Identification and Sorting of Power Quality Disturbances Using Matlab with GUI

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***Abstract*—this paper is related with detection and identification of unwanted signals contaminated in original power line networks. This can be achieved by various techniques as per applications and required accuracy. Feeder points at various locations of electrical substation plays important role in reduction of noise from the supply voltage. But this is of less amount and considerable for general applications. In some industrial applications this may cause large loss due to presence of noise. So for controlling the accuracy one can design a system which overcomes the problems arising due to noise. Using MATLAB software it is implemented for detection and identification. It has various algorithms like K nearest neighbor, Neural Networks, Support Vector Machine (SVM) and RBF. SVM is powerful tool in MATLAB for identification and Classification of voltage signals, images as well as music signals. For this detection of signals database is applied for any type of transform. It is better to use wavelet transform for feature extraction purpose. This paper gives approach for identification and detection of different noises in voltage signals using pair of wavelet transform.**

***Index terms*—Noises, SVM, MATLAB and Pair of wavelet.**

I. INTRODUCTION

In general noise is major problem in any electronic systems. It can be reduced but cannot completely remove. Most of the industries which are manufacturing medical instruments as well as chemical instruments require greater accuracy for the design. So to achieve this goal we require signals which are having less noise.[3] Detection of the type of noise is important to take corrective action on it. There are several ways to detect and classify those types of noises. Using K-NN, ANN and SVM one can detect and classify but using pair of wavelet and SVM tool it gives better performance.[1] In hardware consideration there are spikes guards as well as signal stabilizers for the controlling noise of signals.[4]

Using artificial neural networks this classification is used but its performance is less as compared with Pair of Wavelet and SVM. [3] To maintain the quality of power signal it is necessary to detect the quality of noise present in the signal [1]. Feature selection and subsequent classification is very much important in real life applications.[2] Now a day's one can focus on direct classification strategy.[7] For the single disturbance identification and feature extraction purpose mathematical tools like Wavelet transform and Hilbert huang transform are used.

This can be implemented using neural-networks also. But it gives less accuracy as well as speed of computation is less as compare to SVM. So it is better to use another classification method called support vector machine. SVM has been increasingly popular due to its interesting calculating and practical characteristics.[6] Motivated by this, the aim of this work was to investigate the performance of a SVM classifier used for classification of the most common voltage disturbances when training data and testing data originate from different sources.

Data originating both from real power networks and from synthetic data were used in the experiments.[12] The remaining part includes different pair of wavelets and SVM as combination for accurately classification of signals.[7]

II. SVM CLASSIFICATION

1) Feature vectors with Hyper plane

It is plane which decides boundary between two types of data. This data may be separable or random type. In the given fig.1 Plane 0 indicate hyper plane and lines Plane 1, Plane 2 are parallel lines to hyper plane which used to find out the margin of classifier. It is observed that as margin of hyper plane get increases it improves classification accuracy. If we compared Perceptron and SVM on the basis of margin, SVM has more width of hyper plane. So SVM classifier is preferred for classification purpose. The data points which lies on plane Plane 1 and Plane 2 or closer to hyper plane are called as feature vectors.

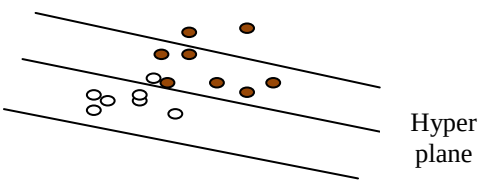

Fig. 1. Flow chart for the entire classification system

When data are not indicated by names learning is not possible, and another technique is used for learning ,which attempts to find clustering and classification of the data into groups, and then map new signal to these formed groups.[4] The SVM algorithm which provides an improvement to the support vector machines is called support vector clustering and is often used in industrial applications either when data is not represented by symbols or when only some data is labeled as a preprocessing for a classification.

2) Analysis using Support vectors

For binary SVM classifiers which distinguishes

(i) One verses all classification.

(ii) One verses one classification.

Classification of new signal using one verses all classification causes less accuracy because it checks each and every type. Initially data divided into two types which consist of one with remaining all. Again for second level of classification it classifies data or signal from one verses remaining. So for this technique if it consists of N different defects then N/2-1different levels.

For the one versus one approach, classification is done by checking any pair for classification of signals. It consists different sub classes and its features. Sane operation is performed on different data and results are obtained from it. For this technique it requires more computations and computational time. So for general applications one to all method is preferred.

More formally, a support vector machine constructs a hyper_plane or set of hyper planes in a high or infinite-dimensional space, which can be used for classification. A good separation is achieved by the hyper plane that has the largest distance to the nearest training-data point of any class since in general the larger the margin the lower the generalization error of the classifier.

Support vectors are the points near to the hyper plane which decides the boundary between the two classification regions. If these are closer to hyper plane then it increases classification accuracy.

