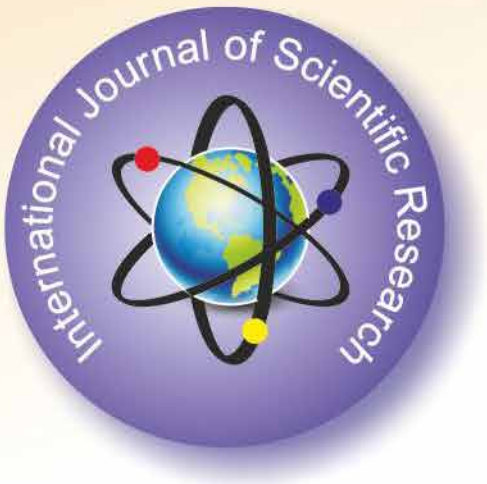
International Journal of Scientific Research

Indexed with International ISSN Directory, Paris

Volume 1 | Issue 2 | July 2012



ISSN No. 2277 – 8179

A Multi-Subject Journal

ISSN No. 2277 – 8179

International Journal of Scientific Research

Journal for All Subjects

Advertisement Details

Position	B/W (Single Color)	Fore Color
Full Inside Cover	₹ 6250	₹ 12500
Full Page (Inside)	₹ 5000	-

Subscription Details

Period	Amount Payable
One Year (12 Issues)	₹ 3000
Two Year (24 issues)	₹ 5800
Three Year (36 issues)	₹ 8700
Five Year (60 issues)	₹ 14400

You can download the Advertisement / Subscription Form from website www.gra.in. You will require to print the form. Please fill the form completely and send it to the **Editor, International Journal of Scientific Research** along with the payment in the form of Demand Draft/Cheque at Par drawn in favour of **International Journal of Scientific Research** payable at Ahmedabad.

Editor-In-Chief

Khansa Memon
Editor, Sarah Publishing Academy

Editorial Advisory Board

Dr. Ashok S. Pawar
Associate Professor, Dept. of Economic
Dr. Babaasaheb Ambedkar
Marathwada.University, Aurngabad

Dr.(Prof) Vijay Kumar Soni
Principal,
Jai Meenesh College, Phagi,
Jaipur, Rajasthan

Dr. A.R. Saravankumar
Assistant Professor in Education
DDE, Alagappa University,
Tamilnadu

Dr.R.Ramachandran
Commerce Dde
Annamalai University
Tamilnadu India

Dr. R Ganpathy
Assistant Professor in Commerce
Directorate of Distance Education
Alagappa University Karaikudi.

Dr. Amit Bandyopadhyay
Assistant Professor
Department of Physiology
University of Calcutta

Dr. V. Kumaravel,
Professor and Head
Vivekanandha Buss. School for Women
Tiruchengode, Namakkal Dist

Dr. K. Prabhakar,
Professor,
Department of Manag. Studies,
Velammal Engg College, Chennai

Dr. Sunita J. Rathod
Maharashtra Education
Service Group-B
DIET Dist. Jalna

1. Thoughts, language vision and example in published research paper are entirely of author of research paper. It is not necessary that both editor and editorial board are satisfied by the research paper. The responsibility of the matter of research paper/article is entirely of author.
2. Editing of the **International Journal of Scientific Research** is processed without any remittance. The selection and publication is done after recommendations of atleast two subject expert referees.
3. In any condition if any National/International University denies accepting the research paper published in IJSR then it is not the responsibility of Editor, Publisher and Management.
4. Only the first author is entitle to receive the copies of all co-authors
5. Before re-use of published research paper in any manner, it is compulsory to take written permission from the Editor-IJSR, unless it will be assumed as disobedience of copyright rules.
5. All the legal undertaking related to **International Journal of Scientific Research** is subject to Ahmedabad Jurisdiction.
7. The research journal will be send by normal post. If the journal is not received by the author of research papers then it will not be the responsibility of the Editor and publisher. The amount for registered post should be borne by author of the research paper in case of second copy of the journal.

