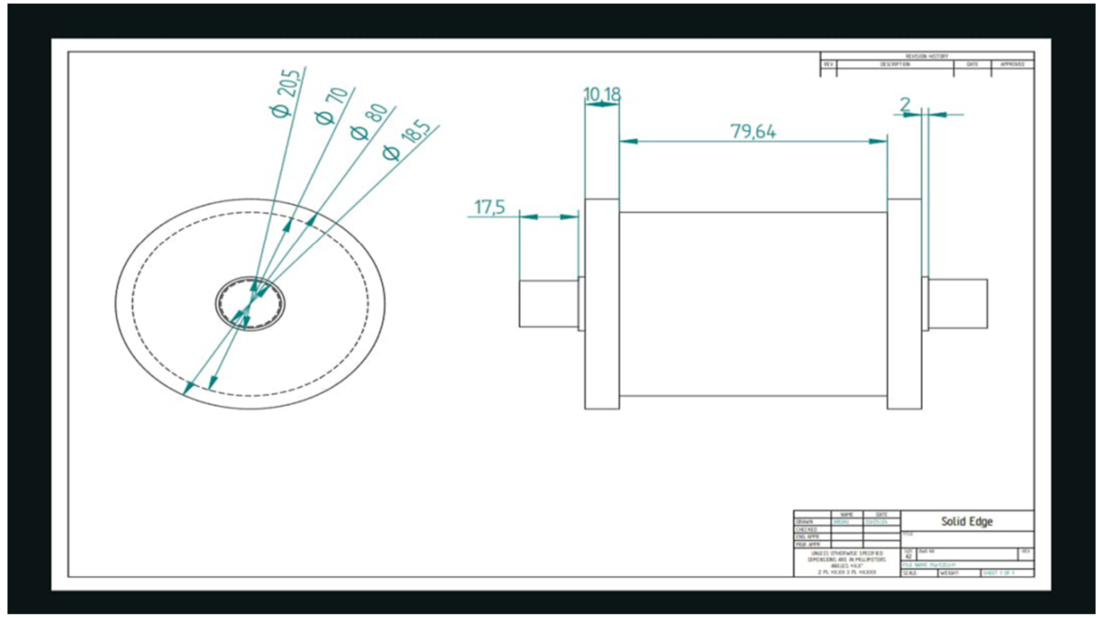
- To diagnose the faults occur in drive pulley of Bucket Elevator using Machine Learning algorithms.
- To fabricate drive pulley with different faults.
- To collect data through Accelerometer sensor & DAQ.
- To plot data in Matlab software via Machine Learning toolbox.

Methodology for fault diagnosis in drive pulley of Bucket Elevator using Machine Learning algorithms.

