International Journal of Mechanical and Production Engineering Research and Development (IJMPERD)
ISSN(P): 2249-6890; ISSN(E): 2249-8001
Vol. 8, Issue 1 Feb 2018, 1135-1150

EFFECTIVE TIME DOMAIN FEATURES FOR IDENTIFICATION OF BEARING FAULT USING LDA AND NB CLASSIFIERS

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ABSTRACT

Recently, the mechanical fault detection of an induction motor (IM) from vibration signals using pattern recognition has proven to be an effective method. This paper has studied for the first time statistical time domain features mean absolute value (MAV), waveform length (WL), zero crossing(ZC), slope sign changes (SSC), simple sign integral(SSI) and Willison amplitude (WAMP) for identification of the mechanical faults using linear discriminant analysis (LDA) and naive Bayes (NB) classifiers. In this study, the effectiveness of the features is investigated using parameters like accuracy, sensitivity and specificity individually and in groups for a total of 63 combinations. Each feature set combination is investigated for 15datasets defined under 5 groups in different combinations of faulty and normal working conditions. The results indicate that the feature set of SSI, WL,SSC and ZC features outperform the conventional features in the identification of faults and is found to be computationally effective. Further, NB classifier is found to be better than LDA in identification of mechanical faults.

KEYWORDS: Fault Diagnosis, Statistical Features, Linear Discriminant Analysis Classifier, Naive Bayes Classifier, Roller Bearings & Pattern Recognition

Received: Jan 05, 2018; **Accepted**: Jan 25, 2018; **Published**: Feb 07, 2018; **Paper Id**.: IJMPERDFEB2018135

Original Article

1. INTRODUCTION

In recent years, there has been considerable evolution in the field of fault diagnosis of induction machines with the aid of expert systems and artificial intelligence algorithms. Many condition monitoring techniques have been successfully developed and implemented. Bearing faults are among the more prominently occurring faults [1] and hence their diagnosis forms an essential part in condition monitoring of induction machines. Large number of detection techniques have been developed based on signature analysis of either stator current or vibration signals. Among this, vibration signals have been proven to be more reliable for diagnosing mechanical faults either invasively or non-invasively. Condition monitoring of bearing faults with pattern recognition involves feature extraction, feature selection, feature reduction and their classification. Typically, pattern recognition methods are applied to diagnose the faults with time domain features like peak value, crest factor, kurtosis, etc.[2-3].Prior researches in this area using time domain features like mean, standard deviation, shape factor, etc. have been found to yield poor results [4]. Investigations using frequency domain features like power spectrum, power spectral density, periodograms etc.[5-6] relies on the differences in frequency characteristics of fault conditions[7]. These differences are non-significant and hence difficult to diagnose. As vibration signals are non-stationary in nature, time–frequency domain analysis like spectrogram, wavelets transforms(WT) etc. have been used for extracting features to identify the bearing faults[7-12]. This analysis using WT methodology [13] suffers a major setback due

Article

Identification of bearing faults using statistical time domain features and fused time-domain descriptor features

January 2018 · Journal of Advanced Research in Dynamical and Control Systems
10(3):17-26

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Abstract

This paper presents implementation of new features for classification of bearing faults in diagnosing induction motor. The proposed features are time dependent spectral features, a set of descriptors of frequency domain features are directly derived from time-domain vibration data of present and previous window segment. The higher order moments and hence logarithmic features are computed for a segment and from nonlinear scaling of same segment to obtain descriptors of the window. The orientation is computed from the descriptors of window segment and non-linear window segment. The orientation of features of current window and previous window is combined to obtain fusion features. The fused features are utilized for three case study data, derived from publicly available database of Case Western Reserve University. The performance of fusion features are compared with conventional features for 10-fold cross validation using linear discriminant analysis and naive Bayes classifiers. The results have shown, the proposed features improve the accuracy of classification and with decrease in computational cost of12.2%, compared to conventional features. In addition, average of 2% increase in accuracy of classification is obtained, compared other of classification.