Editor,
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH
3, SUHANA, Nr. Rubi Apartment, B/H NID, Rajnagar Road,
Paldi – 380007. Ahmedabad-Gujarat. (INDIA)
Contact: +91 98247 02127, +91 88660 03636
Www.theglobaljournals.com | ijsr@theglobaljournals.com

INDEX

Sr. No.	Title	Author	Subject	Page No.
1	Ionic composition of a freshwater lake and its implications on aquaculture	Dr. Shankar P. Hosmani	Biotechnology	1-2
2	Growth and Performance of Mutual Fund Industry in India	Dr. M. K. Maru	Commerce	3-4
3	Waste Management: A New Paradigm of Contemporary Business	Dr. Vipul Chalotra	Commerce	5-6
4	Rural Financial Services in J&K (A study in the field of financial services sector development)	Tarsem lal	Commerce	7-8
5	Banyan, the National Tree of India	Dr. J.K. Sehgal	Commerce	9-10
6	Impact of Online Marketing on Customers with Special Reference to Coimbatore City	Dr. R. Ganapathi	Commerce	11-15
7	Customers' Attitude towards Housing Loan With Reference to Commercial and Rural Banks	Dr. R. Ganapathi, Mrs. B. VIDYA	Commerce	16-23
8	Consumer Behaviour towards Broiler Chicken Retail Stores With Reference to Madurai City	P. Easwaran, J. Gnanadevan, Dr. R. Ganapathi	Commerce	24-30
9	Data Security and Protection in Cloud Computing	Shameena Begum, V. Ratna Vasuki, K.V.V.Srinivas	Computer Science	31-34
10	Foreign Direct Investment in India – An Explanatory Study	Dr. K.Madhu Babu	Economics	35-38
11	Growth - Saving Causality in India: A Cointegration Analysis	Dr. Shradha H. Budhedeo	Economics	39-42
12	Constitutional perspectives on Labour Wages in India	Dr. Shankar Ambhore, Dr. Dilip Arjune, Manish Parshuram Pawar, Dr. Ashok Shankarrao Pawar	Economics	43-45
13	A Critical Study of Special Economic Zones in India	Dr. Shankar Ambhore, Dr. Dilip Arjune, Manish Parshuram Pawar, Dr. Ashok Shankarrao Pawar	Economics	46-48
14	Industrial Relations - Settlement of Disputes in India	Dr. Shankar Ambhore, Dr. Dilip Arjune, Manish Parshuram Pawar, Dr. Ashok Shankarrao Pawar	Economics	49-50
15	AMLA - ITS MEDICINAL USES	Manisha Gaur	Economics	51-52
16	The Role Of Total Quality Management In Higher Education	Ramesh B. Sakhiya	Education	53-55
17	Perceived Competencies Of Graduate Teacher Trainees In The Intensive Teaching Practice [I T P] Session	Dr M. Parimala Fathima, N.Sasikumar, M. Panimalar Roja	Education	56-58
18	Uchch Siksha Ki Rah Men Dushvariyan	Dr. Anup Chaturvedi	Education	59-60
19	Fault Diagnoses of Rotating Machinery with Advance Signal Processing Methods	Prof. Divyang H. Pandya, Prof. Ankit A. Darji	Engineering	61-63
20	A Hybrid Neural Network Approach for Wind Speed Prediction	S.N Deepa, K.gnana Sheela	Engineering	64-67
21	A Study on Phishing: Preventions and Anti-Phishing Solutions	V.Karamchand Gandhi, Prof R.Senthil Kumar	Engineering	68-69
22	The Killari 1993 Intracratonic Earthquake- a Comparative Study	S.S. Patil, K.L. Karkare, I.B. Ghorade	Environment	70-72
23	Cosmic Plants as Alternative Medicine	Dr. Sneh Harshendra Sharma	Environment	73-77