III. METHODOLOGY

In this paper I have presented a new method for detection and classification of power quality disturbances.[7] Two discrete wavelet transforms with different wavelet filters are used in the feature extraction process.[1] In this way we eliminate the problem of the selection of the most adequate wavelets in the current methods for classification of power quality disturbances. [5] For the classification of the power disturbances we use a support vector machine.[9]

It consists of following stages for SVM detection and identification.

- Storage of database.
- Feature extraction.
- Training using wavelet transform.
- Testing of sample waveform.
- GUI representation/Interface.

1) Storage of Database

Database is stored or recorded at required power station. This can be generated using different mathematical equations with some defects.[5]

Generally database can be classified into following types.

I. Normal
This is noise free standard or reference signal.

II. Sag
This signal has amplitude in between 0 to 50 % of normal signal.

III. Swell
This signal has amplitude above reference signal's amplitude.

IV. Outage
This signal has amplitude in between 50 to 99 % of normal signal.

V. Harmonic
This signal contain oscillations as noise

VI. Sag with Harmonic
It is combination of Sag and Harmonic type of noise.

VII. Swell with Harmonic.
It is combination of Swell and Harmonic type of noise.

2) Extraction features :

For feature extraction wavelet of pair of wavelet are used. [8]Pair of wavelet gives more accuracy of classification as compare to single.[4]

For this extraction wavelet transform is used.

$$Wf(a,b) = \frac{1}{\sqrt{a}} \int_{-\infty}^{+\infty} f(x) \Psi\left(\frac{x-b}{a}\right) dx \quad (1)$$

This is equation of wavelet transform. Extracted features are then saved using excel format for training purpose.

3) Feature extraction

Using pair of wavelet these features are trained by the set or group keeping limited data group. One can use curve let or wavelet but wavelet is mostly preferred.

In this paper following pairs are used for feature extraction process.

- DB2 and Coif2
- Coif2 and Haar
- Haar and Dmey
- Dmey and DB20
- DB20 and Coif4
- Coif4 and DB2

4) Testing of waveform

Finally there is random selection of real time data and it get tested by using SVM classifier algorithm and pair of wavelet.

5) GUI representation/Interface

This is used for representation of Result and shows Respective control action for it.

GUI is better technique to represent the results or outcomes of project work in Matlab.