Journal of Astronomical History and Heritage, 21(2 & 3), 202–210 (2018).

THE SOLAR INGRESS (*SANKRĀNTI*) ACCORDING TO THE *MAKARANDASĀRIṆĪ* AND OTHER INDIAN ASTRONOMICAL TEXTS

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Abstract: In the present paper we analyze the procedure for the computation of the sidereal solar ingress according to the popular Indian astronomical table, the *Makarandasāriṇī*. The results are compared with those obtained from the basic treatise *Sūryasiddhānta*, from the *Vākya* and the *Gaṇakānanda*, and also from those based on modern computations.

We have also discussed the varying durations of the solar months and the solar ingress to the twenty-seven *nakṣatras* (zodiacal asterisms). A number of illustrative examples are also provided.

Keywords *sankrānti*, *nakṣatra*, *Makarandasāriṇī* (*MKS*), *saurapakṣa*, *Gaṇakānanda* (*GNK*), *sauramāna*, *cāndramāna*, *adhikamāsa*

1 INTRODUCTION

Saṅkrānti is the instant when the Sun enters a *rāśi* (sidereal zodiac sign). In Indian astronomy a sidereal solar year commences when the Sun enters *Meṣa*, the sidereal sign for Aries. Currently this occurs around 14–15 April, but due to the precision of equinox this date shifts by one day in about 72 years.

In Indian society, the *Meṣa saṅkrānti* plays an important socio-religious role. In the Hindu calendar, religious festivals are celebrated either according to the solar calendar (*sauramāna*) or the lunar calendar (*cāndramāna*). For example, in regions like Tamil Nadu, Kerala, West Bengal and Dakshina Kannda in Karnataka the solar calendar is adopted. On the other hand in most of the other parts of India like Karnataka, Maharashtra and Andhra the lunar calendar is followed.

The solar months (*māsas*) are generally named after the Sun's entry into *rāśis* (sidereal signs) such as *Meṣa* (Aries), *Vṛṣabha* (Taurus) etc. But more popularly, the names of the solar months are the same as those of the lunar months viz., *Caitra*, *Vaiśākha* etc.

Most of the Hindu festivals are based on the luni-solar (or lunar) calendar. For example *Kṛṣṇajanmāṣṭamī* and *Sri Rāmanavamī* etc. are based on the lunar calendar. On the other hand, the festival of *Makara Saṅkrānti* (*Pongal* festival) and Tamil New Year's day (*Sauramānayugādi*) are based on the solar calendar. The famous Kerala festival *Tiruoṇam* is observed annually in the solar month of *Siṁha* when the Moon occupies the *Śravaṇa nakṣatra* (lunar mansion).

In the following sections we discuss the tables for the determination of *Saṅkrānti* given in the *Makarandasāriṇī* (*MKS*). The procedure for this determination as also to find the durations of the successive solar months are discussed mathematically. Examples are provided to illustrate these procedures.

The solar ingress into the 27 *nakṣatras* is also discussed from the corresponding tables of the *MKS*. In fact, the durations of the Sun's occupation of these *nakṣatras* are called *Mahānakṣatras*. The farmers reckon the seasons by

Indian Journal of Biotechnology
Vol. 17, April 2018, pp 302-315

Morphological and phylogenetic identification of a hyper laccase producing strain of *Schizophyllum commune* NI-07 exhibiting delignification potential

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Received 27 March 2015; revised 30 September 2016; accepted 18 October 2016