24	Green Initiatives for Reducing Carbon Footprint	Dr Mahalaxmi Krishnan	Environment Science	78-79
25	Prediction of Urban Sprawl in Hyderabad City using Spatial Model, Remote Sensing and GIS Techniques	S. Indhira Gandhi, Dr. V. Madha Suresh	Geography	80-81
26	Tectono-Provenance and Reservoir Rock Characteristics of the Tipam Sandstones in Parts of Upper Assam Basin	Dr. Pradip Borgohain	Geology	82-84
27	(Jansanchar Aur Bharatiya Samaj)	Dr Subodh Kumar	Journalism	85-86
28	An Overview of Industrial Disputes Settlement Authorities in India	Manish Parshuram Pawar, Dr. Ashok Shankarrao Pawar	Law	87-88
29	Innovative Method of Role Play for Developing English Language Teaching and Learning	K Rajkumar	Literature	89-91
30	Impact of Workers Participation in Management on Industrial Relations	Anuradha Averineni	Management	92-93
31	Consumers Preferences , Behaviour and Satisfaction with respect to banking services quality in Ghaziabad(NCR Region)	Prof(Dr.)H. P. Pandey, Mr. Ashish kumar Singh	Management	94-96
32	Factors Influencing Employee Branding in Higher Educational Institutions: A Special Reference to Management Institutions in Virudhunagar District in Tamilnadu	Jegadeeswari. Mani, Dr. S. Franklin John S.	Management	97-98
33	Evaluation of Service Quality in Internet Banking: An Empirical Study in Coimbatore	Ms. R. Gokilavani, Dr. R. Ganapathi	Management	99-101
34	To Study the Relationship Between Gender & Banking Preferences of Management Graduates at Ibmrd, Ahmednagar	Rajendrasingh Pardeshi, Gadekar Vithal Laxman	Management	102-103
35	FCB model of Advertising Strategy	Prof. Arvind Rathod	Management	104-107
36	Assessing Beneficiary Satisfaction with Service Delivery of Non Governmental Organizations (NGOs)	Dr Papori Baruah, Bhaskar Jyoti Barthakur	Management	108-111
37	Current Trends in Human Resource Management	Dr. Kalyani Kenneth, Mrs.R.Aruna jayamani	Management	112-113
38	“Indian Banking – A Future Ahead”	Haresh B. Barot	Management	114-116
39	Financial Inclusion-Banking Services to the Common Man	Dr. M. Venkata Subba Reddy, Mr. M.s.udaya Banu	Management	117-118
40	A study of Service Marketing Mix w.r.to b-schools in Mumbai	Dr. Balaji S. Mudholkar	Management	119-120
41	A Study on the Customers Opinion on the Benefits of the Credit Cards Around Combatore District	Mrs. G. Murali Manokari	Management	121-123
42	A Study on the Job Satisfaction of the Employees at Sri Kannan Departmental Stores, Coimbatore	Mrs. G. Murali Manokari, Mrs.r.kanaka Rathinam, Mr. G. Lenin Kumar	Management	124-126
43	Foreign Direct Investment In Indian Retail Sector: A Critical Evaluation	Dr. Raghavendra Dwivedi, Ram Kumar	Management	127-128
44	Emerging Challenges to Cyber Security-Internet Monitoring with Specific reference to National Security	Triveni Singh	Management	129-131
45	An Empirical Study of Consumer Impulse Buying Behavior in domestic Markets (special reference to Ahmednagar, (M.S) India.)	Gadekar Vithal Laxman	Marketing	132-135
46	Insomnia and the performance of general population: Results from the Insomnia Survey	Miss Ketaki Sathe, Dr G S Shekhawat	Medical Science	136-137
47	Transition in Human Resource for Health: Challenges Ahead	Dr. Pawan Kumar, Dr. Abdul Majeed Khan	Medical Science	138-139