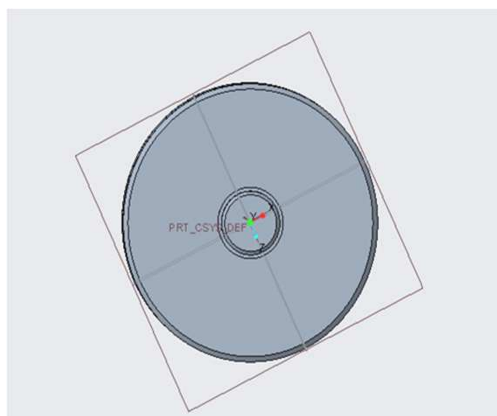


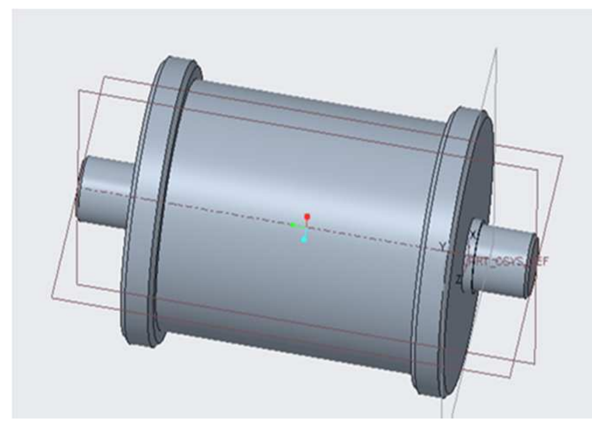
Fabrication of pulley

Pulley drawing with dimensions



3D pulley design in Creo





Materials used

1.Aluminum rod

2. ZZ sealed ball bearing

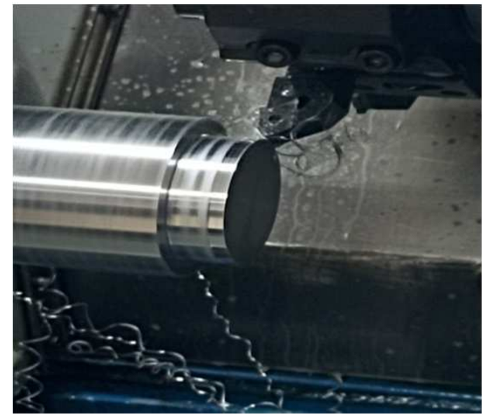
ID= 17mm

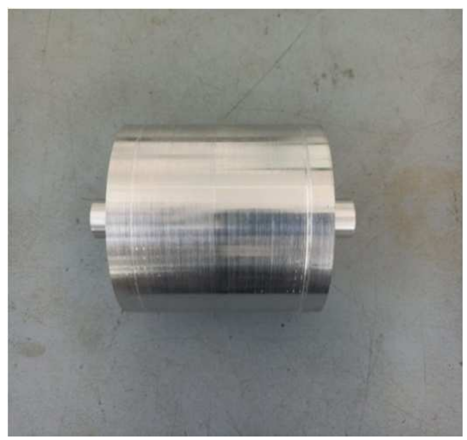
OD= 40mm

3.Anti-vibration

Rubber pads

Fabrication of pulley 1





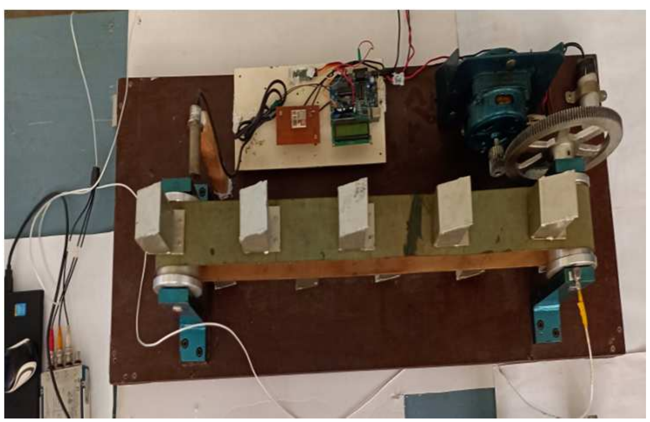
Fabrication of pulley 2

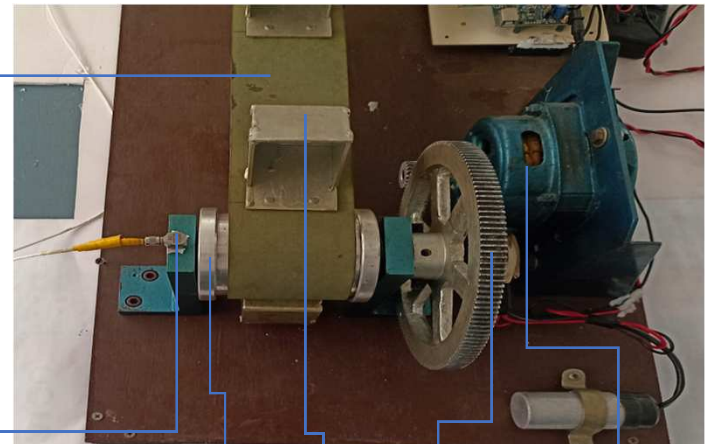
Fabrication of pulley 3






Tri-axial accelerometer sensor near drive pulley of Bucket Elevator

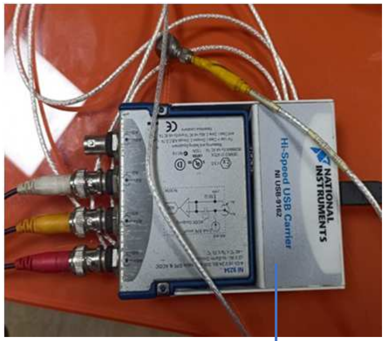


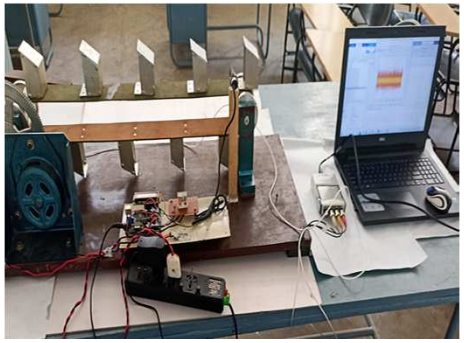


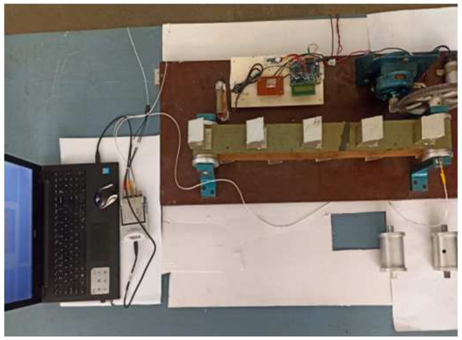
Acquiring signals based on 3 conditions

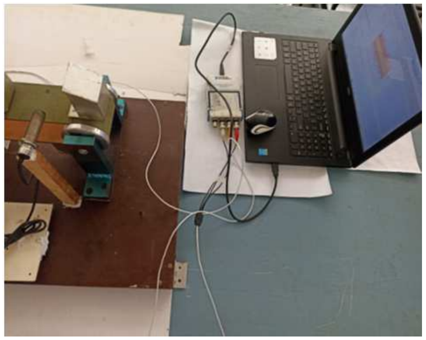
- Good
- Pulley-shaft-wear
- Pulley-outer-layer-wear

with the help of sensor, Ni-DAQ system & laptop.









Ni-DAQ system

Collected data’s from 3 conditions

1) Good condition

G1

	A	B	C	D
1	-0.24052	-0.80414	-0.14421	0
2	-0.13484	-1.31973	-0.15983	0.000391
3	0.11796	-1.3179	0.19058	0.000781
4	0.106184	-0.70579	0.017785	0.001172
5	0.025214	-0.7327	-0.34489	0.001563
6	0.242497	-0.43863	-0.3923	0.001953
7	0.068902	-0.03499	-0.03804	0.002344
8	0.38906	0.217035	-0.00778	0.002734
9	0.24213	0.663502	-0.3624	0.003125
10	0.206923	0.768499	-0.15788	0.003516
11	0.047668	1.179092	0.183015	0.003906
12	0.240544	0.711333	0.203882	0.004297
13	0.351291	0.826702	-0.07746	0.004688
14	0.145296	1.284883	-0.11395	0.005078
15	0.112591	1.225398	0.055188	0.005469
16	0.35843	0.748915	0.018335	0.005859
17	0.362518	0.796014	-0.15232	0.00625
18	0.309799	0.837196	-0.12029	0.006641
19	0.147248	0.886613	-0.16721	0.007031
20	-0.0654	0.488832	-0.36179	0.007422
21	-0.06753	0.099653	-0.44514	0.007813
22	0.21272	0.181711	-0.56357	0.008203
23	0.24573	-0.41996	-0.4732	0.008594
24	-0.04959	-0.52685	-0.60188	0.008984
25	-0.21916	-0.94098	-0.46118	0.009375