In nature lignin degrading enzymes of white rot fungi (WRF) degrade lignin, amongst which laccase play an important role. Our objective was to isolate hyper laccase secreting indigenous WRF. Culture-dependant and molecular methods were used in combination for identification and characterization. The isolate NI-07, the most potent laccase producing isolate was identified as *Schizophyllum commune*, strain (MTCC- 11893). It had pinkish grey split gills, radiating from the attachment point and cylindrical to ellipsoidal smooth white spores. The generative hyphae were thin-walled, having septae and clamp connections, skeletal hyphae were swollen centrally and broad and binding hyphae were comparatively thick-walled and branched. The ITS/5.8S rRNA gene sequence as per phylogenetic tree results showed best matching with Agaricaceae sp. 647 (Sequence ID: gb|JQ312209.1|) as per cladogram while the phylogram showed significant variation and is deposited with GenBank (Bank It 1679236 *Schizophyllum* KF911323). Production of lignolytic enzymes by *S. commune* was investigated in liquid medium under conditions of vegetative growth as well as solid state fermentation in comparison to the reference culture *Trametes versicolor.* Laccase was the sole enzyme detected in *S. commune* with highest activities of 737.78 ± 42.1 U mL^{-1} being obtained in submerged fermentation on day 7 and 338.62 ± 42.5 U mL^{-1} in SSF on day 5 and was considerably higher in comparison to *T. versicolor*. A preliminary investigation conducted to assess the efficacy of this WRF in delignification confirmed its competence in enhancing digestibility of straw by 10-14%.

Keywords: *Schizophyllum,* morphology, phylogenetic, lignolytic, laccase, lignin

Introduction

The rumen microbial utilization of energy-rich cell walls of crop residues, a renewable energy source, is hindered by the presence of lignin, which limits its overall digestion process and can significantly influence animal performance in livestock production systems[1]. Lignin is responsible for the lower digestibility and poor nutritive value of agricultural residues as it is resistant to most of the microbial enzymatic systems. The presence of lignin and its hemi cellulose binding matrix increases the unavailability of other energy rich constituents present in the agricultural residues for the ruminants. Thus, for maximum utilization of straw as cattle feed, either complete or partial degradation of lignin from the lingo-cellulosic complex is necessary[2]. Bio-delignification of such agro-residues has potential to convert this biomass into nutritious easily digestible feed of good quality[3-4]. Microorganisms that can depolymerise lignin are of extreme interest to biotechnologists and animal nutritionists because lignin is the main barrier to cellulose and hemicellulose hydrolysis. The importance of the ability of white rot fungi (WRF) to degrade all principal components of wood for carbon flux in ecosystems[5,6] is well known. As individual species of WRF differ in the composition for the presence of lignin degrading enzymes[7], it is necessary to study the production of these enzymes in species with different ecological backgrounds. *Trametes versicolor* is a well-known WRF and most widely studied for lignin degradation. However, loss of total organic matter is very high during the degradation of lignocellulosics, which limits their practical use and necessitates looking towards selective lignin degrading organisms[8]. The objective of the present work was to find hyper laccase enzyme producing WRF for use in delignification of crop residues. The sole laccase producing fungal isolate NI-07 was identified employing morphological and molecular methods to

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Journal of Applied Biology & Biotechnology Vol. 6(06), pp. 61-63, November-December, 2018
Available online at http://www.jabonline.in
DOI: 10.7324/JABB.2018.60610

Characterization of paper and pulp properties from weed species

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ARTICLE INFO

Article history:
Received on: September 20, 2017
Accepted on: February 02, 2018
Available online: October 20, 2018

Key words:
Paper and pulp,
Weeds,
Merremia peltata (L.) Merr,
Amaranthus viridis L.,
Andropogon saccharoides var.
erianthoides Hack