48	Kartageners Syndrome- A Case Report	Dr. Ramakrishna Ghubde, Dr. Archana Shekokar	Medical Science	140-141
49	Perceptual challenges in auditory neural processing in neurodegenerative conditions like Fredereich Ataxia	Mr. Ayas Muhammed, Ms. Archana, Dr. Rajashekhar	Medical Science	142-143
50	Transient Auditory Dysynchrony Due to Non-Maturational Causes Evidenced by ABR – A Case Report	HariPrakash. P, Sangeetha. G, Bhargavi P.G	Medical Science	144-146
51	Study on Sphenoid Sinsuses Variants in Magnetic Resonance Imaging of South Indian Population	Suresh Sukumar, Sushil Yadav	Medical Science	147-148
52	A Study to Find out the Prevalence and Effectiveness of Occupational Therapy Intervention for Pain and Activity Performance in Mobile Users with Risk of Repetitive Strain Injury	KR.Banumathe, V.Guruprasad, Leena Ann Lukose	Medical Science	149-151
53	Modified Falls Behavioral Scale for Indian Community Dwelling Older Adults	V.Guruprasad, Sebestina A D'Souza, KR.Banumathe	Medical Science	152-154
54	The Essence of Employees Training and its Impact on the Work Force in an Industry	Dr. Mohan Singhe	Organization Behavior	155-156
55	Scientific Behaviourism of Watson and Hull : A Philosophical Perspective	Dr. Jatinder Kumar Sharma	Philosophy	157-158
56	The growth of manganese oxide thin films by spray pyrolysis technique	M.Sudha, P.Duraisamy	Physics	159-161
57	Terrorism and Competitive Terrorism in India	S. Sreejith, P. Sakthivel	Political Science	162-164
58	Kuposhan Se Karahta Bachpan	Dr. Anup Chaturvedi	Social Science	165

Research Paper

Volume : 1 | Issue : 2 | July 2012 • ISSN No 2277 - 8179

Fault Diagnoses of Rotating Machinery with Advance Signal Processing Methods

Engineering

KEYWORDS : Bearing Diagnostics, Time-frequency domain, Spectogram, Welch Periodogram

Prof. Divyang H. Pandya Ph.D Researcher scholar, Vibration and Noise Control Laboratory, Indian Institute of Technology, Roorkee

Prof. Ankit A. Darji Asst. Prof., Mech. Engg. Dept., L.D.R.P-I.T.R, Gandhingar

ABSTRACT

Diagnosis of rolling bearing based on vibration signature analysis in Time-frequency domain. Commonly-used signal analysis techniques, based on spectral approaches such as the fast Fourier transform, are powerful in diagnosing a variety of vibration-related problems in rotating machinery. Although these techniques provide powerful diagnostic tools in stationary conditions, they fail to do so in several practical cases involving non-stationary data. Recent development in signal processing approaches make available new methods in time-frequency representation, which bring up major information concerning the time occurrence of the fault. This paper provides a comparative study between traditional signal processing methods, such as periodograms, with more sophisticated approaches like Welch Periodogram, the spectrogram and the scalogram. Performances of these techniques are assessed through experiments and compared for single point defects on inner race, outer race and ball fault, including balanced condition of rotor bearing system.

1. Introduction

The process of a failure in a rolling bearing starts with microscopic cracks, when the balls make contact with a crack it produces a low energy signal similar to an impact, detecting these impacts out of the machine vibration acceleration signal is the way to monitor and control the condition of its rolling bearings. The drawback behind enveloping is that it is not really designed for processing signals characterized by impulses, it causes averaging out of important data because of the multiple FFT's used; instead, this technique is expected to work better with periodic signals. Moreover, it is necessary to concentrate the application of enveloping in a band with around the natural frequencies of the machine frame because these are excited when the bearing balls produce impacts; thus the design of a band pass filter is required with its boundaries set between the machine natural frequencies, this process requires the good experience of the vibration technician, or if more precision is desired, a modal analysis shall be performed.