2) Pulley-shaft-wear condition

P1

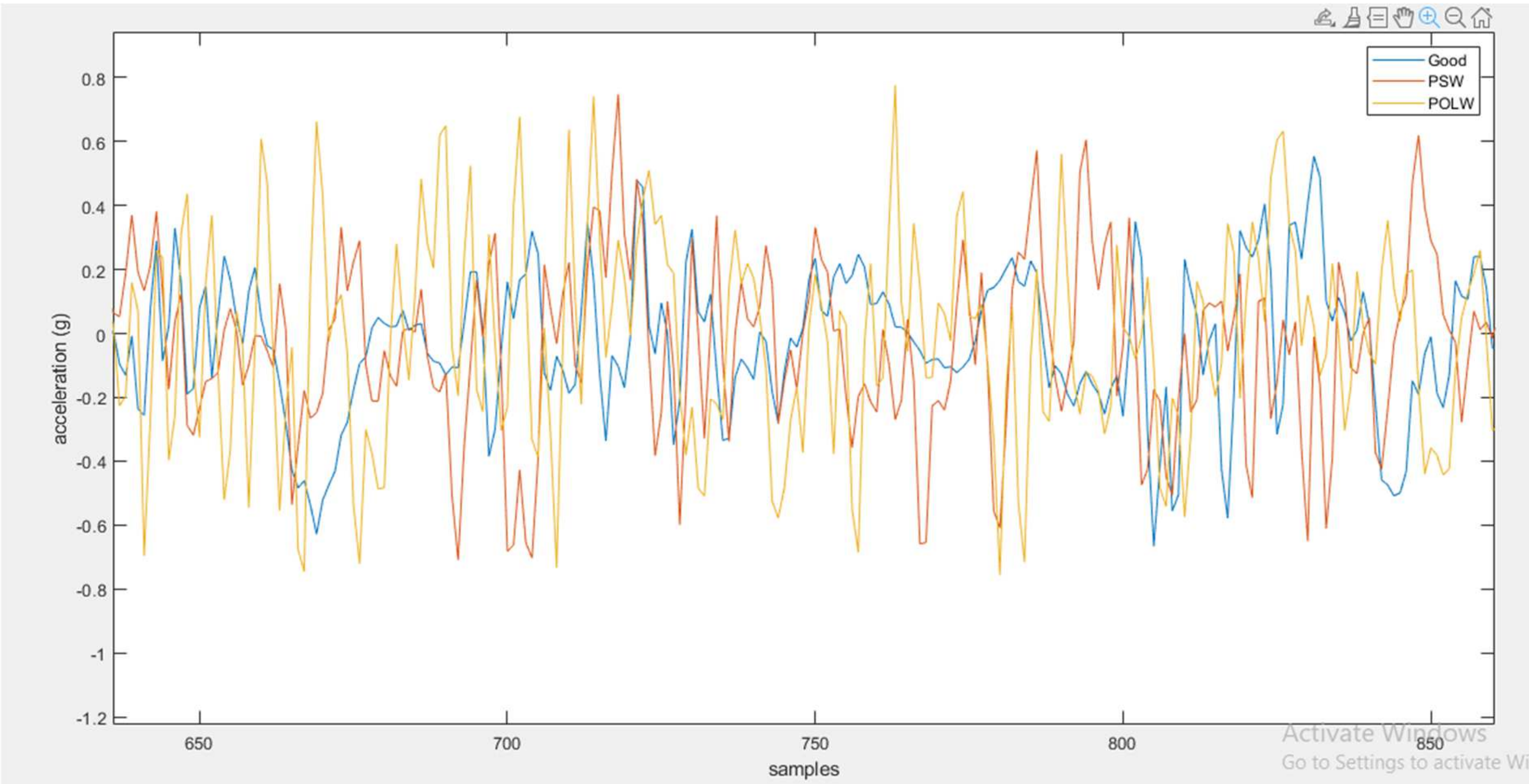
	A	B	C	D
1	-0.35377	2.319907	-0.01577	0
2	-0.18731	2.674128	0.133165	0.000391
3	-0.0978	2.130595	0.238538	0.000781
4	-0.01439	1.998022	0.132128	0.001172
5	-0.31471	1.129309	-0.01071	0.001563
6	-0.14033	0.0384	-0.10876	0.001953
7	0.059566	0.45912	-0.158	0.002344
8	0.327433	-0.10937	-0.32774	0.002734
9	0.301867	-0.40831	-0.73105	0.003125
10	0.343297	0.045538	-0.56735	0.003516
11	0.301317	0.081472	-0.09046	0.003906
12	0.275934	-0.36274	-0.18716	0.004297
13	0.228585	0.349914	-0.34446	0.004688
14	-0.09841	-0.71854	0.11663	0.005078
15	-0.23344	-0.98589	0.169774	0.005469
16	-0.17566	-1.38983	-0.06129	0.005859
17	-0.04673	-2.24732	-0.10089	0.00625
18	0.22053	-1.84557	-0.33574	0.006641
19	0.076102	-1.91482	-0.23287	0.007031
20	-0.24753	-1.1414	0.015223	0.007422
21	-0.19976	0.543313	-0.30761	0.007813
22	-0.0812	0.436791	-0.53123	0.008203
23	0.102157	1.803585	-0.2857	0.008594
24	0.039492	2.295381	-0.04573	0.008984
25	0.123757	1.503845	-0.42348	0.009375

3) Pulley-outer-layer-wear condition

P2

	A	B	C	D
1	-0.02024	-0.35572	0.16349	0
2	-0.23728	0.541849	0.250375	0.000391
3	-0.2673	3.116568	0.265141	0.000781
4	-0.32442	3.112419	-0.04945	0.001172
5	-0.30428	3.341143	-0.48791	0.001563
6	-0.2634	4.336451	-0.31713	0.001953
7	-0.18286	2.763567	0.088685	0.002344
8	-0.09548	2.500678	-0.04329	0.002734
9	0.159696	1.669608	-0.13732	0.003125
10	0.040651	0.10008	-0.11852	0.003516
11	0.179527	-0.85935	0.216207	0.003906
12	0.335975	-2.3007	0.325302	0.004297
13	0.191486	-2.52442	-0.14775	0.004688
14	0.098679	-2.23261	-0.40542	0.005078
15	-0.10542	-1.73862	-0.16056	0.005469
16	0.073783	-1.06776	0.105098	0.005859
17	-0.09054	-0.54107	-0.16276	0.00625
18	0.023993	-0.19795	-0.28625	0.006641
19	0.351596	0.350463	-0.18094	0.007031
20	0.200883	-0.1777	-0.09015	0.007422
21	0.125892	0.058167	0.065072	0.007813
22	-0.10683	-0.13603	-0.01065	0.008203
23	-0.25547	-0.56163	-0.08679	0.008594
24	-0.14204	-0.51331	0.366609	0.008984
25	0.013864	-1.62368	0.308401	0.009375