ABSTRACT

The earth is covered with about 30% of forest land. Between the years 1990 and 2005, there was a net decrease (1.7%) in the global forest area at an annual rate of change of 0.11%. One of the major reasons for deforestation is logging of wood and using a substantial amount of this logged wood for the production of paper and pulp. Hence, non-woody plant species are being sought to complement the conventional process for paper and pulp production. In the present study, the chemical characteristics of three potential weeds *Merremia peltata* (L.) Merr., *Amaranthus viridis* L., and *Andropogon saccharoides* var. *erianthoides* Hack. which were locally available in abundance were analyzed through proximate analysis studies according to Technical Association of the Pulp and Paper Industry standard method. The results show that holocellulose content in *M. peltata* (L.) Merr., *A. viridis* L., and *A. saccharoides* var. *erianthoides* Hack. was found to be 64.19%, 73.26%, and 72.41%, respectively, which is found to be comparable with holocellulose content present in soft and hard wood trees. Furthermore, when the lignin content of *M. peltata* (L.) Merr. (19.46%), *A. viridis* L. (12.30%), and *A. saccharoides* var. *erianthoides* Hack. (22.19%) was analyzed in comparison with the other non-wood species such as sugar maple (21.79%), *Lantana camara* L. (26.93 ± 2.65%), and torpedo grass or *Panicum repens* L. Rank. (21.48%), a comparable result was obtained. These results affirm the potential of these species for use in pulp and paper industries. Furthermore, these species which are locally available can become a potential source of income if an organized effort to pool the biomass is considered.

1. INTRODUCTION

The supply of the preferred softwood is unable to meet the increasing demand for paper and pulp products. This has led to the diversification of different raw materials as supplies for pulp production [1]. Many societies have measured the level of civilization and development using the demand and the consumption rate of pulp and paper products as the basis [2]. As defined by the Oxford Dictionaries, paper is a "material manufactured in thin sheets from the pulp of wood or other fibrous substances." When moist cellulose fibers derived from different sources are pressed together and dried into thin, flexible sheets, a paper is formed. This versatile material finds several uses in packaging, cleaning, writing, and printing and in a number of industrial and construction processes. The bonds in the wood cells that hold together the woody cells are ruptured during the pulping process resulting in a fibrous mass, i.e., the pulp. Paper has a very distinctive ability to look fragile and strong, both at the same time. It is a biodegradable material and a potential alternative for plastic. For a long time, paper making process has involved the use of wood that are cut from tree stems, debarked, chipped and pulped [2]. According to the report on Ecology Global Network, the consumption of paper has grown over 400% in the past 40 years globally. Now, in every continent, paper industries use nearly 4 billion trees or 35% of the total trees cut around the world [3]. Paper has become an omnipresent part of the daily life by appearing in different forms and with different uses. We use paper in the form of tissue paper, cardboard packaging, stereo speakers, electrical plugs, etc. It has been estimated that on an average, 300 million tons of paper is consumed annually around the world. Virgin pulp is most commonly used to make the paper. However, 38% of the world's total fiber supply is from recycled paper and another 7% is from non-wood fibers obtained from plants such as hemp or kenaf. Although the United States (US) comprises only 5% of the world's population, it uses 30% of all paper! Around 200 billion dollars is generated by the forest and paper product industries using 28% of all woodcut in the U.S. This account for 7% of the total manufacturing output of the U.S. Furthermore, in regions with inadequate forest resources, there is a need to find non-wood plant fibers that are suitable for papermaking [4]. Moreover, wood cutting has become more difficult due to global warming and restrictions on carbon dioxide emissions. Although the price of wood pulp is unstable at present, it is expected to have an exponential rise in the long term [5].

Hence, it can be a boon if we can complement the pulping process with non-woody plant species, which are of less commercial importance or,

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International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.11 No.02, pp 35-39, 2018

Comparative study of natural decolourizing agents for degradation of melanoidin present in biomethanated molasses spent wash

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Abstract : Molasses Spent Wash (MSW) is pollution intensive waste water generated by ethanol distilleries. It retains very dark brown colour and severe pungent smell due to the presence of water soluble recalcitrant melanoidin pigment. In present laboratory scale study, removal of melanoidin from MSW was investigated using different cost effective decolorizing agents. The effect of various molasses concentration (10-100% v/v) along with different combination of soil, bagasse, jagerry and fly ash was studied to estimate the removal efficiency. Results indicate that maximal reduction of colour removal of 85% was achieved by using combination of soil and bagasse at molasses concentration of 100% and contact time of 24 days.

Key words : Spent Wash; Soil, Bagasse, Fly Ash, Colour.

Ajay Kumar *et al* /International Journal of ChemTech Research, 2018,11(02): 35-39.