II. DEFECTS IN BEARING

One important issue in rotor bearing application is the reduction of noise and vibration originating from the ball bearings. The rolling element bearing is composed of the rolling elements, inner race, outer race and the cages. One possible source of rolling element bearing vibration is the defects in its various components. Rolling bearings defects may be categorized as point or local defects and distributed defects. The vibrations are generated by geometrical imperfections on the individual bearing components and these imperfections are caused by irregularities during the manufacturing process as well as wear and tear. The various distributed defects are surface roughness, waviness, misaligned races, and off-size rolling elements. The local defects include cracks, corrosion pitting, brinnelling and spalls on the rolling surfaces. The dynamic responses of the rotating bearing elements as they encounter the various modes of failure determine the resulting vibration[1].

The bearing frequency equations provide a theoretical estimation of the frequencies to be expected, when various defects occur on the bearing elements. These frequencies are calculated based upon the assumption that an ideal impulse is generated whenever a bearing element encounters the defect. Assuming no slip and considering outer race to be stationary, the general forms of the bearing characteristic defect frequency equations are given as [2].

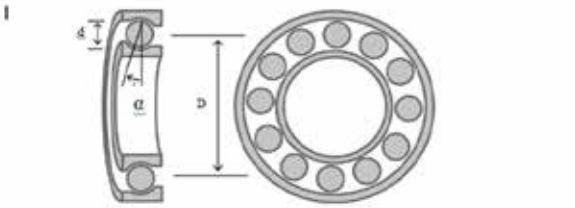


Figure.1 Ball bearing geometry for Characteristic Defect frequency, Where, D = Diameter of ball bearing as measure to the center of rolling element, d = Diameter of rolling element , α = contact angle of ball with outer race,

N =Number of rolling element

Inner race defect frequency $f_{bpfi} = \frac{N_b f_{inner}\left(1+\frac{d}{D}\cos(\alpha)\right)}{2}$

Outer race defect frequency $f_{bpfo} = \frac{N_b f_{inner}\left(1-\frac{d}{D}\cos(\alpha)\right)}{2}$

Cage rotational frequency $f_{cage} = \frac{f_{inner}\left(1-\frac{d}{D}\cos(\alpha)\right)}{2}$

Ball or Roller spin frequency $f_{bsf} = \frac{f_{inner}}{2}\frac{D}{d}\left(1-\left(\frac{d}{D}\cos(\alpha)\right)^2\right)$

III. ADVANCED SIGNAL PROCESSING TECHNIQUES

This section presents different signal processing technique which can be employed to extract the frequency content of a discrete signal. In this following, the current will be denoted by the discrete signal $x[n]$, which is obtained by sampling the continuous time current every $Ts = 1/Fs$ seconds.

I. Periodogram

The periodogram, $P(f)$, estimates the Power Spectral Density (PSD) of a signal $[n]$:

$$P_x(f) = \frac{|X(f)|^2}{N}$$

where $X(f)$ is the Discrete Fourier Transform of $x[n]$ i.e.

$$X(f) = \sum_{n=0}^{N-1} x[n] e^{-2j\pi fn/F_s}$$

where Fs is the sampling frequency. In practice, X (f), is evaluated through a Fast Fourier Transform (FFT) [3], which reduces the number of computations to $O(N\log(N))$ operations. One should note, The periodogram is not a consistent estimator of the PSD since it has a non-zero bias and its variance does not tend to zero as the data length N tends to infinity. Despite of this drawback, the periodogram has been used extensively for failure detection in the literature

II. Welch Periodogram

As compared to the classical periodogram, Welch periodogram

is an improved estimator of the PSD that reduces both the variance and the biais. The Welch method divides [n] into segments, computes a modified periodogram of each segment and then averages the result. The Welch periodogram, (f), can be expressed into a mathematical form as

$$P_w(f) = \frac{1}{L}\sum_{k=1}^{k=L} P_{xw}^k(f)$$

where:

$$P_{xw}^k(f) = \frac{|X_{xw}^k(f)|^2}{NU}$$

and where U is a normalization factor. Furthermore,(k)w (f) corresponds to the DFT of the windowed signal [n]w[n−τk], where w[.] is a time-window (hanging, hamming, Kaiser) and where τk is a time lag.