Vibrational signal



Feature extraction from 3 conditions

1. Good condition

A1 | f_x | Mean

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Mean	Standard E	Median	Mode	Standard D	Sample Va	Kurtosis	Skewness	Range	Minimum	Maximum	Sum	Class
2	-0.01999	0.002396	-0.01998	-0.07191	0.271107	0.073499	0.125036	0.005317	2.136874	-1.03192	1.104954	-255.872	Good
3	-0.02122	0.002359	-0.02187	-0.09375	0.266853	0.071211	0.268684	0.03696	2.352319	-1.07463	1.277688	-271.592	Good
4	-0.02188	0.002398	-0.02245	-0.05165	0.271258	0.073581	0.143133	0.051425	2.22797	-1.07408	1.153888	-280.029	Good
5	-0.02239	0.002365	-0.02203	-0.01413	0.267558	0.071587	0.152401	0.017176	2.149993	-1.11295	1.037044	-286.568	Good
6	-0.02322	0.002358	-0.02184	-0.18655	0.266733	0.071146	0.172429	0.020474	2.172751	-1.08757	1.085185	-297.181	Good
7	-0.02391	0.002429	-0.02377	0.174655	0.274829	0.075531	0.360791	0.045074	2.379227	-1.05883	1.320399	-306.019	Good
8	-0.02485	0.002398	-0.02401	-0.14146	0.271348	0.07363	0.157182	0.012727	2.04047	-1.00745	1.033017	-318.065	Good
9	-0.0247	0.002381	-0.02584	-0.11138	0.269422	0.072588	0.191335	0.011129	2.234926	-1.18013	1.0548	-316.21	Good
10	-0.02503	0.002424	-0.02432	-0.03743	0.274213	0.075193	0.336025	0.039271	2.705292	-1.28336	1.421928	-320.37	Good
11	-0.02587	0.00243	-0.02346	0.017602	0.27488	0.075559	0.120862	0.002207	2.129064	-1.06523	1.06383	-331.078	Good
12	-0.02539	0.002477	-0.02795	0.089783	0.280244	0.078537	0.236832	0.08135	2.420412	-1.1545	1.265912	-325.049	Good
13	-0.02617	0.002414	-0.02782	-0.06995	0.273109	0.074588	0.176301	0.030569	2.110638	-1.02631	1.084331	-335.039	Good
14	-0.0266	0.002436	-0.02453	-0.04921	0.275587	0.075948	0.199721	-0.02036	2.163538	-1.12619	1.037349	-340.42	Good
15	-0.02813	0.00242	-0.02584	-0.04067	0.273799	0.074966	0.36839	-0.01861	2.64208	-1.5245	1.117584	-360.041	Good
16	-0.02686	0.002371	-0.02608	-0.17698	0.268229	0.071947	0.265627	-0.02437	2.285873	-1.27531	1.010564	-343.754	Good
17	-0.02719	0.002399	-0.02971	-0.07575	0.271448	0.073684	0.150689	0.009465	2.431334	-1.31967	1.111666	-347.981	Good
18	-0.02799	0.002404	-0.02712	-0.18497	0.271992	0.073979	0.16647	0.026089	2.190873	-1.14401	1.046868	-358.255	Good
19	-0.02869	0.00245	-0.02651	-0.12133	0.277136	0.076805	0.129494	0.002057	2.351404	-1.15426	1.197148	-367.261	Good
20	-0.02834	0.002371	-0.02785	-0.03286	0.268278	0.071973	0.182866	-0.01599	2.211008	-1.15645	1.054556	-362.713	Good
21	-0.02904	0.002441	-0.02785	-0.05299	0.27619	0.076281	0.329089	-7.35E-05	2.264457	-1.17952	1.084941	-371.717	Good
22	-0.02859	0.002417	-0.0259	-0.13512	0.273435	0.074767	0.158051	-0.01339	2.255793	-1.13821	1.117584	-365.915	Good
23	-0.0287	0.002412	-0.03069	-0.10974	0.272841	0.074442	0.174362	0.013733	2.239075	-1.0706	1.168471	-367.382	Good
24	-0.02958	0.002417	-0.02959	-0.08838	0.273427	0.074762	0.194775	-0.02375	2.377152	-1.23846	1.138696	-378.614	Good
25	-0.03041	0.002376	-0.0292	-0.07978	0.268787	0.072247	0.069477	-0.0197	2.012098	-1.06993	0.942166	-389.305	Good