DOI= http://dx.doi.org/10.20902/IJCTR.2018.110206

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Production of Value Added Products Like Mushrooms from Distillery Yeast Sludge as Nutrient Source.

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Abstract:
This study focused on the estimation crude protein and essential factors like pH, Organic carbon and utilization of the distillery yeast sludge as source of single cell protein as substrate for growth of mushrooms. Distilleries produces yeast sludge as solid waste to a tonne of million tonnes actually, requiring disposal. Sludge consists of nutritional value and rich in vitamins, proteins, trace elements has been converted to a value added by products adopting a scientifically designed composting process. The ability and screening of the distillery yeast sludge use as rich nutritional values to grow and produce mushrooms in laboratory scale. The results shown that 1 gram of yeast sludge contains 10.79 mg of proteins, pH 5.91, Moisture changes the speed of biological activity the moisture content was estimated in the yeast sludge around 12.1%, carbon content was found around 2.9% and carbon and nitrogen ratio (C:N) affects the microbial activity and the rate of organic matter decomposition 60:1 was estimated from yeast sludge. Various percentages of Sludge with Paddy straw show mushroom growth among all substrates the mushroom span shown more growth on high amount yeast sludge.

Key words: Distillery Yeast Sludge, Single Cell Protein, Nutritional values and Mushroom span.

1. Introduction:

Distillery and sugar industries produce yeast sludge as solid waste in anticipation of discarding based on sugar cane molasses these are major industries in Asia and South America. Cane molasses are producing more than 13 million m3/year in the world [11]. Approximately 8–15 L of effluent is generated for every liter of alcohol produced. During the fermentation process of distillery industries yeast sludge refers to surplus yeast at the bottom and it also named as spent yeast or yeast slurry [16]. In India yeast sludges rarely utilized, but it is a rich amount of protein and vitamins. Several studies have been reported to utilize different microbes like fungus, bacteria, algae and yeast used various agro-industrial waste to produce various value-added products like single cell proteins and other by-products [19]. This yeast sludge is used as single cell protein dietary in the poultry industry [2]. Sludge is composed of by-products collected from during the fermentation stages and process. It contains both compounds of agricultural value (including organic matter, nitrogen, phosphorus and potassium, and to a lesser extent, calcium, sulfur and magnesium), and pollutants which usually consist of heavy metals, organic pollutants and pathogens. Sludge is usually treated, before disposal or recycling, in order to reduce its water content the presence of pathogens [12].

During the fermentation process yeast will be produced which is only partially reused for the pitching of subsequent brews. This excess yeast has a higher nutritional value after analysis and it is generally used for animal feed. Disposal of distillery sludge often presents a substantial problem. Distillery Yeast Sludge (DYS) contains a great nutritional potential to be utilized as an economical source of Single Cell Protein for poultry, because it has 27 to 29% crude protein [15]. Drying for a period of 6 h sample weight of 600 kg dried sludge have best nutritional characteristics, namely, moisture contents of 27.42%, protein contents of 22.42%, potassium contents of 5.0%, phosphorous contents of 3.6%, nitrogen contents of 3.02%, fat contents of 2.14%, ash contents of 39.93%, and fibre contents of 0.0031% resulting in the best quality of sludge to use as poultry feed and organic manure [8]. Yeast recycled paper sludge (RPS) generated 10%, increasing annually and it has an average content of 60% moisture and 50% cellulose on a dry basis. 180 and 190 g/l dry materials of Recycled paper sludge (RPS) overall 72% of cellulose getting converted into 32 and 35 g/l of ethanol after 72 hours of incubation [9]. Several researchers have been reported on utilization of distillery effluent for the production of microbial biomass.

Based on the nutritional advantages of yeast sludge consists of water, protein, fats, Carbohydrates, ash and other elements like essential elements like potassium and phosphorous and also it plays role in waste management as waste material are used as substrate [16]. Cultivation of mushrooms is found to have a high biological yield and improved efficiency and richer protein content [1]. In this we have tried to cultivate mushrooms by using yeast sludge as a suitable option for substrate.