III. Spectrogram

To obtain the evolution of the frequency content over time, Fourier transforms can be computed for different time segments and then arranged one next to the other over the time axis. This method is known as the Short Time Fourier Transform (STFT). For discrete signals, the STFT is given by[4]

$$STFT[f,\tau] = \sum_{n=0}^{N-1} x[n]w[n-\tau]e^{-2j\pi fn/F_e}$$

where w[.] is a time window. The spectrogram is defined as the square modulus of the STFT i.e. |[f, τ]|2. The time and frequency resolution is limited by the Heisenberg-Gabor inequality [4]. In the case of the spectrogram, this resolution is the same for all time-frequency bins. One should note that the spectrogram have been used previously in [5], [6] for diagnosis purpose in time-varying condition

IV. Scalogram

Wavelet Transform (WT) provides a time-scale (or time frequency) representation of a signal. While STFT gives constant time-frequency resolution, WT is a multi-resolution technique which analyses frequencies with different resolutions. The WT gives a good time resolution and poor frequency resolution at high frequencies, and provides good frequency resolution and poor time resolution at low frequencies [7]. The Wavelet Transform at frequency scale l is given by:

$$W(a^l,\tau) = \sum_{n=0}^{N-1} x[n]\psi_l^*[n-\tau]$$

where

$$\psi_l[n] = \frac{1}{\sqrt{a^l}}\psi\left(\frac{n}{a^l}\right)$$

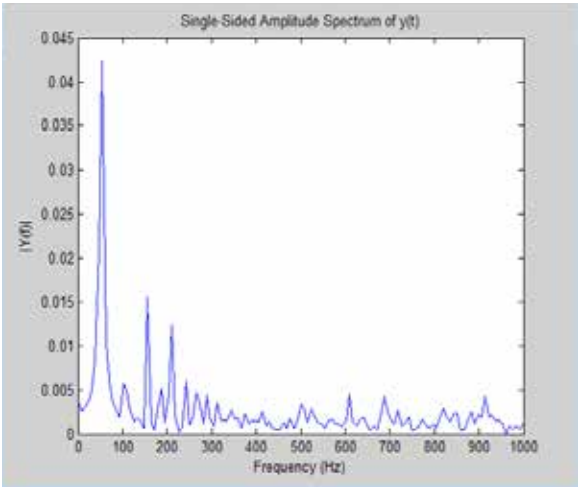
and where ψ(.) is the mother wavelet which satisfies a number of conditions. The scalogram is defined as the square modulus of the WT i.e. |(al, τ)|2. One should note that the Wavelet Transform have been used previously in [8]–[10] for failure detection.

IV. EXPERIMENTAL SETUP

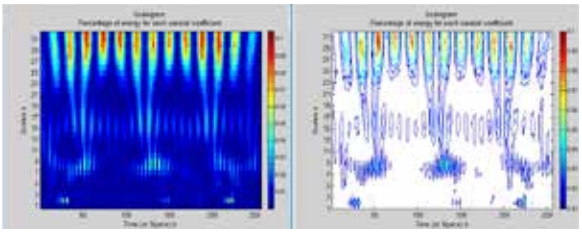
Experimentation is carried out on a rotor test rig. The test rig was developing as a part of DST project at IIT Roorkee, which consists of a shaft supported on rolling element bearings and driven by a DC motor of 3HP. The SKF 6205 bearings have been taken for the study. The localized defect of spall seeded on outer race of bearing and experimental data acquire with unbalance rotor bearing system. Vibration responses at 4000 rpm were analyzed by vibration analyzer with 4 input channels at sampling rate of 2.04 kHz.