2) Pulley-outer-layer-wear condition

O111 f_x

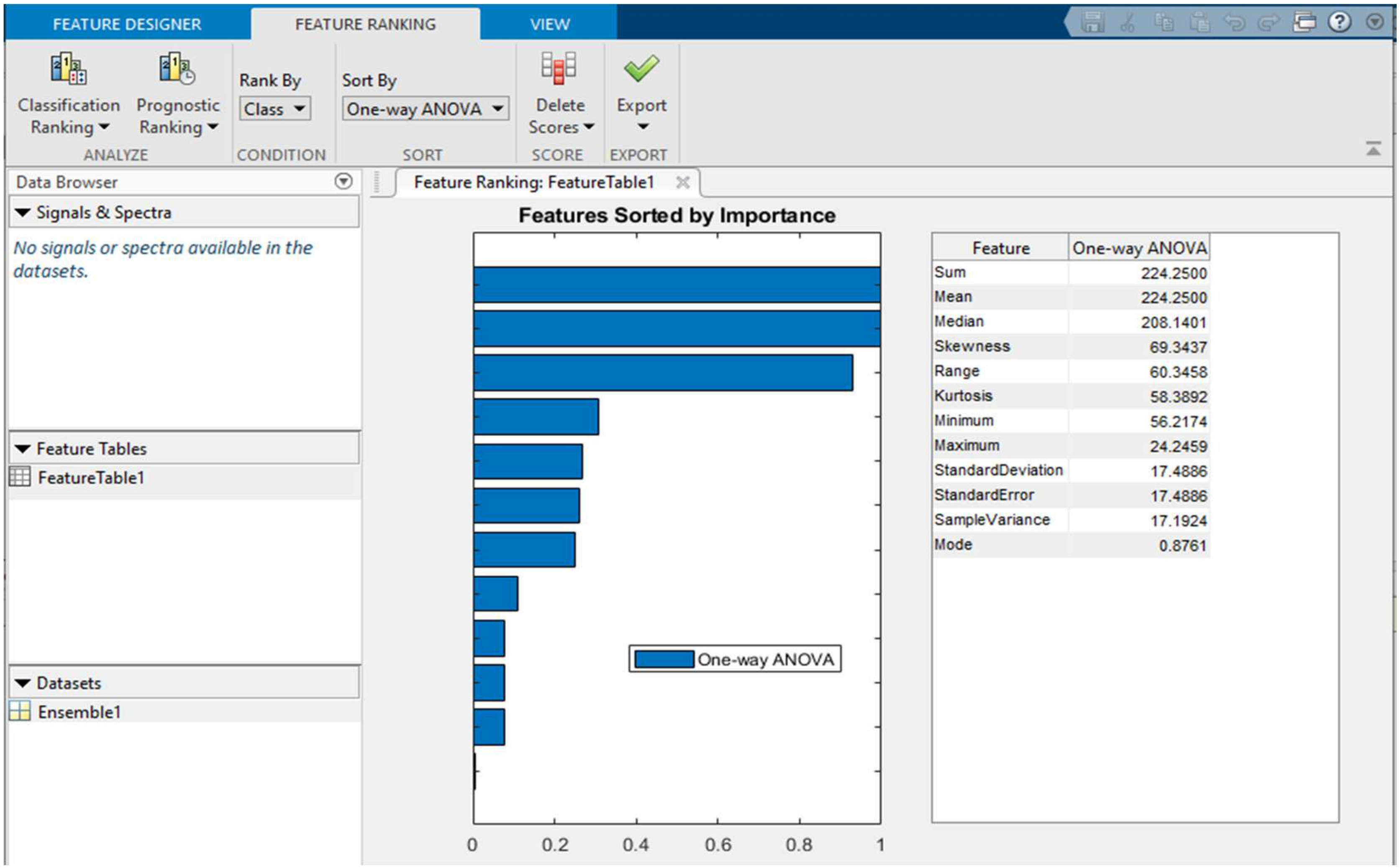
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Mean	Standard E	Median	Mode	Standard I	Sample Va	Kurtosis	Skewness	Range	Minimum	Maximum	Sum	Class
2	-0.01979	0.002466	-0.02072	-0.04384	0.279018	0.077851	0.032618	-0.0009	2.173422	-1.18159	0.991832	-253.338	POLW
3	-0.02047	0.002474	-0.02038	0.063608	0.279916	0.078353	-0.02024	-0.04227	2.092882	-1.03149	1.061389	-262.06	POLW
4	-0.02094	0.002453	-0.01934	-0.1569	0.27754	0.077029	0.0211	-0.02716	2.178365	-1.06566	1.112703	-268.076	POLW
5	-0.02163	0.002449	-0.02139	-0.01144	0.277059	0.076762	-0.0369	-0.0092	2.206371	-1.07933	1.127042	-276.823	POLW
6	-0.02221	0.002445	-0.02282	0.269839	0.276579	0.076496	0.099972	-0.01147	2.226323	-1.14681	1.079511	-284.348	POLW
7	-0.02276	0.002445	-0.02734	-0.16813	0.276624	0.076521	-0.05927	0.034799	2.060605	-1.11929	0.941311	-291.364	POLW
8	-0.02343	0.002474	-0.02398	-0.0655	0.27985	0.078316	0.037696	-0.02979	2.273548	-1.06023	1.213317	-299.898	POLW
9	-0.02269	0.002831	-0.02105	-0.01589	0.320254	0.102563	-0.0283	-0.07065	2.293683	-1.23998	1.053701	-290.46	POLW
10	-0.02199	0.00285	-0.0216	0.086122	0.322424	0.103957	0.013664	-0.05151	2.317052	-1.26774	1.049308	-281.465	POLW
11	-0.02418	0.002819	-0.02105	0.01925	0.318971	0.101742	0.017823	-0.09995	2.262566	-1.18263	1.079938	-309.45	POLW
12	-0.02443	0.002814	-0.02157	0.010586	0.318418	0.10139	-0.02305	-0.08583	2.428832	-1.22461	1.204226	-312.697	POLW
13	-0.02538	0.002853	-0.0259	-0.05043	0.322792	0.104194	0.046278	-0.09697	2.271901	-1.20606	1.065843	-324.809	POLW
14	-0.02658	0.002858	-0.02377	0.128162	0.323351	0.104556	0.05848	-0.13628	2.565628	-1.33382	1.231805	-340.277	POLW
15	-0.02508	0.002843	-0.0256	-0.24684	0.321633	0.103448	0.03886	-0.06228	2.577343	-1.16957	1.407773	-321.022	POLW
16	-0.02773	0.002902	-0.02679	-0.01132	0.328349	0.107813	-0.036	-0.09543	2.313696	-1.25029	1.063403	-354.919	POLW
17	-0.02455	0.002923	-0.02151	0.044083	0.330713	0.109371	-2.8E-05	-0.09532	2.534815	-1.39337	1.141441	-314.179	POLW
18	-0.02716	0.002904	-0.02575	-0.19821	0.328512	0.10792	0.08673	-0.09901	2.483807	-1.23559	1.248218	-347.706	POLW
19	-0.02644	0.002868	-0.02129	-0.22261	0.324492	0.105295	0.053065	-0.11908	2.339079	-1.31839	1.020692	-338.425	POLW
20	-0.02681	0.002877	-0.02114	0.190031	0.325516	0.105961	0.068097	-0.10481	2.491495	-1.27012	1.221371	-343.159	POLW
21	-0.02773	0.002826	-0.02316	-0.04982	0.319771	0.102253	0.040652	-0.12325	2.255122	-1.22455	1.030577	-354.944	POLW
22	-0.02895	0.002829	-0.02453	0.092529	0.320114	0.102473	0.034147	-0.08674	2.462696	-1.23351	1.229181	-370.521	POLW
23	-0.02786	0.00274	-0.02529	-0.16434	0.309984	0.09609	-0.02297	-0.10313	2.321933	-1.14297	1.178966	-356.634	POLW
24	-0.0278	0.00276	-0.02618	-0.0525	0.312282	0.09752	0.024703	-0.06698	2.283128	-1.22375	1.059376	-355.887	POLW
25	-0.02842	0.002705	-0.02447	0.01266	0.306055	0.09367	0.028263	-0.12753	2.534693	-1.25206	1.28263	-363.824	POLW