ARTIFICIAL CELLS, NANOMEDICINE, AND BIOTECHNOLOGY
2018, VOL. 46, NO. 5, 968–979
https://doi.org/10.1080/21691401.2017.1351982

Comparison of anticancer activity of biocompatible ZnO nanoparticles prepared by solution combustion synthesis using aqueous leaf extracts of *Abutilon indicum, Melia azedarach and Indigofera tinctoria* as biofuels

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ABSTRACT

Recently, there has been an upsurge in the use of naturally available fuels for solution combustion synthesis (SCS) of nanoparticles. Although many reports suggest that these biofuels pose less harm to the environment, their strategic advantages and reliability for making NPs has not been discussed. In the present work, we try to address this issue using plant extracts as biofuels for the SCS of zinc oxide nanoparticles as a model system. In the present work, combustion synthesis of ZnO NPs using lactose and aqueous leaf extracts of *Abutilon indicum, Melia azedarach, Indigofera tinctoria* as biofuels has been carried out. A comparative analysis of the obtained powders has been conducted to understand the strategic advantages of using plant extracts over a chemical as combustion fuel for the synthesis of zinc oxide nanoparticles. The X-ray diffractograms of the samples revealed the presence of Wurtzite hexagonal structure with varying crystallite sizes. Morphological studies indicated that samples prepared using biofuels had smaller diameter than those prepared using lactose as fuel. Surface characteristics of the samples were measured by X-ray photoelectron spectroscopy. Qualitative phytochemical screening of aqueous leaf extracts revealed the presence of many phytochemicals in them, which might be responsible for combustion. Gas chromatography mass spectrum was carried out to detect the phytochemicals present in the aqueous extracts of the leaves. Further, anticancer evaluation carried out against DU-145 and Calu-6 cancer cells indicated higher anticancer activity of zinc oxide nanoparticles prepared using biofuels. The results of blood haemolysis revealed the biocompatibility of zinc oxide nanoparticles at lower concentrations. In conclusion, we propose that multiple other studies would be required in order to vindicate the potential advantages of using naturally available fuels in SCS.

ARTICLE HISTORY
Received 30 April 2017
Revised 3 July 2017
Accepted 4 July 2017

KEYWORDS
Solution combustion synthesis; biofuels; XPS; MTT assay; haemolysis

Introduction

Zinc oxide (ZnO) is an inorganic antimicrobial agent which is generally recognized as safe (GRAS) under US-FDA listings, to human beings and animals. Controllable synthesis of ZnO nanomaterials of desired size and shapes has been the subject of investigation by researchers in recent days because it has been found that the properties of ZnO nanoparticles (NPs) are size and morphology dependent. ZnO NPs have shown wide variety of applications in the field of catalysis [1], textiles [2] cosmetics [3], drug delivery [4], cancer therapy [5], antivirals [6,7], etc. Along with the basic properties of ZnO, fine particles of ZnO have deodorizing and antibacterial action and for that reason are added into various materials including cotton fabric, rubber, and food packaging. ZnO NPs have found good application in bio molecular detection, diagnostics, and micro-electronics. Recently antidiabetic activity of ZnO NPs has also been reported [8].

Self-propagating high temperature solution combustion synthesis (SCS) is a novel technique that has been used successfully for the preparation of ceramic, phosphor materials. This method has been employed to prepare $LiNiO_2$, $LiCoO_2$, $LiMn_2O_4$, ZnO, CuO NPs using various organic compounds such as sugar, citric acid, lactose, glycine as fuels [9–12].

Synthesis of nanomaterials by biological approach is cheaper, environment friendly and innovative. Biosynthesis of NPs has been started as they possess advantages over physical and chemical processes. It was observed that many a times, chemical methods lead to the presence of some of the toxic chemicals absorbed on the surface of NPs that may have adverse effects in medical applications [13]. This problem can be overcome by synthesizing nanomaterials by green

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