V. RESULT AND DISCUSSION

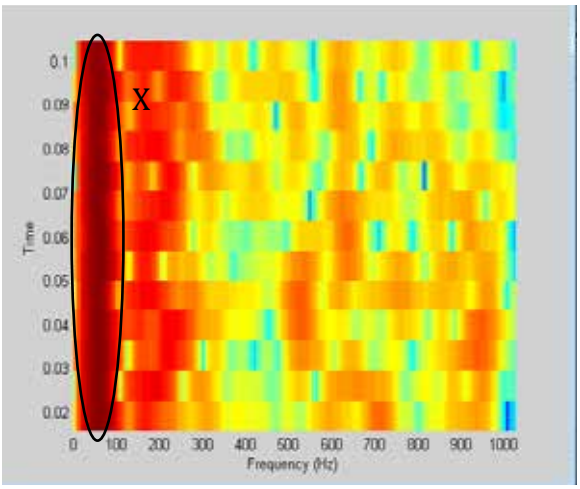
Present experiment carried out at 4000 rpm with unbalanced rotor dynamic bearing condition. Figure.2(a) represent fast fourier transformation of raw signal indicate the highest pick at 66.67 Hz which is at 1X fundamental frequency. Figure 2(b) scalogram shows multi resolution presentation in time scale domain. As shown in figure 2(c) maximum percentage of energy highlighted in 2nd slab with scale number 5-7 and 7-9. The frequency level for these scales are ranging between 256-512 Hz and characteristic defect frequency are 354 (VC), 239(f_{bpfo}) and 361 (f_{bpfi})



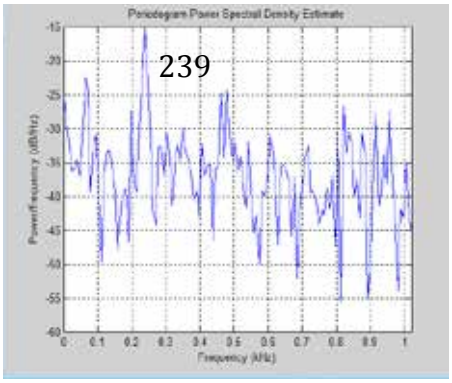
(a) FFT



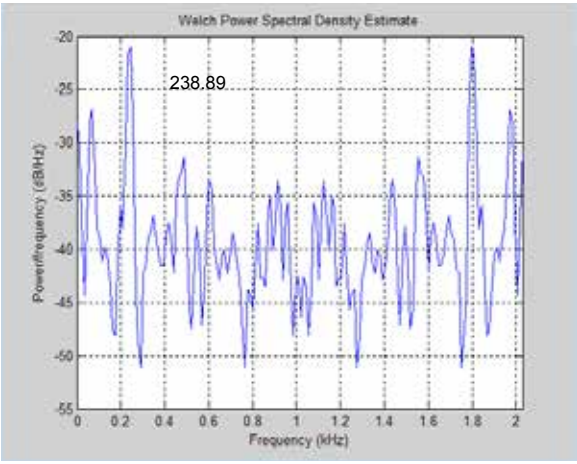
(b) Scalogram (c) contour scalogram



(e) Periodogram



Volume : 1 | Issue : 2 | July 2012 • ISSN No 2277 - 8179



(f) Welch Periodogram

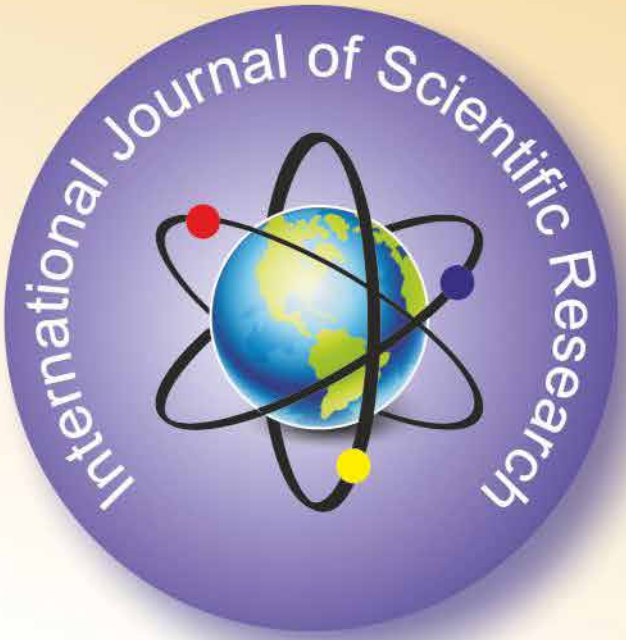
Figure.2 Unbalanced Rotor Bearing system with Outer Race fault at 4000 rpm, (a) FFT (b) Scalogram (c) contour scalogram (d) Spectrogram (e) Periodogram (f) Welch Periodogram