3) Pulley-shaft-wear condition

O1

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Mean	Standard E	Median	Mode	Standard I	Sample Va	Kurtosis	Skewness	Range	Minimum	Maximum	Sum	Class
2	-0.04394	0.002636	-0.04814	0.053967	0.298197	0.088922	0.182166	-0.00799	2.321933	-1.28556	1.036373	-562.494	PSW
3	-0.04355	0.002565	-0.04204	-0.16471	0.29016	0.084193	0.288318	0.003692	2.474654	-1.19477	1.279885	-557.495	PSW
4	-0.04311	0.002637	-0.0435	0.077275	0.298365	0.089022	0.13854	0.034459	2.467089	-1.23559	1.2315	-551.872	PSW
5	-0.04059	0.002651	-0.04103	-0.01419	0.299932	0.089959	0.26589	-0.00305	2.596929	-1.31741	1.279519	-519.591	PSW
6	-0.04293	0.002599	-0.04476	-0.09857	0.293991	0.086431	0.127169	-0.00581	2.228763	-1.20008	1.028685	-549.555	PSW
7	-0.04228	0.002639	-0.0389	-0.11614	0.298579	0.08915	0.228699	-0.02149	2.479353	-1.2459	1.233452	-541.212	PSW
8	-0.04298	0.002621	-0.04454	-0.12426	0.296478	0.087899	0.114868	-0.02042	2.454397	-1.35835	1.096046	-550.18	PSW
9	-0.03895	0.002658	-0.04119	-0.11389	0.300747	0.090448	0.137755	0.025995	2.340848	-1.19892	1.141929	-498.56	PSW
10	-0.04246	0.002679	-0.04607	-0.21615	0.303134	0.09189	0.184227	-0.02089	2.393626	-1.22229	1.171339	-543.469	PSW
11	-0.04081	0.002756	-0.03719	-0.15153	0.31186	0.097257	0.118045	-0.06103	2.702302	-1.37293	1.329368	-522.347	PSW
12	-0.04233	0.002756	-0.04506	0.088502	0.311835	0.097241	0.197264	0.013401	2.531033	-1.41863	1.112398	-541.78	PSW
13	-0.04048	0.002683	-0.03737	0.015711	0.303551	0.092143	0.198273	-0.01676	2.627315	-1.37861	1.248706	-518.2	PSW
14	-0.03966	0.002703	-0.03786	-0.23695	0.30582	0.093526	0.238131	0.017739	2.64989	-1.26957	1.380316	-507.651	PSW
15	-0.04282	0.0027	-0.04408	0.077031	0.305455	0.093303	0.12805	-0.0119	2.370685	-1.21857	1.152119	-548.108	PSW
16	-0.03985	0.002739	-0.04222	-0.08356	0.309916	0.096048	0.127628	-0.00918	2.434201	-1.28507	1.149129	-510.074	PSW
17	-0.04077	0.002736	-0.0421	-0.08149	0.309532	0.09581	0.2014	-0.02855	2.427673	-1.31772	1.109957	-521.883	PSW
18	-0.04029	0.003045	-0.03679	-0.11919	0.344464	0.118656	0.065245	-0.05034	2.796998	-1.58484	1.212158	-515.761	PSW
19	-0.04185	0.003054	-0.04152	0.137924	0.345548	0.119403	0.196681	-0.03744	2.575879	-1.28129	1.294589	-535.647	PSW
20	-0.04094	0.003011	-0.03835	-0.09601	0.340629	0.116028	0.058898	-0.05059	2.837268	-1.41979	1.417474	-524.03	PSW
21	-0.04283	0.003055	-0.04689	-0.18289	0.345676	0.119492	0.083444	-0.03551	2.639518	-1.44133	1.198185	-548.17	PSW
22	-0.04067	0.003079	-0.04051	-0.08679	0.34832	0.121327	0.073735	-0.04039	2.640616	-1.3938	1.246815	-520.625	PSW
23	-0.03891	0.003042	-0.04186	0.024924	0.344189	0.118466	0.072105	-0.02767	2.661422	-1.44585	1.215575	-498.091	PSW
24	-0.04305	0.003017	-0.0425	-0.14452	0.341386	0.116544	0.148014	-0.06562	2.542992	-1.34572	1.19727	-550.985	PSW
25	-0.0437	0.002993	-0.04134	0.153178	0.338616	0.11466	0.182543	-0.06623	2.656297	-1.47495	1.181345	-559.363	PSW