IV. EXPERIMENTAL RESULTS

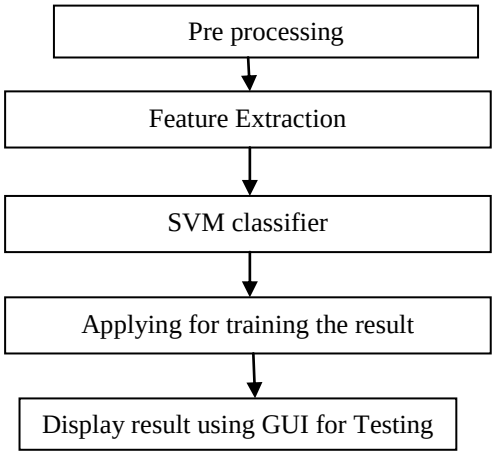

Fig. 2. Flow chart for the entire classification system

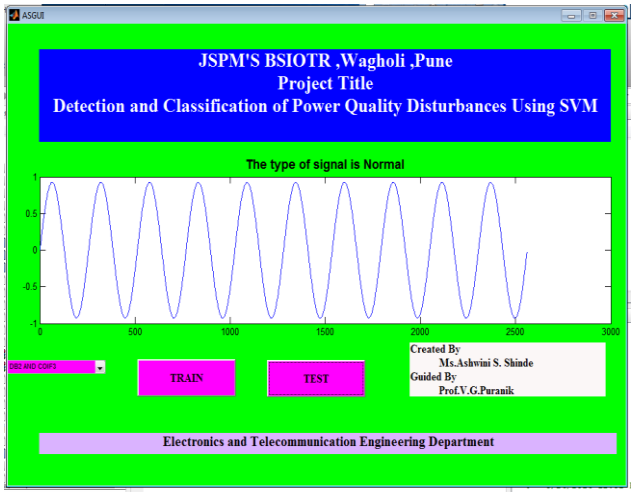

Fig. 3. GUI displaying NORMAL signal

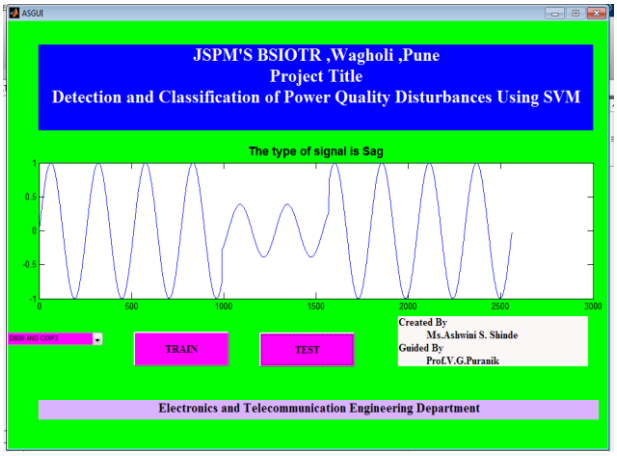

Fig. 4. GUI displaying defect type SAG

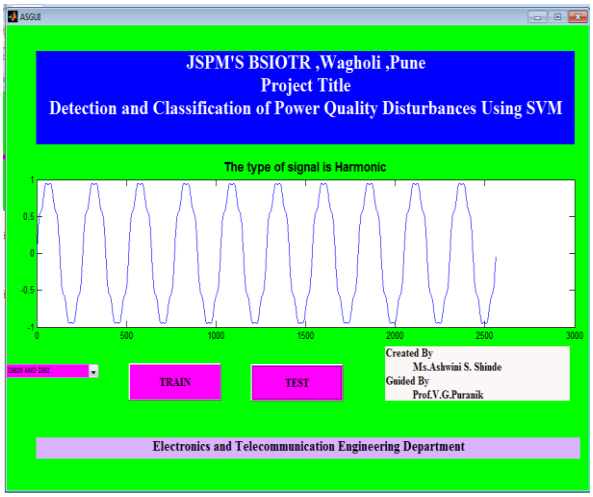

Fig. 5. GUI displaying defect type HARMONIC

Table 1. Table showing classification results using pair of wavelet.

	DB2 & DB4	Coif2 & DB2	Haar & Dmey	Dmey & DB2	DB20 & Coif2	Coif4 & DB4
C1	92	90	86	87	95	90
C2	86	90	87	88	98	88
C3	87	91	88	85	97	88
C4	88	87	89	86	95	86
C5	86	84	89	87	95	87
C6	85	83	87	89	98	84
C7	84	86	85	88	98	86

V. CONCLUSION

For classification of Power quality disturbances high classification accuracy is obtained using pair of wavelet and SVM classification .The accuracy of the proposed method is also dependent on selected pair of wavelet.

REFERENCES

[1] Zhigang Liu, Member, IEEE, Yan Cui, and Wenhui Li "A Classification Method for Complex Power Quality Disturbances Using EEMD and Rank Wavelet SVM." IEEE TRANSACTIONS ON SMART GRID, VOL. 6, NO. 4, JULY 2015

[2] Soumya R. Mohanty, Senior Member, IEEE, Nand Kishor, Senior Member, IEEE, Prakash K. Ray, Member, IEEE, and João P. S. Catalão, Senior Member, IEEE "Comparative Study of Advanced Signal Processing Techniques for Islanding Detection in a Hybrid Distributed Generation System" IEEE TRANSACTIONS ON SUSTAINABLE ENERGY, VOL. 6, NO. 1, JANUARY 2015.

[3] Sovan Dalai, Member, IEEE, Debangshu Dey, Member, IEEE, Biswendu Chatterjee, Member, IEEE, Sivaji Chakravorti, Senior Member, IEEE, and Kesab Bhattacharya, Senior Member, IEEE "Cross-Spectrum Analysis-Based Scheme for Multiple Power Quality Disturbance Sensing Device" IEEE SENSORS JOURNAL, VOL. 15, NO. 7, JULY 2015.

[4] L. S. Moulin, A. P. A. da Silva, M. A. El-Sharkawi, and R. J. Marks, II, "Support vector machines for transient stability analysis of large-scale power systems," *IEEE Trans. Power Syst.*, vol. 19, no. 2, pp. 818–825, May 2010.

[5] A. Milchevski1, D. Kostadinov1, D. Taskovski1 "Classification of Power Quality Disturbances using Wavelets and Support Vector Machine" ELEKTRONIKA IR ELEKTROTECHNIKA, ISSN 1392-1215, VOL. 19, NO. 2, 2013.

[6] M. Karimi, H. Mokhtari, and M. R. Irvani, "Wavelet based on-line disturbance detection for power quality application," *IEEE Trans. Power Del*., vol. 15, no. 4, pp. 1212–1220, Oct. 2010.

[7] S. Santoso, E. J. powers, W. M. Grady, and A. C. Parsons, "Power quality disturbance waveform recognition using wavelet based neural classifier part I: Theoretical foundation," *IEEE Trans. Power Del*., vol. 15, no. 1, pp. 222–228, Jan. 2010.

[8] Whei-Min Lin, Member, IEEE, Chien-Hsien Wu, Chia-Hung Lin, and Fu-Sheng Cheng "Detection and Classification of Multiple Power-Quality Disturbances With Wavelet Multiclass SVM" IEEE TRANSACTIONS ON POWER DELIVERY, VOL. 23, NO. 4, OCTOBER 2008.

[9] N. Ernberg, M. Styvtakis, and M. Bollen, "A statistical-based sequential method for fast online detection of fault- induced voltage dips," *IEEE Trans. Power Del., vol.* 19, no. 2, pp. 497–504, Apr. 2004.

[10] J. Huang, M. Negnevitsky, and D. T. Nguyen, "A neural-fuzzy classifier for recognition of power quality disturbances," *IEEE Trans. Power Del.*, vol. 15, no. 2, pp. 609–616, Apr. 2000.