VI. CONCLUSION

This paper presented a comparison between four signal processing methods for fault detection in the case of deep grove ball bearing for outer race defect. Experimental simulations have shown that the classical and Welch Periodogram have very close performances. However for noisy data, the Welch periodogram exhibits a better signal to noise ratio. One more important conclusion highlighted from this work is that as compared to Periodogram and Welch Periodogram, the spectrogram and the scalogram, which are time-frequency representations, bring up more information concerning the time occurrence of the fault.

REFERENCE

[1] Upadhyay S.H.-A Theoretical & Experimental Study of Nonlinear Aspect of High Speed Rolling Element Bearing, Ph.D. Thesis,2009 | [2] Brändlein, J., Eschmann, P., Hasbargen, L. and Weigand, K., Ball and Roller Bearings- Theory, Design and Application. Third edition, John Wiley & Sons, Ltd. (UK), 1999. | [3] S. Nandi, H. Toliyat, and L. Xiaodong, "Condition monitoring and fault diagnosis of electrical motors - a review," IEEE Trans. Energy Conversion, vol. 20, no. 4, pp. 719–729, 2005. | [4] P. Flandrin, Time-frequency/time-scale analysis. Academoc Press, 1998. | [5] M. Benbouzid and G. Kliman, "What stator current processing based technique to use for induction motor rotor faults diagnosis?" IEEE Transactions on Energy Conversion, vol. 18, no. 2, pp. 238–244, 2003. | [6] J.Cusido, L. Romeral, J. Ortega, J. Rosero, and A. Espinosa, "Fault detection in induction machines using power spectral density in wavelet decomposition," IEEE Transactions on Industrial Electronics, vol. 55, no. 2, pp. 633–643, 2008. | [7] S. Mallat, A Wavelet Tour of Signal Processing: The Sparse Way, 3rd ed. Academic Press, 2008. | [8] H. Douglas, P. Pillay, and A. Ziarani, "A new algorithm for transient motor current signature analysis using wavelet," IEEE Transactions on Industry Applications, vol. 40, no. 5, pp. 1361–1368, 2004. | [9] M. Riera-Guasp, J. Antonio-Daviu, J. Roger-Folch, and M. M. Palo- mares, "The use of the wavelet approximation signal as a tool for the diagnosis of rotor bar failure," IEEE Transactions on Industry Applications, vol. 44, no. 3, 2008. | [10] S. Kia, H. Henao, and G. Capolino, "Diagnosis of broken-bar fault in induction machines using discrete wavelet transform without slip estimation," IEEE Transactions on Industry Applications, vol. 45, no. 4, pp. 1395–1404, 2009.



Sara Publishing Academy
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH
Journal for All Subjects

The Editor,
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH
8-A, BANAS, Opp. SLU Girls College, NR. Congress Bhavan,
Paldi – 380006. Ahmedabad-Gujarat. (INDIA)
Contact: +91 98247 02127, +91 88660 03636
Website : www.theglobaljournals.com
Email Id: ijsr@theglobaljournals.com

Printed at Unique Offset, Novatsing Rupam Estate, Opp. Abhay Estate, Tavdipura, Shahibaug, Ahmedabad