Feature ranking

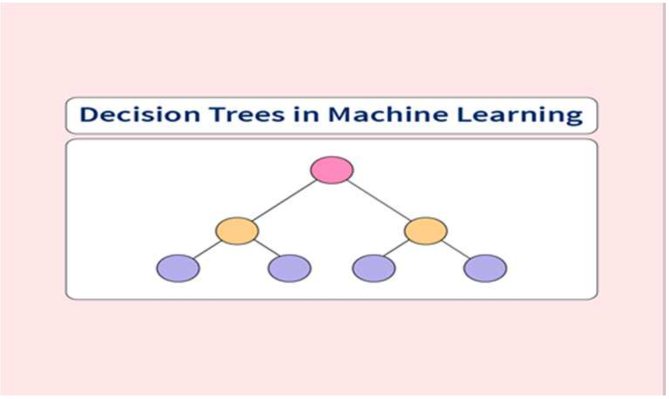


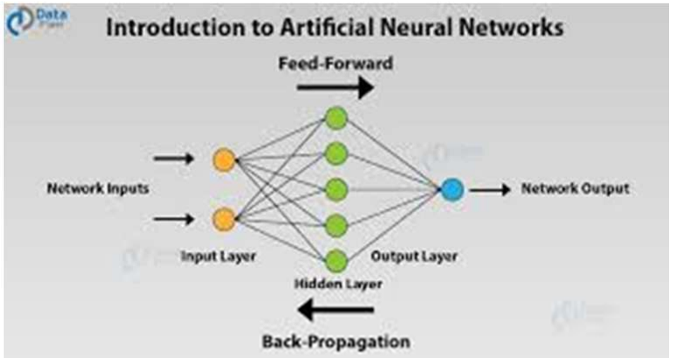
Feature	One-way ANOVA
Sum	224.2500
Mean	224.2500
Median	208.1401
Skewness	69.3437
Range	60.3458
Kurtosis	58.3892
Minimum	56.2174
Maximum	24.2459
StandardDeviation	17.4886
StandardError	17.4886
SampleVariance	17.1924
Mode	0.8761

Machine Learning algorithms

1.Decision Tree:

- It is a type of supervised learning algorithm.
- It is commonly used in machine learning.
- Easy to understand and interpret the data.
- Handle both numerical and categorical data without requiring extensive preprocessing.
- Applicable to both classification and regression tasks.



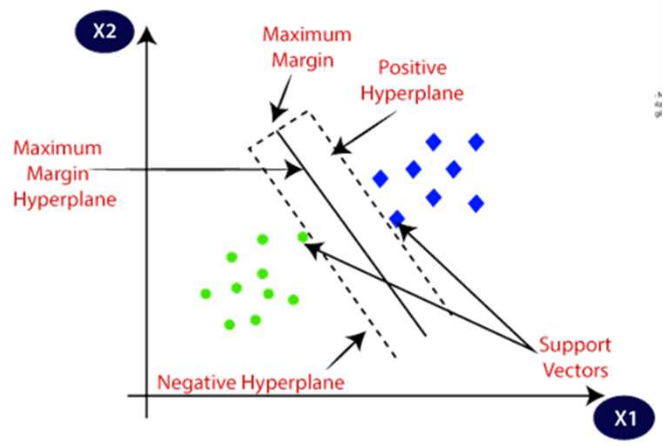


2. Artificial Neural Networks:

- It contain artificial neurons which are called **units.**
- These units are arranged in a series of layers.
- A layer can have only a dozen units or millions of units.
- Commonly, Artificial Neural Network has an input layer, an output layer as well as hidden layers.
- Types - Convolutional neural network, Modular neural network & Recurrent Neural Network.
- Applications - Social Media, Marketing and Sales & Healthcare.

Continue…

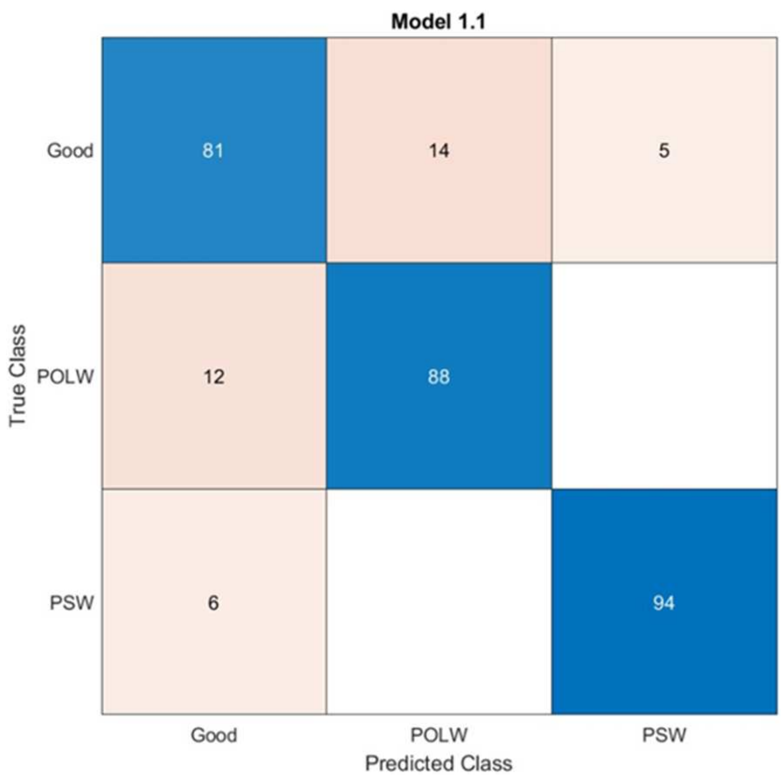
3. Support Vector Machine:



- Support Vector Machine (SVM) is a supervised machine learning algorithm used for both classification and regression.
- Though we say regression problems as well it's best suited for classification.
- The main objective of the SVM algorithm is to find the optimal hyperplane in an N-dimensional space that can separate the data points in different classes in the feature space.
- The hyperplane tries that the margin between the closest points of different classes should be as maximum as possible.

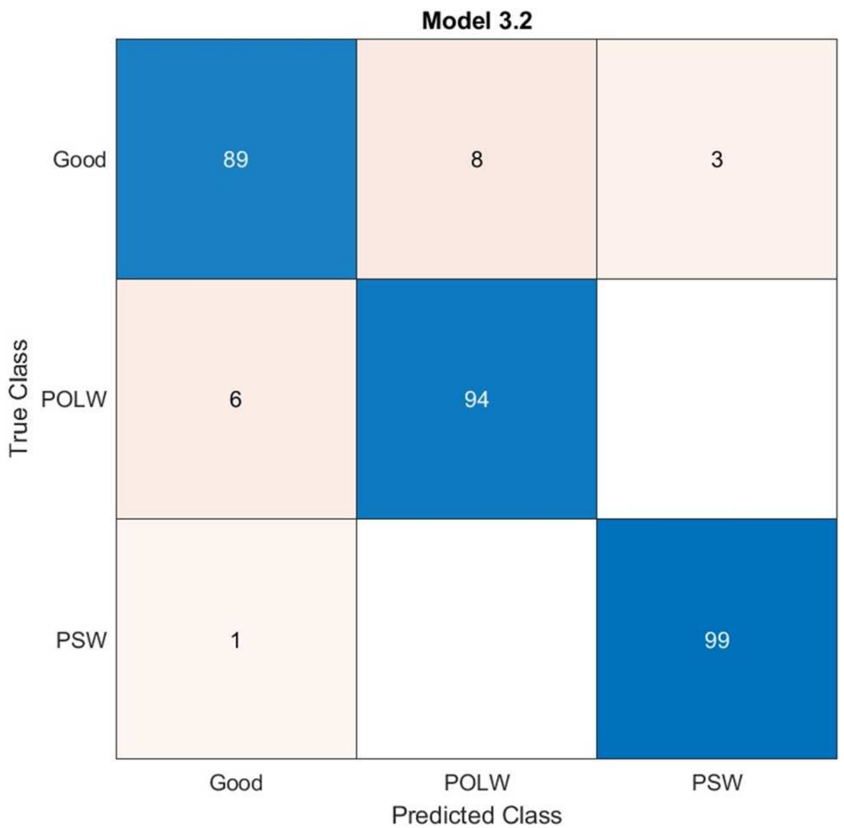
Using algorithms in Matlab via Machine Learning toolbox

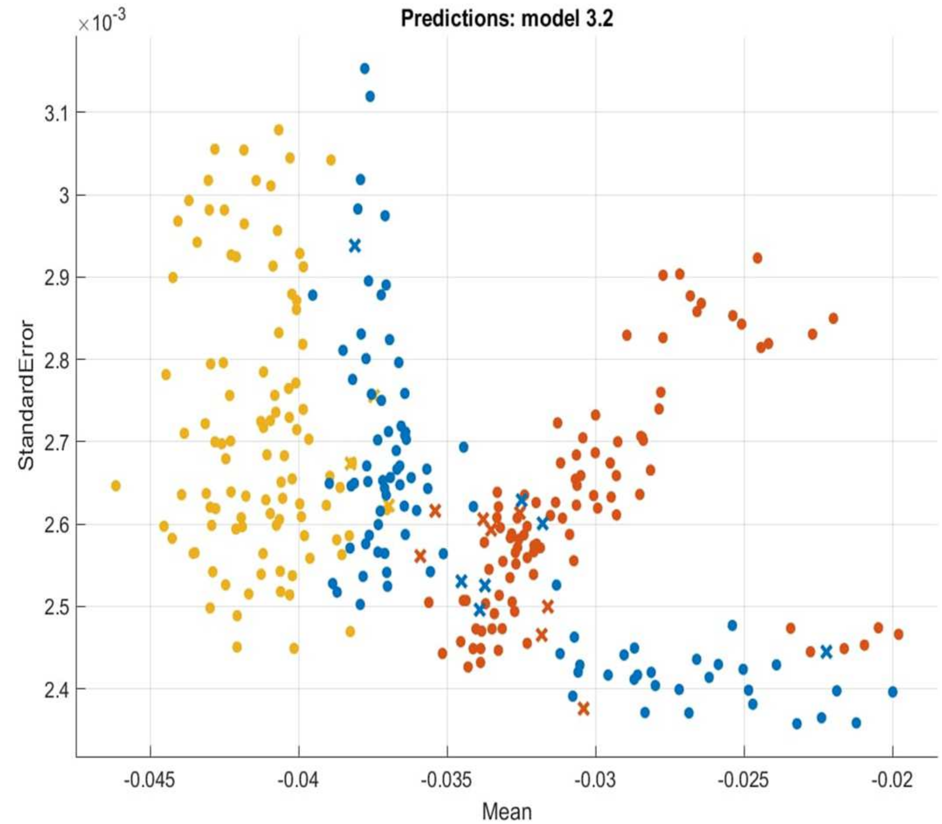
1. Decision Tree (Fine tree)



2. Artificial Neural Networks (Medium Neural Network)

3. Support Vector Machine(Quadratic)	Scatter plot (Good-Blue colour; POLW-Red colour; PSW-Yellow colour)





Output

1) Model 1(Decision Tree): Trained

[Training Results]

Accuracy (Validation)	87.7%
Total cost (Validation)	37
Prediction speed	~1200 obs/sec
Training time	14.976 sec

2) Model 2(Artificial Neural Network): Trained

[Training Results]

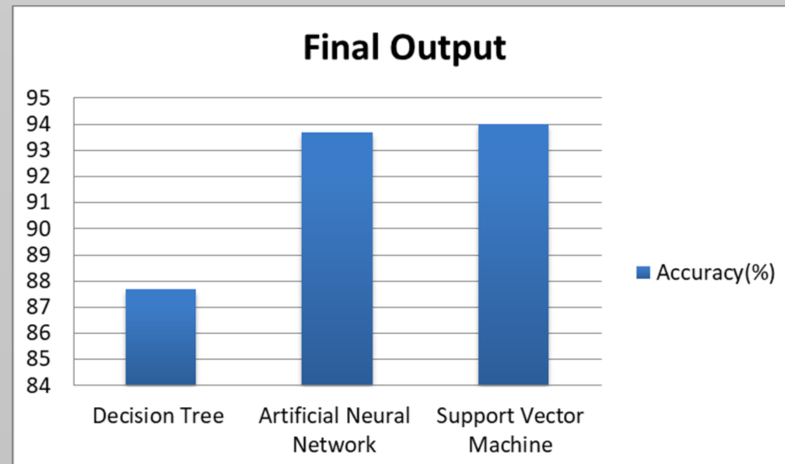
Accuracy (Validation)	93.7%
Total cost (Validation)	Not applicable
Prediction speed	~2300 obs/sec
Training time	3.1368 sec

3) Model 3 (SVM): Trained

[Training Results]

Accuracy (Validation)	94.0%
Total cost (Validation)	18
Prediction speed	~800 obs/sec
Training time	13.439 sec

Thus, algorithm with higher accuracy- SVM



Training resul	Accurac	Total cost	Prediction spee	Training tim
Decision Tree	87.70%	37	~1200 obs/sec	14.976 sec
Artificial Neural	93.70%	Not applicat	~2300 obs/sec	3.1368 sec
Support Vector N	94.00%	18	~800 obs/sec	13.439 sec

THANK YOU